TECHNICAL SPECIFICATIONS

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SECTION 01 11 00 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Work to be performed under this Contract shall consist of furnishing tools, equipment, materials, supplies, and manufactured articles, and furnishing all labor, transportation, and services, including fuel, power, water, and essential communications, and performing all work or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The Work shall be complete, and all work, materials, and services not expressly indicated or called for in the Contract Documents which may be necessary for the complete and proper construction of the Work in good faith shall be provided by the Contractor as though originally so indicated, at no increase in cost to the Owner. The Contractor shall provide all materials and equipment required for construction of the facility except for the materials and equipment provided by Owner as described in the Appendices.

B. The Contractor is responsible to follow the provisions of these Contract Documents, including but not limited to the following of Plans and Specifications; the timely, complete, and accurate submittal of shop drawings; the work of and coordination with his subcontractors and suppliers; timely performance of the Contract; and timely payment of suppliers and subcontractors. Nothing stated in the Contract Documents or Specifications shall be construed to relieve the Contractor of these basic responsibilities.

C. The Contractor shall provide an internet-based construction management software package for submitting and tracking project related documents such as RFI's and Submittals. Access to and the use of this internet-based construction management site will be provided at no cost to the Engineer and Owner.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Overview: The Work of this Contract comprises the upgrade of the Aberdeen Wastewater Treatment Plant for the City of Aberdeen, Idaho specified and shown with all appurtenances.

B. Demolition shall be conducted by the Contractor to ready the site for Work, but shall be scheduled to not remove those process units from the treatment train that are required for operation of the plant in order to meet the IPDES permit requirements and process sludge (see Section 01 35 13 – Special Project Procedures). Demolition activities include:

1. Site, miscellaneous yard structure, and yard piping demolition as noted on the drawings.

2. Concrete pad for existing generator. Owner will remove the existing generator.

3. Existing Headworks (A) floor and drain piping shall be modified. Influent sampler and enclosure, and manual bar screen to be removed.

4. Existing clarifier (C) walkway to be modified for new stairway.

5. IFAS Process Trains (B) shall be modified for new process equipment. Demolish walkways, handrail, equipment and concrete and reconstruct for new equipment installation.

6. Panels and associated electrical to be demolished in the existing control building (F).

7. Valves in existing vault on the outlet from the digesters (G).

8. Two blowers and associated piping will be demolished in the Digester Blower Building (G1).

9. The submersible pumps, piping, valves, controls, electrical equipment will be removed and replaced in the Decant Lift Station (G2).

10. Panels and associated electrical to be demolished in the existing electrical building (H).

C. Construction activities in the base bid include construction of:

1. Site improvements: To include all required upgrades to yard and utility piping, underground power and communications lines, a new generator, site improvements, site grading, excavation and backfill for new structures, rock breaking and removal, site dewatering, and road improvements.

2. Existing Headworks (A) improvements including grating modifications, new crane beams, drain pipe modifications, installation of a new screen and a new influent sampler, and associated electrical and controls.

3. Existing IFAS Basin (B) improvements include construction of new stairs, walkways, grating, concrete channels, and concrete walls; installation of IFAS equipment and instrumentation; installation of new air piping and valves; modification of influent piping; and associated electrical and controls work.

4. New IFAS Splitter Box (B1) includes excavation, backfill, cast-in-place concrete, grating, stairway construction, pipe installation, and installation of weirs and slide gates.

5. New IFAS Blower Building (B2) includes all site work, structural, mechanical, HVAC, controls and electrical shown on the drawings.

6. Existing Clarifiers (C) includes modification of the existing handrail and installation of a new stairway and concrete slab; installation of bases for a portable hoist and lifting wires on pumps; and replacement of electric valve actuators on plug valves in WAS/RAS valve vaults.

7. New Tertiary Filter Building (D) includes all site work, architectural, structural, plumbing, HVAC, mechanical, controls and electrical work shown on the drawings.

8. New Tertiary Lift Station (D1) includes site work, installation of a precast wetwell and valve vault; installation of three pumps and associated piping, valves and accessories; and associated controls and electrical work as shown on the drawings.

9. New Control & Dewatering Building (E) includes all site work, architectural, structural, plumbing, HVAC, installation of piping, valves and mechanical equipment, controls and electrical work shown on the drawings.

10. Electrical work will be performed in the Existing Control Building (F) as shown on the drawings.

11. Replacement of valves in the aerobic digester valve vault.

12. Renovations to the existing Digester Blower Building (G1) include installation of a new blower with associated piping, valves, electrical and controls.

13. Renovations to the existing Decant Lift Station (G2) include installation of new submersible pumps, guiderails, instrumentation, controls and electrical.

14. Electrical work will be performed in the Existing Electrical Building (H) as shown on the drawings.

D. The Work shall also include Additive Bid Item No. 1 if included in the Contract Award. This Additive Bid Item is described in the Bid Form and in the Contract Documents.

1.3 CONTRACT METHOD

A. The Work hereunder will be constructed under a single lump sum.

1.4 CONSTRUCTION PROGRESS SCHEDULE

A. Work under the contract shall be scheduled and performed in such a manner as to result in the least possible disruption to the operation of the existing facilities. Contractor shall not operate any existing valves, pumps, or motors. The Contractor shall submit to the Engineer a construction schedule covering the entire work before any work is commenced. The schedule shall be as described in Section 01 32 16 – Construction Progress Schedule, complete with estimated dates for start and finish of each item of work. The construction constraints are as described in Section 01 35 40 – Special Project Procedures. The construction sequences described therein are suggested methods to accomplish the work. The Contractor shall remain responsible for the successful completion of all work.

B. To minimize the period of disruption of facility operation, all new piping and/or facilities should be constructed, and all preparations shall be made for fast connection to existing piping and facilities.

C. Submit preliminary construction progress schedules as required in the General Conditions within ten (10) days after the award of the contract. The progress schedule is to be in reproducible form and subject to the approval of the Engineer.

D. Commence work on or before a date to be specified in a written "Notice to Proceed" and complete all phases of the work as specified in C-520 – Agreement Form – Stipulated Sum.

E. The time is computed on a calendar basis and a total of 15-day time extension will be allowed for temporary poor weather or other foreseeable delays. The contractor acknowledges that construction during the winter at the project site will require cold weather construction methods.

1.5 PUBLIC WORKS CONTRACTOR'S LICENSE

A. Any Contractor, Subcontractor, or Specialty Contractor is required to have a current license as a Public Works Contractor in the State where the work is to be completed in order to submit a bid or proposal on this contract.

1.6 CODES AND STANDARDS

A. Where codes and standards are referred to, they are the current approved codes. It is the duty of the Contractor to obtain from its supplier any material on this work to submit evidence, if requested, that provided material is in compliance with the applicable codes and standards.

1.7 STATE AND LOCAL LAWS

A. Conform to all applicable State and local laws in carrying out obligations under the contract.

B. Meet the requirements and recommendations of the Manual of Accident Prevention in Construction; Associated General Contractors of America, Inc., and Occupational Safety and Health Act.

1.8 PREDETERMINED EQUIPMENT COSTS

A. The following methods of determination of construction equipment costs apply to all Change Orders and other adjustments of contract price except for Article 15, Suspension of Work and Termination, outlined in the General Conditions.

1. Allowable ownership and operating expense costs for construction equipment in sound workable conditions owned and furnished by the Contractor for work requiring adjustments in contract price shall be based on the applicable provisions of the U.S. Army Corps of Engineers North Pacific Division (NPD) "Equipment Ownership and Operating Expense Schedule." If, for any reason, the schedule referred to above is discontinued or becomes otherwise unavailable, the Owner and the Contractor shall agree upon another schedule or method of price adjustment which, in their opinion, will result in an equitable adjustment of contract price. For forwarding pricing, the issue of NPD Schedule in effect at the time of negotiations shall apply. For retrospective pricing, the issue of the NPD Schedule in effect as of the time work was performed shall apply.

2. For the purpose of determination of the hourly rates to be applied under this contract, working conditions shall be considered to be average unless otherwise determined by the Owner. Rate for equipment not in the schedule may be used for unlisted equipment of comparable horsepower and auxiliary features.

3. For rented equipment, the Owner will accept rates actually paid (substantiated by certified reproduced copies of invoices or bills), but in no event shall they exceed the rates contained in the current "Rental Rate Blue Book for Construction Equipment," published by Equipment Guide-Book Company, 3980 Fabian Way, Palo Alto, California 94303. When the "Blue Book" rates are applied, fuel, lubricants and operating expendables will be computed in accordance with NPD Schedule. Additional shifts or fractions thereof for rented equipment will be computed at 50 percent of the base rate in the "Blue Book" or invoices, as applicable. Rates for equipment under lease-purchase or sale-leaseback arrangements will be determined in accord with NPD Schedule. Rates for equipment rented from an organization under common control will be determined in accord with the NPD Schedule, and no markup will be permitted. A copy of the NPD Schedule will be provided to the successful bidder upon request.

1.9 PRODUCT SUBSTITUTIONS

A. Use equipment and materials specified by name in these Specifications or on Plans. Alternative equipment suppliers shall be reviewed after bid opening as per the procedures outlined in Paragraphs 7.05 and 7.06 in the General Conditions and Section 01 33 00 – Submittal Procedures.

B. Request approval for substitutions by submitting written evidence and convincing Engineer of equality of item and suitability for the service and/or construction conditions anticipated.

C. If alternative equipment or materials are approved, make required changes in structures, buildings, piping, systems, etc., necessary to accommodate alternate items without additional cost to the Owner except as specifically noted for Owner furnished materials.

1.10 PERMITS

A. The Contractor shall be responsible to obtain and pay for all construction and inspection permits required by the State of Idaho, Bingham County, and the City of Aberdeen, and shall include permit fees in in Bid Schedule for the base bid and in the additive bid items in the respective Bid Schedules.

B. Building permit (includes structural) shall be obtained from the County by the Contractor.

C. Mechanical permit (HVAC) shall be obtained from Bingham County.

D. Electrical and plumbing permits shall be obtained from the Idaho Division of Building Safety, and the State will charge a permit fee based on the cost of materials and labor for the plumbing work and the electrical work. State permits may be obtained online at dbs.idaho.gov.

1.11 WAGE RATES

A. The general prevailing rate of wages, as determined by the Secretary of Labor, is a requirement of this project.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 11 00

SECTION 01 14 13 - ACCESS TO SITE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall make its own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress to the site of the Work. It shall be the Contractor's responsibility to construct and maintain any haul roads required for its construction operations.

1.2 TEMPORARY CROSSINGS

A. General: Continuous, unobstructed, safe, and adequate pedestrian and vehicular access shall be provided to fire hydrants, plant facilities, and parking areas.

B. Temporary Bridges: Wherever necessary, to maintain vehicular crossings, the Contractor shall provide suitable temporary bridges or steel plates over unfilled excavations, except in such cases as the Contractor shall secure the written consent of the responsible individuals or authorities to omit such temporary bridges or steel plates, which written consent shall be delivered to the Engineer prior to excavation. All such bridges or steel plates shall be maintained in service until access is provided across the backfilled excavation.

1.3 CONTRACTOR'S WORK AND STORAGE AREA

A. The Owner will designate and arrange for the Contractor's use, a portion of the property adjacent to the Work for its exclusive use during the term of the Contract as a storage and shop area for its construction operations on the Work. At completion of Work, the Contractor shall return this area to its original condition, including grading and landscaping.

B. The Contractor shall make its own arrangements for any necessary off-Site storage or shop areas necessary for the proper execution of the Work.

C. The Contractor shall construct and use a separate storage area for hazardous materials used in constructing the Work as specified in Section 01 57 12 - Construction Site Discharge (SWPPP).

1. For the purpose of this paragraph, hazardous materials to be stored in the separate area are all products labeled with any of the following terms: Warning, Caution, Poisonous, Toxic, Flammable, Corrosive, Reactive, or Explosive. In addition, whether or not so labeled, the following materials shall be stored in the separate area: diesel fuel, gasoline, new and used motor oil, hydraulic fluid, cement, paints and paint thinners, two-part epoxy coatings, sealants, asphaltic products, glues, solvents, wood preservatives, sand blast materials, and spill absorbent.

2. Hazardous materials shall be stored in groupings according to the Material Safety Data Sheets.

3. The Contractor shall develop and submit to the Engineer a plan for storing and disposing of the materials above.

4. The Contractor shall obtain and submit to the Engineer a single EPA number for wastes generated at the Site.

5. The separate storage area shall meet all the requirements of all authorities having jurisdiction over the storage of hazardous materials.

6. The separate storage area shall be inspected by the local Fire Chief prior to construction of the area, upon completion of construction of the area, and upon cleanup and removal of the area.

7. All hazardous materials which are delivered in containers shall be stored in the original containers until use. Hazardous materials which are delivered in bulk shall be stored in containers which meet the requirements of authorities having jurisdiction.

1.4 PARKING

A. The Contractor shall:

1. Provide temporary parking areas for its employees and construction equipment.

2. The Contractor shall direct its employees to park in areas indicated.

3. Traffic and parking areas shall be maintained in a sound condition, free of excavated material, construction equipment, mud, and construction materials. The Contractor shall repair breaks, potholes, low areas which collect standing water, and other deficiencies.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 14 13

SECTION 01 22 00 - MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Measurement and payment will be made as specified in this Section and in accordance with applicable provisions of the General Conditions.

1.2 SCHEDULE OF VALUES

A. The Contractor shall prepare and submit a detailed Schedule of Values to the Engineer within 10 days from the effective date of the Contract. The detailed Schedule of Values shall be based on the values listed in the Bid Schedule. Because the ultimate requirement is to develop a detailed Schedule of Values, sufficient detailed breakdown shall be provided to meet this requirement. The Engineer shall be the sole judge of acceptable numbers, details and description of values established. If, in the opinion of the Engineer, a greater number of Schedule of Values items than proposed by the Contractor are necessary, the Contractor shall add the additional items so identified by the Engineer.

B. The minimum detail of breakdown of the major Work components is indicated.

1. Mobilization and demobilization 2% of contract price - no breakdown required.

2. Bonds and insurance.

3. Construction schedule.

4. Civil Site Work shall be broken down into individual piping, drainage structures, site concrete, paving, excavation cut and fill, removal of existing pipe, clearing and grubbing, demolition, and any other items determined to be necessary for the establishment of pay items.

5. Concrete structures shall be broken down into slabs on grade, walls/columns, suspended slabs, etc. and backfill.

6. Buildings shall be broken down into walls, roofs, decks, insulation, doors/windows/louvers and any other items determined to be necessary for establishment of pay items.

7. Protective Coating Work shall be broken down by structure area. Where specific coating Work at structure areas may be critical to performing the Work to meet milestone and Contract dates, such Work shall be included as individual pay items.

8. Equipment Procurement shall be broken down as indicated in Section 43 05 01 – Equipment General Provisions. Cost of labor associated with installation of the equipment shall be paid as a separate line item.

9. Mechanical Work shall be broken down to identify individual piping systems within each individual structure.

10. The Electrical Work shall be broken down by yard facilities and structures. Yard facilities shall be broken down by duct bank designation and substations. Structures Electrical Work shall be broken down into conduit and raceway installation, cable and wire installation, electrical equipment installation, terminations and lighting.

11. HVAC Work shall be broken down by structure.

12. Instrumentation and Control Work.

13. All other Work not specifically included in the above items shall be broken down as necessary for establishment of pay items.

C. The Contractor and Engineer shall meet and jointly review the detailed Schedule of Values within 35 days from the date of Notice to Proceed. The value allocations and extent of detail shall be reviewed to determine any necessary adjustments to the values and to determine if sufficient detail has been proposed. Any adjustments deemed necessary to the value allocation or level of detail shall be made by the Contractor and a revised detailed Schedule of Values shall be submitted within 40 days from the date of Notice to Proceed.

1.3 CHANGES TO SCHEDULE OF VALUES

A. Changes to the schedule of values shall be made to reflect Owner approved change orders.

B. In the event that the Contractor and Engineer agree to make adjustments to the original Schedule of Values because of inequities discovered in the original accepted detailed Schedule of Values, increases and equal decreases to values.

1.4 TECHNICAL MANUAL SUBMITTAL

A. Up to two percent of the Contract Price will be retained from any monies due the Contractor, if at the 75 percent construction completion point, all technical manuals have not been submitted as required by Section 01 78 23 – Operation and Maintenance Data.

1.5 CONTINGENCY ALLOWANCE

A. This is a contingency item to be paid on a time and materials charge account basis to reimburse the Contractor for work not identified or implied in the contract documents. This bid item is intended to address unanticipated items such as unspecified exploratory excavations, unmarked utilities, unforeseeable subsurface conditions, and conditions that are clearly different than those indicated in the contract documents.

B. The Engineer will provide a Work Change Directive document on the terms for completing the additional work. Within five days after the request from the Engineer, the Contractor shall submit to the Engineer a complete price breakdown of labor, equipment, and materials to complete the additional requested work not included in the contract documents.

C. All work is at the directive of the Engineer. Any work completed without the written authorization of the City of Aberdeen and the Engineer will be denied payment.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 22 00

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SECTION 01 31 19 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Contractor shall attend all Project meetings. Contractor's representative shall include Supervisor or Superintendent and shall have the required authority to commit the Contractor to solutions agreed upon. Other Contractor and subcontractor representatives may attend Project meetings as desired.

B. Contractor shall provide all pertinent Work-related reports or documents for each meeting as requested by the Owner.

C. Engineer will record minutes of all meetings and will furnish one (1) copy to the Contractor. Recipients of copies may make and distribute such other copies as they wish.

D. Contractor shall advise the Engineer of any inaccuracies, discrepancies, objections, or missing items in the minutes within five (5) calendar days of receipt of the minutes.

1.2 PRECONSTRUCTION CONFERENCE

A. A preconstruction conference will be convened to designate responsible personnel, discuss scheduling, shop drawing procedures, pay applications processing, project supervision, coordination, progress reports, payrolls, labor provisions, and to establish a working understanding among the parties as to the Work. The Contractor will be responsible to have all subcontractors and major suppliers represented at the preconstruction meeting.

B. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished to the Contractor prior to the meeting date. However, the Contractor should be prepared to discuss all of the items listed below.

1. Status of Contractor's insurance and bonds.

2. Issuance of Notice to Proceed

3. Contractor's tentative schedules.

4. Transmittal, review, and distribution of Contractor's submittals.

5. Processing applications for payment.

6. Maintaining record documents.

7. Critical work sequencing.

8. Field decisions and Change Orders.

9. Use of Site, office and storage areas, security, housekeeping, and Owner's needs.

10. Major equipment deliveries and priorities.

11. Contractor's assignments for safety and first aid.

12. Daily Report Form.

13. Submittal Transmittal Form which the Engineer will furnish.

C. Unless previously submitted to the Engineer, the Contractor shall bring to the conference one copy each of the following:

1. A preliminary schedule of Shop Drawings, Samples, and proposed Substitute or Equal submittals listed in the Bid.

2. A list of all permits and licenses the Contractor shall obtain indicating the agency required to grant the permit, the expected date of submittal for the permit, and required date for receipt of the permit.

3. A preliminary schedule of values in accordance with the bid schedule.

4. A 60-day plan of operation in accordance with Section 01 32 16 – Construction Progress Schedule.

5. Procurement schedule of major equipment and materials and items requiring long-lead time.

D. The Engineer will preside at the preconstruction conference and will arrange for keeping and distributing the minutes to all persons in attendance.

E. The Contractor and its subcontractors should plan on the conference taking no more than 1 full working day.

1.3 PROGRESS MEETINGS

A. The Engineer will arrange and chair weekly progress meetings. These meetings will be held at the project site and held throughout the course of construction. The Contractor is to ensure that an authorized representative, having authority to act for and on behalf of the Contractor and having full knowledge of the Work and the contract schedule attend the meetings.

B. Representatives of the Contractor's suppliers and subcontractors, and parties providing services for the same, may attend the meeting if the Contractor elects to invite them to assist the Contractor's representatives at the meetings.

C. Relay agenda items to Engineer at least 24 hours prior to meeting.

D. Suggested Agenda

1. Review of Work progress

2. Field observations, problems, and conflicts

3. Problems that impede construction schedules

4. Review of off-site fabrication and delivery schedules

5. Corrective measure and procedures to regain projected schedules

6. Revisions to construction schedules

7. Plan progress schedules during succeeding work period

8. Coordination of schedules

9. Review submittal schedules, field orders, change orders, RFIs, and pay applications; expedite as required

10. Maintenance of quality standards

11. Review proposed changes for effect on construction schedules and on completion dates

12. Other business

1.4 OTHER MEETINGS

A. Other meetings will be held from time to time as may be requested by the Owner or Contractor. Time and place of meeting shall be as mutually agreed upon. Those required to be in attendance at meetings shall be as requested.

B. Other meetings shall also include meetings with regulatory agencies. When requested, the Contractor shall attend meetings held or required by governmental regulatory agencies having jurisdiction of the Work.

C. Other meetings also include Post-Construction Conference. The Post-Construction Conference will be held prior to initial acceptance of the Work to discuss and resolve all unsettled matters.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 31 19

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SECTION 01 32 16 - CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Scheduling of the Work shall be performed by the Contractor in accordance with the requirements of this Section. The purpose of the Construction Schedule is to allow the Contractor to prepare an orderly plan to aid in the timely completion of the project.

B. Development of the schedule and project status reporting requirements of the Contract shall employ computerized Critical Path Method (CPM) scheduling.

C. The approved Construction Schedule shall be used to plan and execute the Work, to measure the progress of the Work, and to aid in evaluating time extensions.

D. Failure to maintain the Construction Schedule in an approved status may result in the Owner withholding a monetary penalty against the responsible Contractor(s) until the schedule is approved as set forth in 3.4 of this Section.

PART 2 - PRODUCTS

2.1 CONSTRUCTION SCHEDULE

A. Prepare a detailed construction schedule in graphic form showing duration and proposed dates of starting and completing each major division of the Work. The schedule is to be consistent with the time and order of Work requirements of the specifications, and is to be the basis of the Contractor's operations. Prepare the schedule utilizing a Gantt chart (bar type) or similar method that connects related activities.

B. Sufficient detail shall be included for the identification of subdivisions of the major components listed below. The major components should be broken in into activities such as excavation, foundation subgrade preparation, foundation concrete, completion of all structural concrete, CMU, roof, pump/equipment, mechanical and plumbing installation, electrical power and controls, coatings, and other activities as required.

1. Submittals
2. Equipment and Materials Procurement
3. Site Work
4. Yard Piping
5. Site Grading
6. Headworks (including installation of screen, modification of existing Headworks utility water system, modification of drainage for the existing grit cyclone/classifier).

7. Splitter Box

8. IFAS System

9. Clarifier Stairs, Portable Hoist, and Valve Actuator Replacement

10. Blower Building

11. Tertiary Lift Station

12. Tertiary Building (Including Tertiary Filtration System, Station, Utility Water System, Chemical Addition System, Blower Room, Electrical Room)

13. Effluent Manhole

14. Digester Valve Vault

15. Digester Blowers

16. Decant Lift Station (Including new pumps and control system)

17. Control & Dewatering Building

18. Selected Additive Bid Item

19. Section 01 75 00 - System Testing and Startup Procedures

C. Submit a horizontal bar chart with separate line for each section of Work, identifying first work day of each week.

D. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration. Clearly indicate critical path and activities/items on the critical path.

E. Indicate estimated percentage of completion for each item of Work at each submission.

F. Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates.

PART 3 - EXECUTION

3.1 INITIAL SCHEDULE SUBMITTAL

A. The Contractor shall submit two short-term schedule documents at the Pre-construction Conference which shall serve as the Contractor's Plan of Operation for the initial 60-day period of the Contract Time, and to identify the manner in which the Contractor intends to complete all Work within the Contract Time.

B. The bar chart shall show the accomplishment of the Contractor's early activities (mobilization, permits, submittals necessary for early material and equipment procurement, and long lead, CPM submittals, initial site work and other submittals and activities required in the first 60 days).

C. Following the Contractor's receipt of the Engineer's review comments, the Contractor shall correct the schedule to identify missing activities and relationships relevant to the Scope of Work. No time extensions will be granted to complete activities not initially included in the Contractor's Construction Schedule.

D. To the extent that there are any conflicts between the approved Construction Schedule and the requirements of the Contract Documents, the Contract Documents shall govern.

3.2 FINAL CONSTRUCTION SCHEDULE SUBMISSION

A. The Final Construction Schedule shall be submitted for approval within 60 calendar days after Notice to Proceed is issued. It shall provide a reasonable level of detail and a reasonable sequence of activities which represent Work through the entire project.

B. The Construction Schedule shall show the sequence and interdependence of activities required for complete performance of the Work, beginning with Contractor's receipt of the Notice to Proceed and concluding with the date of Final Completion of the Contract. The Project Schedule shall show all activities in workdays, with allowance for holidays and the effects of normal weather conditions on outside work.

C. The Construction Schedule shall comply with all limits imposed by the Scope of Work, with all contractually specified intermediate milestones and completion dates, and with all constraints, restraints, or sequences included in the Contract.

D. Procurement Activities: Prepare the schedule in chronological order of submittals. Show specification section of the submittal, name of contractor and generic description of work covered. Include activities to cover the complete procurement process to include but not limited to: submittal, review, approval, resubmittal, procurement, fabrication, delivery, permits, and similar pre-construction work.

E. Manpower:

1. All activities shall have an estimate of the average number of workers per day that are expected to be used during the execution of the activity.

2. Identification of any manpower, material or equipment restrictions, as well as any activity requiring unusual shift work, such as two (2) shifts per day, six (6) day work week, specified overtime, or work at times other than regular days or hours, shall clearly be identified in the Project Schedule.

3. Critical or near Critical Paths resulting from the use of manpower or equipment restraints shall be kept to a minimum. (Near Critical Paths are defined as paths having 10 workdays or less of total float.)

F. Responsibility: All activities shall be identified in the Construction Schedule by the party responsible to perform the Work. Responsibility includes, but is not limited to, the Contracting Firm, the Subcontracting Firm, Contractor Workforce, or Agency performing a given task. Activities shall not belong to more than one responsible party.

G. Work Areas:

1. Arrange the schedule to show each major area of construction for each major category or unit of Work.

2. All activities shall be identified in the Construction Schedule by the Work area in which the activity occurs. Activities shall not be allowed to cover more than one work area.

H. Modification or Claim Number: Any activity that is added or changed by a change order or used to justify any claimed time, shall be identified by change order code that changed the activity. Activities shall not belong to more than one change order.

I. Milestones: The Construction Schedule shall start no earlier than the date that the Notice to Proceed (NTP) was issued. Milestone dates are defined in calendar days following the date set forth in the Notice to Proceed and are required to be met by all Contractors. Time is of the essence for the completion of Milestones and for the Contract Completion date.

3.3 PERIODIC SCHEDULE UPDATES

A. Submit revised schedule with each Application for Payment, identifying changes since previous version.

B. Provide recommendations for adjusting the Construction Schedule to meet milestone completion and Contract completion dates (include why the schedule needs adjusting, i.e., change order, weather, contractor resources, etc.).

C. The Contractor shall prosecute the Work in accordance with the approved Construction Schedule. Out of sequence construction, defined as a change from the Construction Schedule in the Contractor’s actual operation, requires prior approval from the Engineer.

D. Upon the approval of a change order or the issuance of a unilateral change order by the Owner the agreed-upon change order activities, activity durations, logic and impacts shall be reflected in the next schedule submittal by the Contractor.

3.4 PAYMENT FOR CPM SCHEDULES

A. The Contractor’s attention is directed to the condition that 2% of the total Contract Price will be deducted from any money due the Contractor as progress payments until the Original CPM Schedule Submittal listed above has been completed as specified. The aforementioned amount will be retained by the Owner as agreed, estimated value of completing the original schedule. Any such retention of money for failure to complete all such mobilization items as a lump-sum item shall be in addition to the retention of any payments due to the Contractor as specified in the General Conditions of the Contract.

B. Approval of subsequent monthly pay requests may be delayed unless accompanied by a copy of the monthly update to the CPM schedule as described above. Extensive delays in submission of the monthly update may constitute sufficient basis for the Engineer to recommend withholding of some or all of any payment.

END OF SECTION 01 32 16

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SECTION 01 33 00 – SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Wherever submittals are required hereunder, all such submittals by the Contractor shall be submitted to the Engineer as delineated in this Section. The Contractor may use the form provided at the end of this Section for transmittal of submittals or provide their own form for Engineer review that includes the information required in this specification. A copy in Word or PDF format shall be provided to the Contractor.

B. At the Pre-Construction Conference, the Contractor shall submit the following items to the Engineer for review:

1. A preliminary construction schedule.

2. A preliminary schedule of Shop Drawings, Samples, and proposed Substitutes ("Or-Equal") submittals listed in the Bid.

C. Owner's Manuals shall be submitted in accordance with Section 01 78 23 – Operation and Maintenance Data.

D. The Contractor shall provide an internet-based construction management software package for submitting and tracking project related documents such as RFI's and Submittals. Access to and the use of this internet-based construction management site will be provided at no cost to the Engineer and Owner.

1.2 ENGINEER'S REVIEW PERIOD

A. For planning purposes, the Contractor shall assume a **minimum of 14 days** for review by the Engineer following receipt of submittal/resubmittal. If an expedited review is requested by the Contractor, the submittal shall identify the requested expedited review. The Engineer will attempt to accommodate the expedited review.

1.3 SUBMITTAL PROCEDURES

A. Verify that the material or equipment described in each submittal conforms to all requirements of the Specifications and drawings. Where the detailed specifications require specific submittal data, submit all data at the same time. The submittals are to be accompanied by the transmittal form attached at the end of this Section. The Engineer will return for resubmittal any information not accompanied by the specified transmittal form, properly completed.

B. Indiscriminate submittal of only manufacturer's literature is unacceptable and will be rejected.

C. The submittals shall be numbered as XXXXXX-YY-z., where XXXXXX is the specification section number, YY is the sequential number of the submittal, and Z is used for re-submittal labeled a through z. For example, the first submittal of an item from Section 32 13 13 – Concrete for Exterior Improvements would be numbered "32 13 13-01"; the first re-submittal of the submittal would be numbered "32 13 13-01-A".

D. A separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single transmittal form will be rejected. A multiple page submittal shall be collated into sets, and each set shall be stapled or bound, as appropriate, prior to transmittal to the Engineer.

E. Identify Project, Contractor, subcontractor or supplier, pertinent Drawing sheet and detail number(s), and specifications section number, as appropriate.

F. All Contractor shop drawings submittals shall be carefully reviewed by an authorized representative of the Contractor, prior to submission to the Engineer. Each submittal shall be dated, signed, and certified by the Contractor, as being correct and in strict conformance with the Contract Documents. In the case of shop drawings, each sheet shall be so dated, signed, and certified. No consideration for review by the Engineer of any Contractor submittals will be made for any items which have not been so certified by the Contractor. All non-certified submittals will be returned to the Contractor without action taken by the Engineer, and any delays caused thereby shall be the total responsibility of the Contractor.

G. Do not mark the submittals in red. Ensure that any marks are duplicated on all copies submitted. Outline the marks on reproducible transparencies in a rectangular box.

H. Coordinate submission of related items.

I. Identify variations from Contract Documents and product or system limitation which may be detrimental to successful performance of the completed Work.

J. Provide space for Contractor and Engineer Review stamps.

K. Submit electronic samples to:
c/o MATTHEW B. HILL
305 North 3rd Avenue, Suite A
Pocatello, ID 83201
mhill@kellerassociates.com

L. Submit material samples to:
c/o MATTHEW B. HILL
305 North 3rd Avenue, Suite A
Pocatello, ID 83201
mhill@kellerassociates.com

M. Electronic submittals:

1. Electronic submittals shall be submitted in PDF format and combined into a single file.

2. Engineer will return comments only.

3. Contractor is responsible for distributing copies of the submittal and Engineer's comments to concerned parties.

4. Engineer may require hard copies in lieu of an electronic submittal if, in the opinion of the Engineer, the electronic submittal is difficult to read.

5. Revise and resubmit submittals as required, identify all changes made since previous submittals. It is considered reasonable that the Contractor shall make a complete and acceptable submittal to the Engineer by the second submission of a submittal item. The Owner reserves the right to withhold monies due to the Contractor to cover additional costs of the Engineer's review beyond the second submittal.

N. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

1.4 DEVIATIONS FROM CONTRACT

A. If the Contractor proposes to provide material or equipment which does not conform to all of the Specifications and Drawings, the transmittal form accompanying the submittal copies shall indicate under "comments" the deviations.

1.5 SHOP DRAWINGS

A. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, list, graphs, catalog sheets, data sheets, and similar items. Whenever the Contractor is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the project is to be built, unless otherwise directed.

B. Except as may otherwise be indicated herein, the Engineer will return submittal to the Contractor with comments. The Contractor shall make a complete and acceptable submittal to the Engineer by the second submission of a submittal item.

C. If submittal is returned to the Contractor marked "NO EXCEPTIONS TAKEN," formal revision and resubmission of said submittal will not be required.

D. If submittal is returned to the Contractor marked "MAKE CORRECTIONS NOTED," formal revision and resubmission of said submittal will not be required.

E. If submittal is returned to the Contractor marked "AMEND-RESUBMIT," the Contractor shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the Engineer.

F. If submittal is returned to the Contractor marked "REJECTED-RESUBMIT," the Contractor shall revise said submittal and shall resubmit the required number of copies of, said revised submittal to the Engineer.

G. Fabrication of an item shall be commenced only after the Engineer has reviewed the pertinent submittals and returned copies to the Contractor marked either "NO EXCEPTIONS TAKEN" or “MAKE CORRECTIONS NOTED". Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis for changes to the contract requirements.

1.6 ORGANIZATION

A. A single submittal transmittal form shall be used for each technical specification section or item or class of material or equipment for which a submittal is required. A single submittal covering multiple sections will not be acceptable unless the primary specification references other sections for components.

B. On the transmittal form, index the components of the submittal and insert tabs in the submittal to match the components. Relate the submittal components to specification paragraph and subparagraph, drawing number, detail number, schedule title, room number, or building names, as applicable.

C. Unless indicated otherwise, terminology and equipment names and numbers used in submittals shall match those used in the Contract Documents.

1.7 EFFECT OF ACCEPTANCE OF CONTRACTOR INFORMATION

A. Acceptance by the Engineer of any drawings, method of work, or any information regarding materials or equipment the Contractor proposes to provide shall not relieve the Contractor of his responsibility for any errors therein and shall not be regarded as an assumption of risk or liability by the Engineer or Owner, or by any officer or employees thereof, and the Contractor shall have no claim under the contract on account of the failure or partial failure or inefficiency of any plan or method of work or material or equipment so accepted. Such acceptance shall be considered to mean merely that the Engineer has no objection to the Contractor using, upon his own full responsibility, the plan or method of work proposed, or providing the materials or equipment proposed.

B. Approval of shop drawings by the Engineer is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the Plans and Specifications. The Contractor is responsible for dimensions which shall be confirmed and correlated at the job site, fabrication process and techniques of construction, coordination of his work with that of all other trades and the satisfactory performance of his work.

1.8 PRODUCT DATA AND SAMPLES

A. Where required in the Specifications and as determined by the Engineer, test specimens or samples of materials, appliances and fittings to be used or offered for use in connection with the Work shall be submitted to the Engineer at the Contractor's expense. Specimen or sample submittals shall be made with information as to their sources, with all cartage charges prepaid, and in such quantities and sizes as may be required for proper examination and tests to establish the quality or equality thereof, as applicable.

B. All samples and test specimens are to be submitted in ample time to enable the Engineer to make any tests or examinations necessary, without delay to the Work. The Contractor will be held responsible for any loss of time due to the neglect or failure to deliver the required samples to the Engineer as specified.

C. Samples are also to be taken during the course of the Work, as required by the Engineer.

D. Laboratory tests and examinations that the Owner elects to make will be made at no cost to the Contractor, except that, if a sample of any material or equipment proposed for use by the Contractor fails to meet the Specifications, the cost of testing subsequent samples will be borne by the Contractor.

E. All tests required by the Specifications to be performed by an independent laboratory are to be made, and the samples therefore furnished shall be at the sole expense of the Contractor.

F. Material used in the Work is to conform to the submitted samples and test certificates as approved by the Engineer.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 33 00

STANDARD SUBMITTAL FORM

Transmittal of Shop Drawing or Submittal

CONTRACTOR: <CONTRACTOR NAME>

Tracking No. XXXXXX

Item covered by this submittal

Refer to the following attachment(s) for a detailed description of the item.

Applicable specification section(s)

☐ First Submittal OR ☐ Resubmittal No. _____

☐ This item is as specified OR ☐ This item is a substitution/or equal

☐ Supplier/Subcontractor certifies:

- ☐ Conforms to contract
- ☐ Minor deviations as specifically noted
- ☐ Major deviations as specifically noted

Review Priority: ☐ 1 ☐ 2 ☐ 3

Due Date: XX-XX-XX (Engineer's standard review period is 14 days)

Notes to Engineer:

Date Received by Contractor: _____ Date Returned to Subcontractor/Supplier _____

Contractor Comments:

Deviations Specifically Noted

SECTION 01 35 13 – SPECIAL PROJECT PROCEDURES

PART 1 - GENERAL

1.1 GENERAL

A. The existing wastewater treatment facility must remain operational during construction. As a result, phasing and sequencing of work is critical. Contractor shall take measures to maintain the plant's existing level of treatment at all times during construction.

B. Temporary pumping, piping, power, lighting, controls, instrumentation, alarms, security devices, and all required safety devices shall be provided by the Contractor whenever his work or interruption due to his work affects the existing flows, treatment processes, pumping, piping, power, lighting, controls, instrumentation, alarms, etc.

C. Critical events in the sequence of construction are described in this Section and shall be utilized by the Contractor as a guideline. The construction constraints presented do not include all items affecting the completion of the work but are intended to describe the sequence of critical events necessary to minimize disruption to the ongoing wastewater treatment processes. It shall be understood and agreed by the Contractor that the critical events described are not all inclusive and that additional items of work not described may be required to minimize disruption and ensure compliance. Deviation from or modification of these suggested sequences is permitted if techniques and methods known to the Contractor will result in reducing the disruption of the facility operation and maintain treatment or operational efficiency and is approved in advance by the Engineer.

D. The construction constraints described herein shall be incorporated into the Contractor's schedule as described in Section 01 32 16 – Construction Progress Schedule.

1.2 SUBMITTALS

A. A plan showing the size and location of the temporary facilities and piping shall be submitted to the Engineer at the same time as the outage plan required. All costs for design, provision, operation, and removal of temporary facilities and piping shall be the responsibility of the Contractor.

B. The request for any deviation shall be submitted as a shop drawing. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

C. Outage Plan Submittal Requirements

1. Modifications to existing facilities, the construction of new facilities, and the connection of new to existing facilities will require the temporary outage or bypass of treatment processes or facilities. In these cases, the Contractor's work shall be coordinated with the operation of the plant in advance. In addition to the Construction Schedule under Section 01 32 16 – Construction Progress Schedule, the Contractor shall submit a Request for Shutdown and a detailed outage plan and time schedule for each construction activity which will require a tank, pipeline, electrical circuit (other than lighting), control circuit, equipment, or other facilities to be removed from service.

2. The Request for Shutdown and outage plans shall be submitted to the Engineer for the Owner's review and acceptance a minimum of two weeks in advance of the time that such outages are required. The outage plans shall be coordinated with the construction schedule specified in Section 01 32 16 – Construction Progress Schedule and shall meet the restrictions and conditions specified in this section. The detailed plan shall describe the Contractor's method for preventing bypassing of other treatment units; the length of time required to complete said operation; any necessary temporary power, controls, instrumentation or alarms required to maintain control, monitoring and alarms for the treatment plant processes; and the manpower, plant and equipment which the Contractor shall provide in order to ensure proper operation of associated treatment units.

3. In addition, the outage plan shall describe the Contractor's contingency plan that shall be initiated in the event that his temporary facilities fail, or it becomes apparent that the time constraints described in the approved Outage Plan cannot be met. The contingency plan shall conform to all specified outage requirements. All costs for preparing and implementing both the outage and contingency plans shall be borne by the Contractor.

1.3 OPERATION OF PLANT EQUIPMENT

A. Operational functions or shutdown of the existing facility required to facilitate Contractor's operation will be done by the Owner’s personnel only.

B. The Owner’s operation and maintenance personnel will cooperate in every way that is practical in order to facilitate Contractor's operation. However, certain shutdown and connections may only be permissible at times other than normal working hours such as nights or weekends. No additional payment will be made to the Contractor for any night, weekend or holiday work or overtime payments. Contractor shall be sensitive to Owner’s overhead due to overtime pay and may be responsible for compensation if excessive outages are required.

C. If it is necessary for the proper operation or maintenance of portions of the existing facility, the Owner may require the Contractor to reschedule an approved shutdown. The Contractor shall then reschedule his operations so there shall be no conflict with necessary operations or maintenance of the plant. The Contractor shall, within two (2) working days, provide the Owner with revised Request for Shutdown and a plan for rescheduling of the work in accordance with the requirements of the Contractor's Schedule.

1.4 OUTAGE PLANS

A. The Contractor shall not begin an alteration until specific written permission has been granted by the Engineer in each case.

B. The Engineer will coordinate the Contractor's planned procedure with the Owner’s personnel. The Engineer has the authority to modify any proposed shutdown procedures if said work would adversely impact the plant facility’s operations.

C. The Owner shall be notified in writing at least one week in advance of the required outage if the schedule for performing the work has changed or if revisions to the outage plan are required.

D. The Contractor shall provide written confirmation of the shutdown date and time two working days prior to the actual shutdown.

E. The making of connections to existing facilities or other operations that interfere with the operation of the existing equipment shall be thoroughly planned in advance, and all required equipment, materials, and labor shall be on hand at the time of undertaking the connections. Work shall be completed as quickly as possible and with as little delay as possible and shall proceed continuously (24 hours a day and seven days a week) if necessary to complete modifications and/or connections in the minimum time.

F. Any temporary facilities and night, weekend, or holiday work and overtime payments required during process interruptions shall be included in the bid price for the work.

1.5 CONSTRAINTS AND WORK SEQUENCE

A. The Contractor shall be responsible for development of the construction sequencing. In implementing the construction sequencing, the Contractor shall maintain the existing facilities in service until new facilities are constructed and are operational. When new facilities are operational, the existing facilities may be taken out of service. The following general guidelines shall be used by the Contractor in planning the sequence of construction.

B. The following general information and guidelines shall be used by the Contractor in planning the sequence of construction. The list is not comprehensive, and items are not necessarily listed sequentially:

1. Permits. Contractor shall obtain all necessary permits.

2. Storm Water Pollution Prevention Plan (SWPPP). Submit Notice of Intent (NOI) and implement SWPPP measures to control storm water runoff, erosion, and discharge from construction dewatering efforts. The Contractor shall be responsible for management of storm water and sediment control measures in accordance with Section 01 57 12– Construction Site Discharge (SWPPP).

3. Groundwater. Groundwater dewatering may be required for construction (see Geotechnical Report).

4. Demolition. Demolition shall take place in phases, in order to maintain conveyance of wastes and existing treatment level during construction.

5. Rock: Rock requiring blasting or breaking to remove may be encountered throughout the WWTP (see Geotechnical Report).

6. Construction of new process equipment in the IFAS basins, the digester blower building, digester valve vault, and decant pump station, along with all architectural, structural, mechanical and electrical components should be planned for minimal outages and disruption of existing processes.

7. Construction of new buildings and structures that will require tie-in to existing facilities.

8. Electrical. Powering of new facilities and moving electrical from existing facilities to new electrical power feeds.

C. Construction sequencing shall provide for maintaining existing level of treatment, in accordance with the criteria in Section 3.3 and as summarized in the following sections.

1.6 ELECTRICAL POWER REQUIREMENTS

A. All switching, safety tagging, etc., required for plant facility shutdown or to isolate existing equipment shall be performed by the Contractor. In no case shall the Contractor begin any work in, on, or adjacent to existing equipment without written authorization by the Engineer.

B. The Contractor shall make all modifications or alterations to existing electrical facilities required to successfully install and integrate the new electrical equipment as indicated. Modifications to existing equipment, panels, or cabinets shall be made in a professional manner with all coatings repaired to match existing. The costs for modifications to existing electrical facilities required for a complete operating system shall be included in the Contractor's original bid amount and no additional payment for this Work will be authorized. Extreme caution shall be exercised by the Contractor in digging trenches in order not to damage existing underground utilities. Cost for repairs of damages caused during construction shall be the Contractor's responsibility without any additional compensation from the Owner.

C. The Contractor shall be responsible for identifying available existing circuit breakers in lighting panels for the intended use as required by the Drawings. Costs for this Work shall be included in the Contractor's original bid amount.

D. The Contractor shall visit the Site before submitting a bid to better acquaint itself with the Work of this Contract. Lack of knowledge will not be accepted as a reason for granting extra compensation to perform the Work.

1.7 ROAD ACCESS

A. The project site may be congested, and the Contractor shall conduct his operations to minimize interference with others as specified in Section 01 14 13 – Access to Site. Access roads and circulation roads shall not be closed unless equivalent road access is provided and maintained.

B. The project site entrance shall remain clear so vehicles can pull into the project site and to allow normal activities at the existing facility.

1.8 OPERATIONS AND MAINTENANCE ACCESS

A. Owner’s operations personnel must have continuous safe access to all process control equipment.

1.9 TEMPORARY BYPASSING, SHUTDOWNS, AND CONNECTIONS

A. Contractor to provide a schedule of anticipated shutdowns and temporary bypass pumping and connections. This shall be submitted as a Deactivation Plan as described in Part 1.10 below.

B. Making connections to or bypassing existing facilities or other operations that interfere with the operation of the existing equipment shall be thoroughly planned in advance, and required equipment, materials, and labor shall be on hand at the time of undertaking the connections. Work shall be completed as quickly as possible and with as little delay as possible and shall proceed continuously (24 hours a day and seven days a week if necessary) to complete modifications and/or connections in the minimum time.

C. The cost of any temporary facilities and night, weekend, or holiday activity and overtime payments required during process interruptions shall be included in the Work.

D. Temporary pumping facilities and piping shall be located to minimize interference with Contractor's construction facilities and Owner's operation and maintenance of the WWTP. Unless otherwise indicated, each temporary pipeline shall be of the same size as its connection to the existing or permanent facility at the downstream end of the pipeline. Piping materials shall be suitable for the material being conveyed and be as required in the piping schedule.

E. When temporary hoses, piping, electrical power, controls, instrumentation, alarms, etc. are required for bypass pumping or air pipe, the Contractor shall provide the necessary equipment and appurtenances. Prior to installing electrical equipment and appurtenances, Contractor shall furnish a submittal on the proposed components and installation for Engineer and Owner's review and approval.

1. For bypass pumping events that are anticipated to exceed 24 hours, Contractor shall provide controls, instrumentation, and alarms necessary to notify Contractor and Owner personnel in the event that a pump has failed. A completed redundant pumping system with backup power for these events will be considered an acceptable alternative.

F. Contractor shall provide provisions for contingency, including redundant pumps, backup power and other plans as required to ensure that backup or spill events do not occur.

1.10 DEACTIVATION REQUESTS

A. Modifications to existing facilities, the construction of new facilities, and the connection of new to existing facilities may require the temporary deactivation or bypass of existing treatment processes or facilities. In addition to the construction schedule required under Section 01 32 16 – Construction Progress Schedule, the Contractor shall submit a detailed Deactivation Plan within 60 calendar days following Notice to Proceed for the Engineer and Owner’s review and acceptance. The Deactivation Plan will define general deactivation requirements and shall include a schedule for all construction activities which will make it necessary to remove a tank, pipeline, channel, electrical feeder, instrumentation and control circuit, equipment, structure, road or other facilities from service. This Deactivation Plan shall be updated and resubmitted for the Engineer and Owner’s review and acceptance, as needed, throughout the duration of the project to accommodate all deactivation activities.

B. For each deactivation activity summarized in the Deactivation Plan (except as noted below), a Deactivation Request shall be submitted for the Engineer and Owner's review per Section 01 33 00 – Submittal Procedures and acceptance a minimum of two weeks in advance of the time that such outages are required. For deactivation activity requiring longer than 6 hours, the Deactivation Request shall be submitted a minimum of thirty (30) days in advance of the time that such outages are required, in order to allow for a coordination meeting (Section 01 31 19 – Project Meetings) 14 days in advance of the time that such outages are required.

C. All costs for preparing and implementing all the Deactivation Requests shall be included in the original Contract Price.

D. The Deactivation Request shall be coordinated with the Deactivation Plan and construction schedule and shall comply with the constraints of this Section.

E. The Deactivation Request shall describe which structures or pieces of equipment are to be deactivated, the method for bypassing the deactivated item(s), the work that is to be completed during the deactivation, and the length of time required to complete said operation. If any bypass pumping is required, then the submittal shall include a layout for the pumps and temporary piping; complete information on the pumps (number, size, power, capacity, etc.), any necessary temporary power, backup power, controls, instrumentation, or alarms required to maintain control, monitoring, and alarms; and the manpower and equipment which the Contractor shall provide to ensure proper operation of associated facilities.

F. The Owner and Engineer shall be notified in writing at least one week in advance of the required deactivation if the schedule for performing the Work has changed or if revisions to the deactivation plan are required.

G. The Contractor shall provide written confirmation to Owner and Engineer of the deactivation date and time two working days prior to the actual shutdown.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Temporary facilities and piping shall be located to minimize interference with Contractor's construction facilities and Owner's operation and maintenance of the facility. Unless otherwise specified, each temporary pipeline shall be of the same size as its connection to the existing or permanent facility at the downstream end of the pipeline with respect to the liquid or gas flow in the pipeline. Piping materials shall be suitable for the material being conveyed and be as specified in their respective specification sections.

B. When temporary electrical power supply controls, instrumentation or alarms are required for routine continuous operations of existing or new equipment, the Contractor shall provide the necessary equipment and appurtenances for such temporary power supply controls, instrumentation or alarms. Prior to installing said equipment and appurtenances Contractor shall provide a submittal on the proposed components and installation for Engineer’s review and approval.

C. During all rehabilitation, modification and demolition work, safe working conditions for the Owner's and Contractor's personnel shall be maintained at all times. The foregoing includes, but is not limited to, proper trench excavation, the provision of temporary equipment guards, supports, warning signs, walkways, covers over openings, handrailing and protection of electrical equipment and power supply. All temporary facilities shall be constructed in accordance with applicable codes and regulations so that they operate safely and properly. Valves to be temporarily shut off during the work shall be tagged as such and shall be wired shut with a crimped lead seal and padlocked. Electrical and mechanical equipment shall be similarly shut down.

3.2 CULTURAL RESOURCES

A. The Contractor's attention is directed to the National Historic Preservation Act of 1966 (16 U.S.C. 470) and 36 CFR 800 which provides for the preservation of potential historical architectural, archaeological, or cultural resources (hereinafter called cultural resources). The Contractor's attention is also directed to RCW 27.44 regarding Indian Graves and Records, RCW 27.53 regarding Archaeological Sites and Resources, RCW 68.60 regarding Abandoned and Historic Cemeteries and Historic Graves, and WAC 25-48 regarding Archaeological Excavation and Removal Permits.

B. The Contractor shall conform to the applicable requirements of the National Historic Preservation Act of 1966, and RCW 27.44, RCW 27.53, RCW 68.60 and WAC 25-48 as they relate to the preservation of cultural resources,

C. In the event potential cultural resources are discovered during subsurface excavations at the site of construction, the following procedures shall be instituted:

1. The Engineer will issue a Field Order directing the Contractor to cease all construction operations at the location of such potential cultural resources find.

2. Such Field Order shall be effective until such time as a qualified archaeologist can be called to assess the value of these potential cultural resources and make recommendations to the Engineer.

D. If the archaeologist determines that the potential find is a bona fide cultural resource, at the direction of the Washington State Department of Archaeology and Historic Preservation, the Contractor shall suspend work at the location of the find under the provisions for changes contained in the General Conditions.

3.3 PROPOSED SEQUENCE OF CONSTRUCTION

A. The following paragraphs are provided as guidance to the Contractor with the intent of providing general information regarding the required sequencing of construction of individual processes and infrastructure. It is not the intent of the following paragraphs to identify all the work required to be in place for a given process to be Substantially Complete. Thus, items such as utility water connections, access roads, plant drain system, and process piping may not be specifically listed and discussed below. The listing of items below also does not indicate or imply that all constraints or special conditions have been identified. The list is not a substitute for the duty of the Contractor to coordinate and plan for completion of all Work by the Substantial/Contract Completion Dates specified in the Contract Documents. The Contractor is responsible for all coordination and scheduling with plant staff and personnel. The Contractor shall verify that all processes are available before the start-up of the systems. Also, some of the process infrastructure may be constructed (but not Substantially Complete) simultaneously, or ahead of the identified process predecessors. It is noted that the guidelines may change upon a more detailed review of the scheduling. The Engineer is not responsible for scheduling the Contractor's work.

B. Suggested Phasing

1. Task 1: Installation of New Electrical Service

a. Activities

1) Coordination with electrical utility to install new service.

2) Installation of new transformer, switchboard, automatic transfer switch, and generator.

3) Installation of feeders for both utility and standby power to existing transfer switch.

4) Install feed to new transfer switch and extend to Structure E. All new structures (B2 and D) are fed from Structure E.

5) Maintaining electrical services to the existing plant. Contractor to provide temporary power as required to maintain operation.

b. Predecessors: None.

c. Construction Notes: The refeeding of power to the existing plant will require a shutdown of the existing service. This shutdown shall be coordinated with plant staff and shall be limited to 3 hours and shall occur during low flow conditions.

2. Task 2: Modifications to Structure A

a. Activities

1) Modifications to existing structure in the bypass channel, including removal of manual bar screen and grating.

2) Installation of all mechanical appurtenances, control and electricity.

3) Installation of new fine screen.

4) Modifications to existing structure for the existing grit cyclone/classifier, including removal of existing drainage and installation of new drainage.

5) Install new influent sampler with associated control and power.

b. Predecessors: Task 1.

c. Construction Notes: At no time shall coarse screened wastewater in the main channel be allowed to be diverted into new downstream IFAS treatment process. Installation of the new fine screen shall be completed prior to the new IFAS system. During the period of time when no drainage from grit cyclone/classifier is available, the Contractor shall be responsible to remove and dispose of drainage collected.

3. Task 3: Construction of New Plant Processes and Structures:

a. Activities:

1) Removal or abandonment of existing piping in the areas where new structures are to be constructed.

2) Contractor shall clean out one process train and dispose of wastewater as directed by Operator before starting demolition. Contractor shall proceed with construction of one process train in Structure B and any structural and electrical work that will not interfere with the operation of the second process train. One train shall remain in service at all times. Contractor shall bypass pump from IFAS tanks to Clarifiers as required during construction to keep one process train in service.

3) Coordinate with Owner to keep existing facilities in service to meet IPDES permit limits. Modifications in Structure B shall be performed during the summer months when flows are at their lowest.

4) Construction of Structure B1 IFAS Splitter Box.

5) Construction of Structure B2 IFAS Blower Building including all structural, mechanical, and electrical work.

6) Construction of Structure D1 Tertiary Lift Station including wet well, pumps, valve vault and appurtenances and connections to Structure D.

7) Construction of Structure D Tertiary Filter Building including all structural, mechanical, and electrical work. Installation of new 4" chemical dosing pipe to IFAS basins.

8) Construction of Building E including all structural, architectural, mechanical, electrical and controls.

9) Construction of new sampler and new effluent manhole. Cut out top of existing pipe.

10) Installation of new piping and pipe connections required to start up the new facilities.

11) Startup and commissioning of all process, mechanical and electrical equipment in all the above Structures. Run clean water test for 7 days through one train in Structure B with aeration (B2), one clarifier (C), the tertiary lift station (D1), and the tertiary filters (D). Contractor shall propose a method to circulate flow through these structures.

12) Obtain approval for 30-day performance testing with wastewater. Fill new process train with mixed liquor and successfully complete before isolating the second process train for conversion to the IFAS process. The new IFAS basin shall be capable of meeting discharge permit limits before taking the second process train out of service for conversion to the IFAS process.

13) Clean and pump out second process train prior to starting structural work. Dispose of wastewater as directed by Owner during periods of low flow until process basin is clean. Complete modifications to the second process train. Perform clean water test for 7 days on process train and aeration system. Contractor shall circulate clean water through the process train by pumping from one of the clarifiers to the effluent box of Structure B1.

14) Upon successful completion of the 7-day clean water test, Contractor shall pump out clean water and discharge to location as directed by the Operator.

15) Before starting the 30-day performance test, fill the second basin with mixed liquor and aerate until full. Obtain approval to start 30-day performance test. Direct mixed liquor to both process trains and operate for 30 days. Run concurrently with all treatment processes complete and online.

16) After the 30-day test is complete, treatment process shall be tested by directing mixed liquor to one process train to simulate max. month design flows and loadings to verify process performance.

b. Construction Predecessors: Tasks 1 and 2.

4. Task 4: Aerobic digesters and Solids Handling Facilities

a. Activities

1) Install new digester blower and piping in Building G1. Two existing blowers to remain operational while the new blower is installed.

2) Replace valves and piping in digester valve vault. Owner shall coordinate with Contractor to remove as much sludge as possible by gravity prior to start of the work.

a) Only one valve is currently operational. Coordinate with Operator. This tank will need to be pumped down and used for waste sludge storage while the valves for the other tanks are replaced. Each digester tank shall be pumped down and sludge pumped to the sludge drying beds into geotube(s) (provided by Contractor) as directed by the plant Operator. Contractor shall clean out each tank and dispose of wastewater as directed by Owner. While valves are being replaced in the valve vault, Operator shall inspect the diffusers and replace diffuser sleeves as required. Coordinate with Owner on timing to place tanks back in service.

b) Three of the 4-inch valves may be replaced while the sludge tanks are out of service. After the three new tank outlet valves are replaced, move sludge from the operating tank into the other three tanks for temporary storage. Clean out fourth tank and dispose of wastewater water as directed by Owner. Shut off all aerobic digester effluent valves and replace valve for remaining tank. Coordinate with Owner so sludge wasting process is not disrupted.

c) The 6-inch valves are used for decanting. Lower tank elevation as required to replace these valves in the vault.

3) Install and test piping. Complete sludge pipe tie-ins to existing WAS piping, the aerobic digester, and the sludge drying beds. Complete connection of new 4” water to Structure E. Complete drain lines from Structure E.

b. Construction of new mechanical and electrical equipment in Structure E, including screw press, utility water system, sludge feed pumps, polymer dosing system, sludge conveyors, and piping.

c. Construction Notes: Where services, such as power and sewer to the Control & Dewatering building, are to be rerouted, the Contractor shall limit these shutdowns to no more than 24 hours and shall provide adequate backup services to the Owner as approved by the Owner and Engineer.

d. Predecessors: Task 1, 2 and 3.

e. Perform start-up of the dewatering equipment and operate for 7 days with aerobically digested sludge and WAS to optimize performance.

f. Perform 30-day test concurrently with all plant facilities online after completion of both IFAS process trains.

5. Task 5: Modifications to Decant Lift Station

a. Activities

1) Removal and replacement of existing pumps, guiderails, valves, and controls in the Decant Lift Station.

2) Installation of new pumps, controls and electricity connection.

b. Predecessors: Task 3

c. Construction Notes: Modifications to the Decant Lift Station will require the shutdown of existing 6" drain from Structure G. It is not anticipated that bypass pumping will be required for this work, since the drainage from the Structure G is periodic. However, the Contractor shall coordinate with the Owner regarding timing and duration for this work.

END OF SECTION 01 35 13

SECTION 01 35 53 – SECURITY PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall implement security procedures to ensure existing facilities and new construction are protected from vandalism, theft, and unauthorized entry. The Contractor shall:

1. Initiate security program in coordination with Owner's existing security system during mobilization.

2. Maintain program throughout construction period until Substantial Completion.

1.2 ENTRY CONTROL

A. The Contractor shall:

1. Restrict entry of persons and vehicles into construction areas.

2. Allow entry to construction area only to authorized persons with proper identification.

3. Keep all Contractor employees out of existing facilities that are not being modified under the Work.

4. Coordinate with Owner entry control to existing facilities that are not being modified under the Work.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 35 53

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SECTION 01 42 13 - ABBREVIATIONS AND ACRONYMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Wherever in these Specifications references are made to the standards, specifications, or other published data of the various international, national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user of these Specifications, the following acronyms or abbreviations which may appear in these Specifications shall have the meanings indicated herein.

1.2 ABBREVIATIONS

1.3 ACRONYMS

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturer's Association
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturer's Association, Inc.
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AHAM	Association of Home Appliance Manufacturers
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association

ANS	American Nuclear Society
ANSI	American National Standards Institute, Inc.
APA	American Plywood Association (or) American Parquet Association, Inc.
API	American Petroleum Institute
APWA	American Public Works Association
ARI	Air-Conditioning and Refrigeration Institute
ASA	Acoustical Society of America
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society of Nondestructive Testing
ASQC	American Society for Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWCI	American Wire Cloth Institute
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BBC	Basic Building Code, Building Officials and Code Administrators
BHMA	Builders Hardware Manufacturer's Association
CBM	Certified Ballast Manufacturers
CDA	Copper Development Association
CEMA	Conveyors Equipment Manufacturer's Association

CGA	Compressed Gas Association
CLFMI	Chain Link Fence Manufacturer's Institute
CLPCA	California Lathing and Plastering Contractors Association
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
DCDMA	Diamond Core Drill Manufacturer's Association
DEQ	Department of Environmental Quality
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
DOE	Department of Ecology
DWR	Department of Water Resources
EIA	Electronic Industries Association
ETL	Electrical Test Laboratories
EPA	Environmental Protection Agency
FCI	Fluid Controls Institute
FM	Factory Mutual System
FPL	Forest Products Laboratory
HI	Hydronics Institute (or) Hydraulics Institute
HPMA	Hardwood Plywood Manufacturers Association
IAPMO	International Association of Plumbing and Mechanical Officials
IBC	International Building Code
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IFC	International Fire Code
IME	Institute of Makers of Explosives

IP	Institute of Petroleum (London)
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
ISDSI	Insulated Steel Door Systems Institute
ISEA	Industrial Safety Equipment Association
ISO	International Organization for Standardization
ISPWC	Idaho Standards for Public Works Construction
ITE	Institute of Traffic Engineers
MBMA	Metal Building Manufacturer's Association
MIL	Military Standards (DoD)
MPTA	Mechanical Power Transmission Association
MSS	Manufacturers Standardization Society
MTI	Marine Testing Institute
NAAMM	National Association of Architectural Metal Manufacturer's
NACE	National Association of Corrosion Engineers
NAGDM	National Association of Garage Door Manufacturers
NB	National Board of Boiler and Pressure Vessel Inspectors (alternate NBBPVI)
NBS	National Bureau of Standards (Now NIST)
NCCLS	National Committee for Clinical Laboratory Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association (or) National Fluid Power Association (or) National Forest Products Association
NISO	National Information Standards Organization
NLGI	National Lubricating Grease Institute
NMA	National Microfilm Association

NSF	National Sanitation Foundation
NWMA	National Woodwork Manufacturers Association
NWWDA	National Wood Window and Door Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PPI	Plastics Pipe Institute
RCRA	Resource Conservation and Recovery Act
RIS	Redwood Inspection Service
RMA	Rubber Manufacturers Association
RVIA	Recreational Vehicle Industry Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SAMA	Scientific Apparatus Makers Association
SDI	Steel Door Institute
SMA	Screen Manufacturers Association
SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SPI	Society of the Plastics Industry, Inc.
SPIB	Southern Pine Inspection Bureau
SPR	Simplified Practice Recommendation
SSA	Swedish Standards Association
SSBC	Southern Standard Building Code, Southern Building Code Congress
SSPC	Steel Structures Painting Council
SSPWC	Standard Specifications for Public Works Construction
TAPPI	Technical Association of the Pulp and Paper Industry
TFI	The Fertilizer Institute
TIA	Telecommunications Industries Association

UBC	Uniform Building Code
UFC	Uniform Fire Code
UL	Underwriters Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WCRSI	Western Concrete Reinforcing Steel Institute
WEF	Water Environment Federation
WIC	Woodwork Institute of California
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 42 13

SECTION 01 42 19 - REFERENCE STANDARDS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Titles of Sections and Paragraphs: Captions accompanying specification sections and paragraphs are for convenience of reference only, and do not form a part of the Specifications.

B. Applicable Publications: Whenever Specification references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Work is advertised for bids shall apply. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of, or omission from, said standards or requirements.

C. Specialists' Assignments: In certain instances, specification text requires specific work be assigned to specialists or expert entities who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements over which the Contractor has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the Work. In addition, these requirements are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of contract requirements remains with the Contractor.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to or exceed the requirements of applicable codes and the applicable requirements of the following documents:

1. References herein to "Building Code" shall mean current International Building Code (IBC).

2. References to "Mechanical Code" or "Uniform Mechanical Code," "Plumbing Code" or "Uniform Plumbing Code," "Fire Code" or "Uniform Fire Code," shall mean International Mechanical Code, Uniform Plumbing Code and International Fire Code of the International Conference of the Building Officials (ICBO).

3. "Electric Code" or "National Electric Code (NEC)" shall mean the National Electric Code of the National Fire Protection Association (NFPA).

4. The latest edition of the codes as approved by the Municipal Code and used by the local agency as of the date that the Work is advertised for bids, as adopted by the agency having jurisdiction, shall apply to the Work herein, including all addenda, modifications, amendments, or other lawful changes thereto.

B. In case of conflict between codes, reference standards, drawings, and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the Engineer for clarification and directions prior to ordering or providing any materials or furnishing labor. The Contractor shall bid for the most stringent requirements.

C. The Contractor shall construct the Work specified herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards, and specifications listed herein.

D. References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

E. References herein to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

F. Applicable Standard Specifications: References in the Contract Documents to "Standard Specifications" shall mean the Idaho Standards for Public Works Construction, the latest Edition.

1.3 REGULATIONS RELATED TO HAZARDOUS MATERIALS

A. The Contractor shall be responsible that all work included in the Contract Documents, regardless of if shown or not, shall comply with all EPA, OSHA, RCRA, NFPA, and any other Federal, State, and Local Regulations governing the storage and conveyance of - hazardous materials, including petroleum products.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 42 19

SECTION 01 45 00 - QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Specific quality control requirements for the Work are indicated throughout the Contract Documents. The requirements of the Section are primarily related to performance of the Work beyond furnishing of manufactured products. The term “Quality Control” includes inspection, sampling and testing, and associated requirements.

B. The Work shall be inspected and tested according to the requirements stated in Article 14 of the General Conditions and as amended by the Supplementary Conditions.

1.2 SUBMITTALS

A. Submit testing results in accordance with Section 01 33 00 – Submittal Procedures.

B. For Engineer and Owner approval, the Contractor shall submit testing laboratory’s qualifications and certifications prior to entering into a contractual agreement to perform quality control testing and inspection work.

C. Reports of testing will be submitted to the Engineer indicating observations and results in test and indicating compliance or non-compliance with Contract Documents. It is the responsibility of the Contractor to ensure these submittals are provided in a timely manner to reduce cost impact of potential removal of defective work.

1.3 SAMPLING AND TESTING

A. When not otherwise specified, all sampling and testing shall be in accordance with the methods prescribed in the current ASTM standards, as applicable to the class and nature of the article or materials considered; however, the Owner reserves the right to use any generally-accepted system of inspection which, in the opinion of the Engineer will ensure the Owner that the quality of the workmanship is in full accord with the specifications.

B. Any waiver of any specific testing or other quality assurance measures, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the specified testing or other quality assurance requirements as originally specified, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial work, shall not be construed as a waiver of any technical or qualitative requirements of the specifications.

C. Notwithstanding the existence of such waiver, the Engineer shall reserve the right to make independent investigations and tests as specified in Subparagraph 1.3.D, following; and, upon failure of any portion of the Work to meet any of the qualitative requirements of the specifications, shall be reasonable cause for the Engineer to require the removal or correction and reconstruction of any such work.

D. In addition to any other inspection or quality assurance provisions that may be specified, the Engineer shall have the right to independently select, test, and analyze, at the expense of the Owner, additional test specimens of any or all of the materials to be used. Results of such tests and analyses shall be considered along with the tests or analyses made by the Contractor to determine compliance with the applicable specifications for the materials so tested or analyzed; provided, that wherever any portion of the work is discovered, as a result of such independent testing or investigation by the Engineer, which fails to meet the requirements of the specifications, all cost of such independent inspection and investigation, and all costs of removal, corrections, and reconstruction or repair of any such work shall be borne by the Contractor.

1.4 TESTING SERVICES

A. The Contractor shall hire an independent testing lab to perform quality control tests as specified in each specification. All tests shall be paid for by the Contractor.

Item	Reference for testing requirements
Earthwork	See Section 31 00 00 – Earthwork
Trench Backfill	See Section 31 23 33 – Trenching and Backfilling
Asphalt Pavement	See Section 32 12 16 – Asphalt Paving
Cast-in-Place Concrete	See Section 03 30 00 – Cast-in-Place-Concrete
Masonry	See Section 04 22 00 – Concrete Unit Masonry
Grout	See Section 03 30 00 – Cast-in-Place-Concrete and Section 04 22 00 – Concrete Unit Masonry, as applicable
Structural Steel	See Section 05 12 00 – Structural Steel Framing

B. Testing company shall meet the following qualifications:

1. Basic requirements of ASTM E329, “Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials as Used in Construction” and ASTM D3666, “Standard Specification for Minimum Requirements for Agency Testing and Inspecting Bituminous Paving Materials”, as applicable.

2. Calibrate testing equipment at reasonable intervals by devices of accuracy traceable to either the National Bureau of Standards or accepted values of natural physical constants.

C. The Contractor shall notify Engineer 24 hour prior to the expected time for operations requiring inspection and laboratory test services. Failure of the Contractor to notify the Engineer at least 24 hours in advance of any such inspections shall be reasonable cause for the Engineer to order a sufficient delay in the Contractor's schedule to allow time for such inspections and any remedial or corrective work required, and all costs of such delays, including its effect upon other portions of the Work, shall be borne by the Contractor.

D. Samples and test specimens required under these specifications shall be furnished and prepared for testing in ample time for the completion of the necessary tests and analysis before said articles or materials are to be used. The Contractor shall furnish and prepare all required test specimens at his own expense.

E. Should any tests fail the specified requirements, the work shall be redone and retested at the Contractor's expense.

1.5 REGULATORY REQUIREMENTS

A. General

1. Comply with all Federal, State, and local Codes as referenced herein. Such regulations apply to activities including, but not limited to, sitework and zoning, building practices and quality, on and offsite disposal, safety, sanitation, nuisance, and environmental quality.

2. Contractor designed structural systems are subject to the same overall inspection requirements as all other work.

B. Special Inspection

1. Special Inspection is in addition to, but not replacing, other inspections and quality control requirements herein.

2. Contractor will contract with and pay for the services of an independent Special Inspection Agency. Contractor shall coordinate with the designated Special Inspector to schedule the timing of site visits to perform the inspections in a timely manner.

3. A schedule of required Special Inspections is provided in the Contract Drawings.

C. Structural Observation

1. Inspect framework, shoring, pipe supports, and other Contractor-designed systems for adequacy.

2. Engineer will provide structural observation in addition to the inspection performed by the Special Inspection Agency.

1.6 RIGHT OF REJECTION

A. The Engineer may reject portions of the Work as provided in Article 14 of the General Conditions.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION

A. Inspection: The Contractor shall inspect materials or equipment upon their arrival on the job site and immediately prior to installation and reject damaged and defective items.

B. Measurements: The Contractor shall verify measurements and dimensions of the work as an integral step of starting each installation.

C. Manufacturer's Instructions: Where installation includes manufactured products, the Contractor shall comply with manufacturer's applicable instructions and recommendations for installation, to whatever extent these are more explicit or more stringent than applicable requirements indicated in Contract Documents.

3.2 SITE INVESTIGATION AND CONTROL

A. Contractor shall verify all dimensions in the field and shall check field conditions continuously during construction. The Contractor shall be solely responsible for any inaccuracies built into the Work due to his failure to comply with this requirement.

B. Contractor shall inspect related and appurtenant work and shall report in writing to the Engineer any conditions which will prevent proper completion of the Work. Failure to report any such conditions shall constitute acceptance of all site conditions, and any required removal, repair or replacement caused by unsuitable conditions shall be performed by the Contractor at his sole cost and expense.

END OF SECTION 01 45 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall be responsible to provide all equipment including that required for office, sanitation, signage, lighting, etc., as per requirements in paragraph 7.04 in Section C-700 – General Conditions.

1.2 SAFETY

A. The Contractor shall comply with "Safety and Protection" requirements as described in paragraph 7.13, 7.14, and 7.15 in Section C-700 – General Conditions.

B. Appropriate first aid facilities and supplies shall be kept and maintained by the Contractor at the site of the work. All persons within the construction area shall be required to wear protective helmets and eye protection. In addition, all employees of the Contractor and his subcontractors shall be provided with, and required to use, personal protective and lifesaving equipment as set forth in "Subpart E" of the OSHA Safety and Health Standards for Construction (29CFR 1926) including all of its amendments.

C. During the performance of the Work, the Contractor shall erect and maintain temporary railings and barriers and shall take all other necessary precautions and place proper guards for the prevention of accidents and the Contractor shall erect and maintain suitable and sufficient lights and other signals.

1.3 TEMPORARY UTILITIES

A. Types: The types of utility services required for general temporary use at the Site include the following:

1. Water service
2. Storm sewer
3. Sanitary sewer
4. Electric power service
5. Telephone service

B. Scheduled Uses: The Contractor shall, in conjunction with establishment of job progress schedule, establish a schedule for implementation and termination of service for each temporary utility at the earliest feasible time, and when acceptable to Owner and Engineer, change over from use of temporary utility service to permanent service.

1.4 TEMPORARY FACILITIES

A. Contractor shall obtain all necessary permits, arrange for connection of utilities, and pay all required fees and utility costs associated with the work site during the construction activities.

B. Suitable areas for on-site materials storage shall be maintained by Contractor as specified in Section 01 14 13 – Access to Site. Locations of storage areas shall be subject to Owner's approval but shall remain the responsibility of the Contractor. Location shall not interfere with drainage, traffic, or private property.

C. Contractor shall set up and maintain in a neat and orderly manner all temporary construction facilities. Locations shall be subject to Owner's approval but shall remain the responsibility of the Contractor.

1.5 CULTURAL RESOURCES

A. The Contractor's attention is directed to the National Historic Preservation Act of 1966 (16 U.S.C. 470) and 36 CFR 800 which provides for the preservation of potential historical architectural, archaeological, or cultural resources (hereinafter called cultural resources.).

B. The Contractor shall conform to the applicable requirements of the National Historic Preservation Act of 1966 as it relates to the preservation of cultural resources.

C. In the event potential cultural resources are discovered during subsurface excavations at the site of construction, the following procedures shall be instituted:

1. The Engineer will issue a Field Order directing the Contractor to cease all construction operations at the location of such potential cultural resources find.

2. Such Field Order shall be effective until such time as a qualified archaeologist can be called to assess the value of these potential cultural resources and make recommendations to the Engineer.

D. If the archaeologist determines that the potential find is a bona fide cultural resource, at the direction of the Idaho State Historical Society, the Contractor shall suspend work at the location of the find under the provisions for changes contained in Section C-700 – General Conditions.

1.6 DUST ABATEMENT

A. The Contractor shall prevent its operation from producing dust in amounts damaging to property, cultivated vegetation, or domestic animals, or causing a nuisance to persons living in or occupying buildings in the vicinity. The Contractor shall be responsible for any damage resulting from dust originating from its operations. The dust abatement measures shall be continued until the Contractor is relieved of further responsibility by the Engineer.

1.7 RUBBISH CONTROL

A. During the progress of the Work, the Contractor shall keep the Site and other areas used by it in a neat and clean condition, and free from any accumulation of rubbish. The Contractor shall dispose of all rubbish and waste materials of any nature occurring at the Site and shall establish regular intervals of collection and disposal of such materials and waste. The Contractor shall also keep its haul roads free from dirt, rubbish, and unnecessary obstructions resulting from its operations. Disposal of all rubbish and surplus materials shall be off the Site in accordance with local codes and ordinances governing locations and methods of disposal, and in conformance with all applicable safety laws, and to the particular requirements of Part 1926 of the OSHA Safety and Health Standards for Construction.

1.8 CHEMICALS

A. All chemicals used during project construction or furnished for project operation, whether defoliant, soil sterilant, herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall show approval of either the U.S. Environmental Protection Agency or the U.S. Department of Agriculture. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer. In addition, see the requirements set forth in Section 01 57 12 – Construction Site Discharge (SWPPP).

PART 2 - PRODUCTS

2.1 MATERIALS

A. The Contractor shall provide either new or used materials and equipment, which are in substantially undamaged condition and without significant deterioration and which are recognized in the construction industry, by compliance with appropriate standards, as being suitable for intended use in each case. Where a portion of temporary utility is provided by utility company, the Contractor shall provide the remaining portion with matching and compatible materials and equipment and shall comply with recommendations of utility company.

PART 3 - EXECUTION

3.1 INSTALLATION OF TEMPORARY UTILITY SERVICES

A. Wherever feasible, the Contractor shall engage the utility company to install temporary service to project, or as a minimum, to make connection to existing utility service; locate services where they will not interfere with total project construction Work, including installation of permanent utility services; and maintain temporary services as installed for required period of use; and relocate, modify or extend as necessary from time to time during that period as required to accommodate total project construction Work.

B. Temporary connections for electricity shall be subject to approval of the Engineer and the power company representative and shall be removed in like manner at the Contractor's expense prior to final acceptance of the Work.

C. Separation of Circuits: Unless otherwise permitted by the Engineer, circuits used for power purposes shall be separate from lighting circuits.

D. Construction Wiring: Wiring for temporary electric light and power shall be properly installed and maintained and shall be securely fastened in place. Electrical facilities shall conform to the requirements of Subpart K of the OSHA Safety and Health Standards for Construction.

3.2 INSTALLATION OF POWER DISTRIBUTION SYSTEM

A. Power: The Contractor shall provide power required for its operations under the Contract and shall provide and maintain all temporary power lines required to perform the Work in a safe and satisfactory manner.

B. Temporary Power Distribution: The Contractor shall provide a weatherproof, grounded, temporary power distribution system sufficient for performance of entire Work of project, including temporary electrical heating where indicated, operation of test equipment and test operation of building equipment and systems which cannot be delayed until permanent power connections are operable, temporary operation of other temporary facilities, including permanent equipment and systems which must be placed in operation prior to use of permanent power connections (pumps, HVAC equipment, elevators, and similar equipment), and power for temporary operation of existing facilities (if any) at the Site during change-over to new permanent power system.

1. Provide circuits of adequate size and proper power characteristics for each use;

2. Run circuit wiring generally overhead, and rise vertically in locations where It will be least exposed to possible damage from construction operations and will result in minimal interference with performance of the Work;

3. Provide rigid steel conduit or equivalent raceways for wiring which must be exposed on grade, floors, decks, or other exposures to damage or abuse.

3.3 WATER SUPPLY

A. The Contractor shall coordinate with the Utility he is obtaining water service connection from. The Contractor shall provide all facilities necessary to convey the water from the source to the points of use in accordance with the requirements of the Contract Documents; this includes back flow prevention in accordance with the Utilities requirements.

B. The Contractor shall provide and operate all pumping facilities, pipelines, valves, hydrants, storage tanks, and all other equipment necessary for the adequate development and operation of the water supply system. Water used for domestic purposes shall be free of contamination and shall conform to the requirements of the State and local authorities for potable water. The Contractor shall be solely responsible for the adequate functioning of its water supply system and shall be solely liable for any claims arising from the use of same, including discharge or waste of water there from.

C. The Contractor shall not make connection to or draw water from any fire hydrant or pipeline without first obtaining permission of the Owner. For each such connection made, the Contractor shall first attach to the fire hydrant or pipeline a valve, meter, and backflow prevention device acceptable to the Owner.

3.4 STORM WATER

A. All storm water runoff and control of soil erosion shall be managed as outlined in Specification Section 01 57 12 – Construction Site Discharge (SWPPP).

3.5 INSTALLATION OF SANITARY FACILITIES

A. Fixed or portable chemical toilets shall be provided wherever needed for the use of Contractor's employees. Toilets at construction job sites shall conform to the requirements of Subpart C Section 1926.51 of the OSHA Standards for Construction.

B. The Contractor shall establish a regular daily collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the Contractor or organic material wastes from any other source related to the Contractor's operations shall be disposed of away from the Site in a manner satisfactory to the Engineer and in accordance with all laws and regulations pertaining thereto.

C. The Contractor shall coordinate with the Owner for obtaining sewer connection and shall pay all permit and sewer usage charges. The sewer capacity charges will be paid by the Owner.

3.6 INSTALLATION OF COMMUNICATIONS

A. Telephone Services: The Contractor shall provide and maintain at all times during the progress of the Work not less than one telephone in good working order at its own field construction office at or near the Site.

3.7 OPERATIONS AND TERMINATIONS

A. Prior to placing temporary utility services into use, the Contractor shall inspect and test each service and arrange for governing authorities' required inspection and tests and obtain required certifications and permits for use thereof.

B. The Contractor shall maintain distinct markers for underground lines and protect from damage during excavating operations.

C. When need for a temporary utility service or a substantial portion thereof has ended, or when its service has been replaced by use of permanent services, or not later than time of substantial completion, the Contractor shall promptly remove installation unless requested by Engineer to retain it for a longer period. The Contractor shall complete and restore Work which may have been delayed or affected by installation and use of temporary utility, including repairs to construction and grades and restoration and cleaning of exposed surfaces.

D. Before final acceptance of the Work on the project, all temporary connections and piping installed by the Contractor shall be entirely removed, and all affected improvements shall be restored to original condition or better, to the satisfaction of the Engineer and to the Owner.

END OF SECTION 01 50 00

SECTION 01 52 13 – ENGINEER'S FIELD OFFICE

PART 1 - GENERAL

1.1 RESIDENT ENGINEER'S OFFICE

A. Contractor shall provide the Owner's Resident Engineer with a temporary office at the site of the Work, at a location agreeable to the Engineer and separate from the Contractor's office. The office shall be provided within two weeks of the written Notice to Proceed and shall be subject to approval by the Engineer. The Contractor's attention is directed to the condition that no payment for mobilization, or any part thereof, will be approved for payment under the contract until all field office facilities specified herein, have been provided.

B. Unless released earlier by the Engineer in writing, the field office shall be maintained in full operations at the site with all utilities connected and operable until final Notice of Completion has been executed and recorded. Upon recordation of final Notice of Completion, or upon early release of the field office by the Engineer, the Contractor shall remove the field office within 10 working days from said site and shall restore the site occupied by field office to the original condition or better.

C. The door to the office shall be equipped with a satisfactory lock, and all keys (four required) in connection therewith shall be turned over to the Resident Engineer. All facilities and equipment provided under this Section shall remain the property of the Contractor.

1.2 OFFICE FACILITIES

A. Contractor shall provide and maintain for the exclusive use of the Engineer and the Owner's representative and personnel, at a point convenient to the construction operations, one separate, well-lighted, air-conditioned, electrically-heated field office with an outdoor outhouse. The office shall be located close to the Contractor's field office. Said office shall be of the portable trailer type unless otherwise specifically authorized by the Engineer in writing and shall be a separate unit not attached or connected to any other structures.

B. Said office shall be provided with at least 4 windows, electric lights, internet access, four 120-volt receptacles, heater, air-conditioning, bottled drinking water with chilled water dispenser, and outdoor toilet. The electrical and internet installation charge and monthly electric and internet bills shall be paid by the Contractor.

C. Contractor shall furnish and install all necessary electrical wiring, sanitary facilities, air condition and heating equipment, and shelving, and shall furnish all necessary light, heat, water, internet, and janitorial services in connection with the field office specified herein, for the duration of the Work.

D. Contractor shall provide a meeting room as either a part of the Contractor's or Engineer's office or as a separate trailer. The room shall have a table and adequate space for 15 chairs around the table and shall be a minimum of 250 square feet. The room shall be well lit, air conditioned, and electrically heated.

1.3 FIELD OFFICE SERVICES

A. Field office required hereunder shall be provided with sufficient lighting to provide not less than 50-foot candles at desktop height at each desk location. Exterior lighting shall be provided over the entrance door.

B. A minimum of four 110-volt ac duplex electric convenience outlets shall be provided, with at least one such outlet on each wall. The electric distribution panel shall provide not less than 2 circuits providing 110-volt, 60-Hertz service.

C. Refrigerated, bottled water service and a continuous supply of paper cups shall be provided for the field office.

D. A chemical toilet with an approved holding tank shall be provided. All such sanitary waste material shall be regularly pumped out and the chemicals recharged. Contractor shall provide and maintain a continuous supply of toilet paper and paper towels with holders.

E. Regular janitorial services shall be provided during working hours on a weekly basis. Office shall be swept, dusted, and waste receptacles emptied.

PART 2 - PRODUCTS

2.1 FIELD OFFICE EQUIPMENT

A. Contractor shall provide the following listed items in good condition for the field office:

1.	1 each	Standard 30x60 inch desk(s) with not less than 3 drawers.
2.	2 each	Metal file cabinet, 4-5 drawer with lock and keys.
3.	1 each	30-inch x 8-foot reference table.
4.	2 each	Office chair(s) standard arm rest type, adjustable, swivel, tilt-back with casters.
5.	2 each	Wastebaskets
6.	1 each	Tack board 36x42 inches
7.	1 each	7 linear-foot Bookshelf
8.	1 each	Refrigerated-type bottled water dispenser unit and bottled water and paper cup supply.
9.	1 each	Fire extinguisher
10.	1 each	Printer/copier/scanner

PART 3 - EXECUTION NOT USED

END OF SECTION 01 52 13

SECTION 01 57 12 - CONSTRUCTION SITE DISCHARGE (SWPPP)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Construction activities that disturb one acre or more are regulated under the Idaho Pollutant Discharge Elimination System (IPDES) Regulations for Storm Water Discharges. The Idaho Department of Environmental Quality (IDEQ) has created a Construction General Permit (CGP) which outlines a set of provisions construction operators must follow to comply with the requirements of the IPDES storm water regulations.

B. The IPDES through the CGP governs the construction activities to prevent and control soil erosion, transport, sedimentation, and further water and air pollution that may degrade receiving waters including rivers, streams, lakes, reservoirs, groundwater and wetlands. The control measures contained herein shall be installed and maintained through the construction contract and coordinated with any permanent or temporary pollution control feature specified elsewhere on the plans and in the specifications to assure effective and continuous water pollution control throughout the construction and post construction periods. The controls may include silt fences, straw wattles, rock berms, diversion dikes, interceptor swales, sodding, mulching, soil retention blankets, or other structural or non-structural stormwater pollution controls. Any and all erosion control structures and stabilization practices will be inspected, maintained by the Contractor on a weekly basis, and after any storm event of 0.25 inches or greater. The Contractor will all keep a detailed record of inspections, maintenance and discharge events.

C. The Owner reserves the right to have required temporary erosion sedimentation and water pollution prevention and control work performed by others should the Contractor fail to perform required temporary erosion, sedimentation, and water pollution prevention and control work in a timely fashion or should the Contractor fail to prevent and control soil erosion, sedimentation, and water pollution which may degrade receiving water. All costs, including engineering, for the work required shall be borne by the Contractor.

1.2 REFERENCES

A. Agency Documents:

1. Construction General Permit and Related Documents: https://www.deq.idaho.gov/water-quality/wastewater/storm-water/

2. Catalog of Stormwater Best Management Practices for Idaho Cities and Counties: https://www2.deq.idaho.gov/admin/LEIA/api/document/download/14968

3. Construction General Permit Resources, Tools, and Templates: https://www.epa.gov/npdes/construction-general-permit-resources-tools-and-templates#swppp

B. Other guidance documents:

1. Customizable SWPPP template for construction site operators in unauthorized states including Idaho. This SWPPP template is in Microsoft Word format: https://www.epa.gov/sites/production/files/2017-04/sw_cgp2017_swppptemplate-4-5-17.docx

1.3 SUBMITTALS

A. Stormwater Pollution Prevention Plan (SWPPP): Prior to submitting a Notice of Intent, the Contractor shall create and submit the SWPPP that details how the Contractor proposes to comply with CGP. The Contractor's SWPPP will be subject to review by the Engineer prior to commencement of Work.

B. Notice of Intent (NOI): Prior to commencement of any work, the Contractor shall submit an NOI with IDEQ. The NOI must be submitted through the E-Permitting System to the IDEQ at least 14 calendar days prior to commencing earthwork. An executed NOI from IDEQ shall be submitted to the Engineer prior to commencing work.

1. E-Permitting System website:

a. https://www2.deq.idaho.gov/water/IPDES/

C. Notice of Termination (NOT): Upon completion of all work, the Contractor shall submit a complete NOT with IDEQ through the E-Permitting System. The NOT shall be submitted to the Engineer.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. The Owner and Contractor shall be co-permittees of the General Construction Permit (CGP) and, as such, both are responsible for the implementation of the SWPPP. If the Contractor fails to prevent pollutants from leaving the construction site, the Owner shall have the right to take corrective measures and withhold monies from the Contractor for such cost incurred by the Owner for corrective actions.

1. Prior to the Owner withholding costs for corrective actions. The Owner or Engineer will notify the Contractor of pollutants leaving the site. The Contractor shall have 8 hours to take corrective actions.

2. If the Contractor fails to take corrective actions, within 8 hours of notification, to prevent the pollutants from leaving the site, the Owner may take corrective actions and all costs incurred by the Owner for the corrective actions shall be withheld from payments owed to the Contractor.

B. A copy of the SWPPP, NOI and the IPDES Stormwater General Construction Permit shall be kept on site at all times.

C. Copies of the required site inspection reports shall be made as an appendix to the SWPPP.

D. All documents shall be maintained and available for public review anytime during the project including up to three years after substantial completion.

3.2 MAINTENANCE & INSPECTION PROCEDURES

A. Any and all erosion control structures and stabilization practices will be inspected by the Contractor on a weekly basis at a minimum and after any storm event of 0.25 inches or greater. During the winter when the ground is frozen and runoff is unlikely to occur, such inspections shall be conducted at least every two weeks.

1. The SWPPP shall be modified as necessary to include additional or modified Best Management Practices (BMPs) designed to correct problems identified. Revision to the SWPPP shall be made within 7 calendar days following any identified correction. Copies of the revised SWPPP shall be provided to the Owner and Engineer.

2. All areas that undergo temporary and final stabilization with seeding or sodding shall be inspected; areas that have lack of growth and bare spots shall be reseeded by the Contractor to ensure healthy growth.

3. All erosion control structures and stabilization practices shall be maintained in good working condition throughout the duration of the construction project.

4. Repair of the damage to any structural erosion control structure shall be completed by the Contractor within 24 hours of discovery of the damage.

5. In locations where silt fences or wattles are used around catch basins, trapped sediment shall be removed by the Contractor when one-third of the height of the silt fence or wattle is covered by sediment.

6. Hard surfaces shall be swept at the end of each day’s work.

B. If a detention/retention ponds are employed, the depth of the detention/retention ponds shall be measured monthly by the Contractor and the depth shall be provided to the Owner within one day of measuring. The Contractor shall remove sediment buildup in the pond if the buildup begins to interfere with the proper operation of the pond. The detention/retention ponds shall be excavated to design profile depths and slopes at the end of the project, if sediment buildup has significantly altered the pond profile.

1. Excavated material from any detention/retention ponds or swales shall not be used as structural fill and shall be disposed of as spoil material, in a location selected by the Contractor and approved by the Engineer. Once placed, the excavated material shall be stabilized using one of the suggested BMPs listed in IDEQ's Catalog of Stormwater BMPs.

3.3 CLEAN UP AND REMOVAL OF BMPS

A. After final stabilization, remove all temporary BMPs and dispose of off-site at no cost to the Owner.

B. After removal of temporary BMPs, sweep all sediment accumulated on project hard surfaces, including asphalt, sidewalks, and adjacent roadways.

END OF SECTION 01 57 12

SECTION 01 58 13 - TEMPORARY PROJECT SIGNAGE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall furnish and install temporary signs identifying the project, funding agencies, and design firms as specified herein.

B. The Contractor may furnish and install temporary sign identifying Contractor and Sub-Contractor businesses as specified herein.

1.2 SUBMITTALS

A. Shop Drawings: The Contractor shall provide shop drawings of all signs in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Shop Drawing shall consist of full-size layouts of all signs. Details of installation shall be submitted showing support system, location, and relative layout of signs.

1.3 REFERENCE STANDARDS

A. USDA-RD website:

https://www.rd.usda.gov/programs-services/water-environmental-programs/water-waste-disposal-loan-grant-program/id

PART 2 - PRODUCTS

2.1 GENERAL

A. A separate sign shall be provided for funding agencies. Design firms and construction business signs may be combined in a single layout.

B. Style and color of lettering and logos shall be as specified herein and of professional quality; all lettering will be in proportion to the sizes shown. All wording shall be as indicated and shall be verified and approved before fabrication.

C. Materials shall be durable and weather resistant.

D. Information specified on the attached details will be displayed on the sign.

E. Any additional information displayed on the sign will not detract from or displace the information required in the drawing.

2.2 FUNDING AGENCY SIGN

A. The following funding agency(s) must be represented on the sign:

1. USDA – Rural Development

2. IDEQ – Idaho Department of Environmental Quality

3. IDOC – Idaho Department of Commerce

B. Sign shall be constructed of 4.0 feet by 8.0 feet exterior type high-density overlaid plywood or other sign material of equivalent quality and durability.

C. Layout, wording, colors, and logos shall be as shown in C-800 – Supplementary Conditions RD Idaho Attachment 2 and as per example sign at the end of this section.

2.3 PROJECT IDENTIFICATION SIGN

A. Sign shall be constructed of 4.0 feet by 8.0 feet exterior type high-density overlaid plywood or other sign material of equivalent quality and durability.

B. The Contractor shall submit artistic sketches and layout as shop drawing for review and approval before fabrication. The Owner's and Engineer's logos shall be incorporated into the design. At a minimum, the lettering on the sign shall include the following:

CITY OF ABERDEEN

WASTEWATER TREATMENT PLANT IMPROVEMENTS 2023

Design Engineer: Keller Associates, Inc.
Contractor: TBD

C. Sign layout shall be such that Project Identification is prominent and equal visual weight is given to Owner and Engineer logos.

D. Inclusion of Contractor's logo is encouraged but not required, and shall meet the following requirements:

1. Visual weight for Contractor's logo shall not exceed that of Owner or Engineer. (Space allotted for Contractor's logo and lettering shall not exceed (by area) space allotted for Owner or Engineer.)

2. A limited number of Sub-Contractor's logo(s) may also be incorporated, subject to Owner and Engineer approval, the sum of which shall not exceed (by area) the space allotted for Contractor's logo and/or lettering.

2.4 CONTRACTOR IDENTIFICATION SIGN

A. A third sign may be allowed for identification of Contractor and a limited number of Sub-Contractor's logo(s), subject to Owner and Engineer approval. The Contractor shall submit artistic sketches and layout as shop drawing for review and approval before fabrication.

B. Sign shall be constructed of exterior type high-density overlaid plywood or other sign material of equivalent quality and durability, no bigger than half the size of the Project Identification Sign.

PART 3 - EXECUTION

3.1 GENERAL

A. Signs shall be installed prior to commencement of construction at a location which is near the project site and amenable to public viewing.

B. Signs shall be displayed continuously throughout project construction. Vandalized and/or damaged signs shall be repaired or replaced immediately and meet the same specifications as the original sign.

C. The signs will be removed and appropriately disposed of when the construction is complete and accepted by Owner and funding agency(s).

3.2 INSTALLATION

A. Signs shall be located near the main construction access to the project and be visible from the main public access corridor to the site.

B. Signs and supports shall not impede access to or from site.

C. Fasten signs securely in level and plumb positions.

D. The sign will be adequately supported with regard to site conditions and will be an adequate distance above the prevailing grade to permit public viewing.

END OF SECTION 01 58 13

FUNDED BY:

Joseph R. Biden
President of the United States

Tom Vilsack
Secretary of Agriculture

Financed by United States Department of Agriculture (USDA) Rural Development

USDA is an equal opportunity provider and employer

Idaho Department of Environmental Quality

State Revolving Loan Fund

Department of Commerce

HUD / Community Development Block Grant

BRAD LITTLE, Governor

SECTION 01 64 00 – OWNER-FURNISHED PRODUCTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall install, test and start up Owner-purchased Integrated Fixed Film Activated Sludge (IFAS) system, an upflow moving bed filter system, and sludge dewatering system including all structural, mechanical, electrical, instrumentation and control components and appurtenances for a complete and properly operable system, in accordance with the requirements of the Contract Documents.

B. The executed Procurement Agreement and the contract documents for the pre-selected equipment including IFAS system, upflow moving bed filter, and sludge dewatering system are included in the Appendices to these specifications. The Equipment Pre-Purchase Scope of Supply, equipment, piping, other support systems layouts, and selected shop drawings are also included in the Appendices. The Contractor shall examine these documents to determine the extent of the Vendor's responsibility for the pre-selected equipment and to coordinate the Contractor's Work with that scope of supply.

1. Submittal information provided in the Appendices is given for reference only. Due to manufacturer’s proprietary information, the submittals in the Appendices may not include all necessary information for bidding purposes. It is the contractor’s responsibility to contact the manufacturer to obtain all required information for bidding purposes. Note that any change orders due to the contractor’s failure to obtain required information on equipment submittals from vendors will not be accepted.

2. Contact information for each pre-selected equipment package are as follows:

Veolia Water Technologies, Inc.			
Kruger's AnoxKaldnes Hybas IFAS technology			
Manufacturer's Representative	Scott Forsling, PE, Coombs Hopkins Company	435-659-7199	scott@chcwater.com
Project Manager	Rodrigo Lara, Kruger / Veolia	503-380-3995	rodrigo.lara@veolia.com
Nexom, Inc.			
CF64-60 Upflow Moving Bed Filter			
Manufacturer's Representative	Brad Gwinnup, W-Cubed INC.	801-821-3770	bradg@wcubedinc.com
Project Manager	Greg Roppelt, Nexom	239-565-8873	greg.roppelt@wastewater.com
Huber Technology, Inc.			
HUBER Screw Press Q-PRESS 620.2®			
Manufacturer's Representative	Ryan Spanton, Goble Sampson	(801) 268-8790	rspanton@goblesampson.com
Project Manager	Ron Maiorana, Huber Technology, Inc.	(704) 990-2422	Ronald.Maiorana@hhusa.net

C. The Procurement Agreements for the equipment selected and ordered by the Owner are to be assigned to the Contractor.

1.2 SUBMITTALS

A. The Contractor shall review the manufacturers' instructions and submit a detailed plan of their proposed assembly and installation procedure setting forth the schedule of construction to the Engineer. The Contractor shall review Section 01 35 13 - Special Project Procedures regarding the sequence of construction for this equipment.

B. Submittals shall be furnished in accordance with Section 01 33 00 – Submittal Procedures.

C. Delivery Schedule: The Contractor shall coordinate the delivery of the equipment with the supplier and submit a schedule of delivery to the Owner. This equipment delivery schedule shall be incorporated into the Contractor's CPM schedule as outlined under Section 01 32 16 – Construction Progress Schedule.

1.3 QUALITY ASSURANCE

A. All Work shall be performed in accordance with Section 01 45 00 - Quality Control.

B. The Work shall be performed only by skilled personnel certified and experienced in the installation of similar equipment. The Contractor shall ensure that firms which undertake the electrical and instrumentation control Work are regularly engaged in the installation, rehabilitation, and modification of similar equipment.

1.4 VENDOR'S REPRESENTATIVE

A. The Purchase Agreements for the equipment includes the services of a Vendor's representative for assistance during the installation, start up, testing and optimization of the equipment. The Vendor representative will also provide instruction/training of the Owner's personnel. The Contractor shall coordinate the on-site time of the representative and shall schedule visits a minimum of two weeks in advance. Delays caused by the inability of the representative to be on site will not result in additional contract time awarded to the Contractor, unless two weeks' notice is given to the equipment Vendor prior to installation, start up, testing or any of the other services for which the presence of the representative is required. The Contractor shall examine the proposal documents, equipment Procurement Specifications, Procurement Agreement, and approved shop drawings to determine the extent of services to be furnished by the Vendor and shall notify the Engineer in writing if there are conflicts which affect the performance of the Work as specified.

1.5 INSURANCE

A. The Contractor shall include in the insurance coverage for the Work under this Contract, sufficient coverage to protect the Owner-furnished equipment and materials against all losses during unloading, and storage, until final acceptance of the Work by the Owner. The Owner shall be named as co-insured for this equipment.

B. Estimated total value of Owner Pre-selected equipment is approximately $1.95 Million. Reference Bid Form. Contractor is responsible for any sales and use taxes required by the Idaho Tax Code for this equipment.

1.6 DELIVERY

A. The Contractor shall review the Vendor's requirements for delivery, receiving, and storage of the goods and all other relevant information contained in the Appendices.

B. The Vendor will arrange to have the Goods delivered to the project site between 8:00 A.M. and 3:30 P.M., Monday to Thursday and 8:00 am and 11:30 am on Friday, statutory holidays exempt. The Owner shall not be responsible for Goods delivered outside the acceptable time for delivery.

C. The delivery date of the equipment is tentatively scheduled as listed below. The Contractor shall coordinate with the Vendors on a delivery schedule as needed throughout construction. The Contractor shall have no claim for added costs or time extension resulting there from.

1. IFAS System: TBD

2. Continuous Backwash Sand Filters: TBD

3. Screw Press: TBD

PART 2 - PRODUCTS

2.1 GENERAL

A. Contractor shall furnish all materials and tools, including precision instruments which are necessary for proper installation of the equipment. Such additional material and tools shall include, for example, bracing, jacks, blocking, supports, shims, anchor bolts, and other lifting and rigging equipment, foundation material, plumb lines, and other necessary precision measurement instruments.

B. Furnish all other necessary materials such as piping, tubing, fittings, gaskets, bolts, hangers, supports, grout, and weld rod as required for installation of the equipment.

C. Contractor shall be fully responsible for providing all of the materials necessary for complete erection and installation of the equipment and accessories.

PART 3 - EXECUTION

3.1 DELIVERY AND TRANSPORT

A. The Contractor shall coordinate delivery of the equipment with the appropriate Vendor. The Vendor is responsible for delivery, inspection, and acceptance of the delivered Goods, while the Contractor is responsible for unloading and storage of the Goods in accordance with the Vendor’s recommendations.

B. The Contractor shall be responsible for maintaining the appropriate insurance on the equipment, including Builder's All Risk Insurance for the full replacement value, from the time of delivery to final close-out of the project. The Contractor shall have full responsibility to schedule, insure, install, test, start up and initially operate the equipment as though the Contractor had furnished it. The Contractor shall repair or replace any equipment or components damaged while under its care and shall restore the equipment or components to new condition.

3.2 INSTALLATION, GENERAL

A. The Contractor shall coordinate with the Vendor on field assembly, unloading and initial inspection, installation, certification of installation, and testing, as described in the Appendices and the Contract Documents for the Pre-selected Equipment.

B. The Contractor shall be responsible for the complete installation and operation of the equipment including all mechanical, electrical, instrumentation and structural connections, drainage piping, foundations, platforms, conduits, and all other features and appurtenances required for the successful installation and operation of the IFAS system, upflow moving bed filter, and sludge dewatering system.

C. The Contractor shall be responsible for installation of the equipment as described in the equipment Vendor's complete set of equipment installation instructions.

D. The Contractor shall coordinate any warranty issues arising prior to final close out of the job with the Vendor.

E. Contractor shall be responsible for protection of all equipment prior to final acceptance of installation.

F. Distribute loadings on floors and platforms during installation of equipment. Maintain installation procedures and techniques which will not overstress structural components.

G. Cover openings in equipment prior to, during, and following installation so as to prevent dirt, rubbish, or water from entering.

H. Equipment shall not be subjected to electrical or mechanical shock. The Contractor shall replace or repair damaged, dented, or marred equipment in a manner satisfactory to the Owner, at the option of the Owner, and at no additional cost to the Owner.

I. Provide miscellaneous materials as required to provide a complete, operable equipment installation. Such miscellaneous materials include, but are not limited to, the following:

1. Stainless steel and brass shim stock.

2. Thread lubricants, pipe dope, gasket compound and sealers.

3. Non-hazardous solvents and cleaning compound.

4. Welding rod and other expendable construction materials.

5. Cribbing, jacks, slings, rigging, blocking, scaffolding, lifting eyes, and other erection materials.

6. Grout, grout forms, and blocking.

7. Bolts, studs, nuts, and gaskets for makeup of connections to the equipment, securing the equipment to its support, and to replace manhole gaskets damaged or misplaced during storage, inspection, cleaning, filling, or placing into service.

J. Equipment Mounting

1. Provide support, anchorage and mounting of piping and equipment in accordance with manufacturer's recommendations, UBC/IBC and industry standard requirements, unless otherwise specified.

2. Provide elements required to resist the forces described herein, including seismic forces and as required by the equipment manufacturer.

3. Provide and install structural steel and cast-iron bases, concrete pads and pedestals, anchor bolts and necessary mounting hardware.

4. Mounting arrangements and details shown on the Drawings are intended only to provide general guidance.

5. Provide adequate support of equipment, tanks, piping, duct work and anchorages as required to provide a complete, operating installation.

6. Absence of indication of support on the drawings shall not constitute grounds for additional compensation for Work required to meet the requirements of this Section.

K. Painting. All ferrous metal for the equipment shall have field touch-up painting by the Contractor in accordance with Section 09 90 00 – Painting and Coating.

3.3 INSTALLATION CHECKS AND TESTING

A. The factory representative from the equipment manufacturer shall check installation, perform calibration and adjustments, and supervise start-up of each system as specified in the Appendices.

B. Refer to the Appendices for the Contract Documents for the Pre-selected Equipment for the description of required field tests to be conducted by the manufacturer's representative.

C. The Vendor shall operate each unit to demonstrate the equipment will perform to Owner's requirements. Any and all adjustments required for proper operation shall be made by the Vendor and the Contractor.

END OF SECTION 01 64 00

SECTION 01 71 13 - MOBILIZATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Mobilization consists of preparatory work and operations including, but not limited to those necessary for the movement of personnel, movement of equipment, temporary construction facilities, supplies and incidentals to the project site. Included is the establishment of all necessary offices, buildings, signs, utilities, acquisition of permits, preconstruction submittals, and all other work which must be performed and costs incurred prior to beginning work on the various items of the contract.

B. Mobilization shall include the following principal items:

1. Moving onto the site all Contractor's plant and equipment required for first month operations.

2. Providing all necessary temporary on-site utilities per Section 01 50 00 – Temporary Facilities and Controls.

3. Arranging for and erection of Contractor's work and storage yard in accordance with Section 01 14 13 – Access to Site.

4. Arranging for and erection of Resident Engineer’s field office in accordance with Section 01 52 13 – Engineer’s Field Office.

5. Constructing and implementing security features and requirements complying with Section 01 35 53 – Security Procedures.

6. Installing proper stormwater pollution prevention measures as specified in the Stormwater Pollution Prevention Plan developed in accordance with Section 01 57 12 – Construction Site Discharge (SWPPP).

7. Obtaining all required permits and property insurance.

8. Having all OSHA required notices and establishment of safety programs.

9. Having the Contractor's superintendent at the job site full-time.

10. Installing the Project Sign(s) in accordance with Section 01 58 13 – Temporary Project Signage.

11. Submitting pre-construction submittals in accordance with Specification Section 01 33 00 -Submittal Procedures.

1.2 SITE AREA

A. The limits of the project site are as indicated on the Drawings.

B. Contractor shall provide and maintain all signing, barricades, fencing, drainage facilities, and other items as required to protect public and private property from damage caused by mobilization operations.

1.3 ACCESS

A. Refer to Section 01 14 13 – Access to Site.

B. If construction access is required in addition to that shown on the Drawings, Contractor shall secure Owner's approval of all additional project entrances prior to construction. Contractor shall also obtain written approval from impacted landowner(s) if other than project owner.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 PAYMENT FOR MOBILIZATION

A. Allowable amounts for partial payment of mobilization are as follows:

1. First monthly progress estimate: Up to 60% of the Mobilization contract price in the agreed-upon Schedule of Values, or 2% of the total Contract Amount, whichever is less.

2. The balance of the Mobilization contract price in the agreed-upon Schedule of Values shall be paid after Substantial Completion.

3. The Contractor's attention is directed to the condition that 2 percent of the total Contract Price will be deducted from any money due the Contractor as progress payments until all mobilization items listed above have been completed as specified. The aforementioned amount will be retained by the Owner as the agreed estimated value of completing all of the mobilization items listed. Any such retention of money for failure to complete all such mobilization items as a lump-sum item shall be in addition to the retention of any payments due to the Contractor as specified in Section C-520 – Agreement Between Owner and Contractor or Section C-700 – General Conditions of the Contract.

END OF SECTION 01 71 13

SECTION 01 71 23.16 - CONSTRUCTION SURVEYING

PART 1 - GENERAL

1.1 SCOPE

A. The Contractor shall provide construction surveying for the project.

B. The Contractor shall hire a professional land surveyor to reset any disturbed survey monuments in accordance with Idaho Code.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. The electronic AutoCAD base maps used to create the drawings are available to the Contractor. In the event of a discrepancy between the stamped paper drawings and the electronic files, the stamped paper drawings shall govern. The Contractor shall immediately notify the Engineer of any discrepancies prior to proceeding. The Contractor shall indemnify and hold harmless the Owner and Engineer from all liability, claims, damages, losses and expenses, including attorneys' fees arising out of or resulting from the Contractor's use or interpretation of electronic files.

3.2 CONSTRUCTION STAKING

A. The Contractor shall provide location and grade construction surveying as required to locate the Work.

3.3 MONUMENTATION

A. The Contractor shall employ a professional land surveyor, duly and properly registered in the State of Idaho, to reference all public and private land survey monuments that will be disturbed by construction activities prior to construction. Reestablish such monuments as part of the survey work for this project before project completion in accordance with Idaho Code. Section corner and quarter corner monuments reset after construction shall include corner perpetuations and filing with the county. Sixteenth corner monuments reset and having existing corner perpetuation filed with the county shall have new perpetuation records filed after the corner has been reset. Perform all monument work in accordance with Title 55, Chapter 16 of the Idaho State Code. Perform all corner, property, and roadway centerline reestablishment in accordance with standard surveying practices under the responsible charge of a professional land surveyor.

END OF SECTION 01 71 23.16

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SECTION 01 71 33 - PROTECTION OF ADJACENT CONSTRUCTION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. It shall be the Contractor's responsibility to ascertain the actual location of all existing utilities and other improvements indicated on the drawings and to see that such utilities or other improvements are adequately protected from damage due to all construction operations. The Contractor shall take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be directed by the Owner.

1.2 RIGHTS-OF-WAY

A. The Contractor shall not do any work that would affect any oil, gas, sewer, or water pipeline; any telephone or electric transmission line; any fence; or any other structure.

1.3 EXISTING UTILITIES AND IMPROVEMENTS

A. The Contractor shall protect all existing utilities and improvements not designated for removal and shall restore damaged or temporarily relocated utilities, including underground utilities and improvements to a condition equal to or better than they were prior to such damage or temporary relocation, all in accordance with requirements specified herein, and in accordance with the requirements of the Contract Documents.

B. The Contractor shall determine the exact locations and depths of all underground utilities indicated on the drawings.

C. The right is reserved to the Owner and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the Work of this contract.

D. Existing utility lines that are shown on the drawings or the locations of which are made known to the Contractor prior to excavation and that are to be retained, and all utility lines that are constructed during excavation operations, shall be protected from damage during excavation and back-filling and, if damaged, shall be immediately repaired by the Contractor at his expense.

E. In the event that the Contractor damages any existing utility lines that are not shown on the drawings or the locations of which are not made known to the Contractor prior to excavation, the Contractor shall refer to procedures in the General Conditions regarding unforeseen conditions.

F. When utility lines that are to be removed are encountered within the area of operations, the Contractor shall notify the Owner a sufficient time in advance for the necessary measures to be taken to prevent interruption of the service.

G. All repairs to a damaged improvement shall be inspected and approved by an authorized representative of the improvement owner before being concealed by backfill or other work.

H. Where the proper completion of the Work requires the temporary or permanent removal and/or relocation of an existing utility or other improvement which is shown on the drawings, the Contractor shall, at his own expense, remove and without unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to the Engineer and the Owner of the facility. In all cases of such temporary removal or relocations, restoration to former location shall be accomplished by the Contractor in a manner that will restore or replace the utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 NOTIFICATION BY THE CONTRACTOR

A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; and all roadway and state highway rights-of-way, the Contractor shall notify the respective authorities representing the owners or agencies responsible for such facilities not less than 3 days nor more than 7 days prior to excavation so that a representative of said owners or agencies can be present during such work if they so desire.

END OF SECTION 01 71 33

SECTION 01 75 00 – EQUIPMENT TESTING AND STARTUP (WWTP)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Equipment testing and startup are requisite to satisfactory completion of the contract and, therefore, shall be completed within the contract time.

B. The Contractor shall coordinate with the Owner all work necessary for the successful operation of all equipment, including owner furnished equipment.

C. During all equipment testing plant/facility startup period and acceptance test periods, the Owner shall ensure that experienced, trained, and qualified personnel are onsite at all times to oversee and safeguard such testing and operations.

D. Coordinate the Work in this section with the requirements in Section 01 35 13 – Special Project Procedures.

1.2 SUBMITTALS

A. Testing and Startup Plan: Not less than 60 days prior to startup, the Contractor shall submit for review a detailed Testing and Startup Plan. The Plan shall include schedules for equipment certifications, submittal of final Owner's Manuals, training of the Owner's personnel, electrical testing, and a detailed schedule of operations to achieve successful equipment plant testing, startup, performance, and acceptance testing and activities to implement the 7-day and 30-day tests. The Plan shall include test checklists and data forms for each item of equipment and shall address coordination with the Owner's staff. The Contractor and Owner shall revise the Plan as necessary based on review comments.

B. System Outage Requests: Request for shutdown of on-line systems as necessary to test or start up the plant and equipment. Shutdown requests must be submitted at least two weeks prior to shutdown.

C. Records and Documentation:

1. Submit documentation that the equipment has been properly installed, is in accurate alignment, is free from undue stresses from connecting piping and anchoring and has operated satisfactorily under full load conditions.

2. Testing and Startup Records as specified in Section 3.3.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Prior to scheduling any operations testing, the Contractor shall have previously furnished the Owner's Manuals required under Section 01 78 23 – Operation and Maintenance Data.

B. The Contractor shall coordinate the scheduling of all operations testing. The Contractor is advised that the Engineer and the Owner's operating personnel will witness operations testing and that the equipment supplier's representative shall be required to instruct the Owner's operating personnel in correct operation and maintenance procedures.

C. The Contractor shall notify the Engineer at least 7 days in advance for testing installed equipment.

3.2 FACTORY ACCEPTANCE TESTING

A. The Contractor shall be responsible for conducting a factory acceptance test and achieving Engineer approval as to the outcome of the test prior to the field installation of the equipment, if required by the specifications for the equipment.

B. The Contractor is advised that the Engineer and the Owner’s operating personnel may witness factory testing.

C. The Contractor shall be responsible for scheduling all factory acceptance testing. The Contractor shall coordinate the factory acceptance testing schedule with the Engineer at least 1 week in advance.

D. Factory acceptance testing shall be conducted per the requirements in the equipment specifications.

E. Factory acceptance testing shall involve the bench setup of the SCADA computers and RTU/PLC panels communicating with each other all in the same location at the same time. Followed by a demonstration of all SCADA software screens and navigation menus, process data displays, alarm/status indication, and implementation of control strategies described in Division 40. In addition, the Contractor shall demonstrate sustained communication between SCADA computers and RTU/PLC’s for a minimum of eight continuous hours when operated in conjunction with other system components.

3.3 EQUIPMENT INSTALLATION AND TESTING

A. The Contractor shall coordinate directly with the Equipment Vendor to provide the services of an experienced and authorized representative of the manufacturer, who shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation.

B. The Contractor shall arrange to have the manufacturer's representative revisit the job site as often as necessary until any and all trouble is corrected, and the equipment installation and operation are satisfactory to the Vendor and Engineer.

C. The Contractor shall require that each manufacturer's representative furnish to the Engineer a written certification addressed to the Owner certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts and has been operated satisfactorily and tested under full-load conditions.

3.4 PROCESS SYSTEM TESTING

A. In addition to individual equipment and subsystem testing, the Contractor shall perform testing of all process control, electrical and other systems, as listed below and/or in the Contract Documents, to demonstrate proper operation with equipment operating over full operating ranges and under actual operating conditions, in all of the automatic and manual modes as specified in the control strategies and descriptions in the equipment specifications and Division 40.

B. The Contractor shall repeat the system tests as necessary to demonstrate proper operation to the satisfaction of the Engineer. The Contractor shall be back charged the cost of Owner's personnel and Engineer's personnel for all tests beyond the second test.

C. Prior to initiating the system testing, the Contractor shall submit the testing procedures to the Engineer for approval. Systems that are included in a 7-day test shall be tested and accepted prior to commencement of the 30-day startup test. The systems that shall be included in the 7-day and 30-day tests include the following and other systems as indicated in the Contract Documents:

1. Headworks screen (test for 2 hours in clean water with no alarms).

2. IFAS splitter box (7-day clean water test).

3. IFAS system including process blowers, DO probes, aeration grids, air mass flow meters, level sensors, chemical mixer, air sparge valves and piping, effluent collection/splitter box, and process control panel (7-day clean water test). Only one tank may be out of service while the work is being performed. The other tank shall remain in service and provide full treatment of the wastewater until the first renovated tank can be brought online to provide secondary treatment.

4. Tertiary lift station (7-day clean water test).

5. Tertiary filtration (7-day clean water test).

6. Chemical feed system (clean water test for 4 hours if no alarms).

7. Utility water system including all skid-mounted equipment (test for 2 hours).

8. Digesters (24-hour clean water test) diffusers and new blower (7-day clean water test).

9. Sludge dewatering equipment including screw press, sludge feed pumps, polymer feed equipment and sludge conveyor (complete testing with digested sludge and WAS before the 30-day test).

10. Power distribution, switchgear, standby generator, and motor control equipment (7-day test with other associated equipment).

11. SCADA system.

12. Other systems as specified in the Contract Documents.

D. System testing in general shall involve demonstration that all controls, instrumentation loops, alarm/status indication, and all controls described in Division 40 function properly. In addition, the Contractor shall demonstrate sustained equipment operation for a minimum of eight continuous hours when operated in conjunction with other system components. The Contractor shall schedule, provide, and coordinate the services of all manufacturers, suppliers, subcontractors, the Engineer, and the Owner for successful system testing.

E. All system testing activities shall follow detailed test procedures, check lists, etc., previously developed and submitted by the Contractor which have been reviewed by the Engineer. Completion of all system testing activities shall be documented by a certified report. Successful completion of the system testing is required prior to commencement of the 7-day test and 30-day test specified below.

F. The Contractor shall test and fully demonstrate proper operation of the utility, safety equipment, and other support systems before commencing the process system testing.

G. The Contractor shall give the Engineer written notice confirming the date of any system test at least (3) working days before the time the system is scheduled to be tested. The Owner’s staff will observe system's testing.

H. Operational instruction for the controls and instrumentation shall occur before the test.

3.5 7-DAY CLEAN WATER TEST

A. The startup of the wastewater treatment process is a complex operation requiring the combined technical expertise of the Contractor, Owner, and the Engineer. The Owner shall provide the effective coordination of all parties necessary for successful 7-day test.

B. The Owner and Contractor shall provide operating personnel for the duration of the 7-day test.

C. The 7-day test shall not commence until all required equipment tests have been completed to the satisfaction of the Engineer.

D. All defects in materials or workmanship which appear during this test period shall be immediately corrected by the Contractor.

E. During the 7-day test, the Owner and Contractor shall provide the services of authorized representative, in addition to those services required under operations testing, as necessary, to correct faulty equipment operation.

F. 7-Day Test: The Contractor shall be required to conduct the 7-day test, operate facilities being tested, and pass a 7-day test. All equipment must properly run continuously 24 hours per day for the test period at test flow rates. If any item malfunctions during the test, the item shall be repaired, and the test restarted at day zero with no credit given for the operating time before the aforementioned malfunction. Contractor shall provide temporary piping and pumps to pump treated effluent from the outlet of the existing UV system to the systems being tested in order to fill them with water. The Contractor shall provide any other temporary piping and pumps required to move the clean water from one structure to another. The test flow rate shall be 1,200 gpm (1.73 mgd).

1. The Owner shall lubricate and maintain the equipment in accordance with the manufacturer's recommendations.

2. Prerequisites: The following shall be completed before 7-day testing begins.

a. All Owner's manuals information required by the Contract Documents has been furnished.

b. Provide all safety equipment, fire extinguishers, protective guards and shields, handrails, grating, safety signs, and valve and piping identification required by the Contract Documents. Devices and equipment shall be fully functional, adjusted and tested.

c. Manufacturer's certification of proper installation has been accepted.

d. Leakage tests, electrical tests, and adjustments have been completed.

e. Training of Owner's personnel on all equipment included in the 7-day test has been completed, and copy of training on DVD provided to Owner.

f. The Engineer has approved the 7-day testing and startup Plan. The Plan shall include a check list documenting that all the prerequisites have been provided and/or completed.

g. Functional verification of the individual instrumentation loops (analog, status, alarm, and control).

h. Adjustment of the pressure switches, timing relays, level switches, temperature switches, HMI monitors, and all other control devices to the settings determined by the Engineer or the equipment manufacturer.

i. Functional verification of the individual interlocks between the field-mounted control devices and the motor control circuits, control circuits of variable-speed controllers, and packaged system controls.

j. Clean water from the 7-day and other clean water test shall be pumped out of the system as required. Contractor is responsible to emptying the system of clean water. Coordinate with Owner for proper treatment and disposal of the water.

3.6 30-DAY TEST AND PLANT STARTUP

A. The Contractor shall be required to incorporate the Plant improvements into the plant operation, operate it, and pass a 30-day test prior to acceptance. The new plant improvements shall be started up together after each has completed the 7-day test. All process equipment must properly run continuously 24 hours per day for the 30-day test period. If any item malfunctions during the test, the item shall be repaired, and the test restarted at day zero with no credit given for the operating time before the aforementioned malfunction.

1. Prerequisites: The following shall be completed before plant testing and startup begins.

a. 7-day clean water test shall be completed and accepted.

b. Clean water from the 7-day clean water test has been pumped out of the system. Contractor is responsible for emptying the system of clean water. Coordinate with the Owner for proper disposal of the water. It is expected that the clean water will be discharged through the treatment plant by pumping out of the utility water tank.

c. The Engineer has approved the 30-day Testing and Startup Plan.

B. The startup of the wastewater treatment process is a complex operation requiring the combined technical expertise of the Contractor, Owner, and the Engineer. The Owner and/or Engineer shall provide the effective coordination of all parties necessary for successful 30-day test.

C. After approval of the 30-day Startup Plan and coordination with the Owner, the Contractor shall start the 30-day test by diverting the influent flow to the channel where the new mechanical fine screen was installed.

D. Throughout the 30-day test, all plant flow shall run through the new facilities.

E. All defects in material or workmanship which appear during the tests shall be immediately corrected by the Contractor.

F. The Owner and Contractor shall provide operating personnel for the duration of the 30-day test.

G. The Owner shall lubricate and maintain the equipment in accordance with the manufacturer’s recommendations.

H. During the 30-day test, the Contractor shall provide the services of authorized representative, in addition to those services required under operations testing, as necessary, to correct faulty equipment operation.

I. Testing and startup records per Section 3.8.

J. After successful completion and acceptance of the 30-day test, the Contractor shall:

1. Complete closeout of the project per Section 01 77 00 – Closeout Procedures.

3.7 SUPPLIES

A. The Owner shall furnish all wastewater, treated wastewater chemicals, and all other necessary equipment, facilities, and services required for conducting the tests.

B. If the 7-day clean water tests are run using potable water, well water, or irrigation water, Contractor shall make arrangements and provide water.

3.8 RECORDS OF TESTING AND STARTUP

A. The Contractor shall maintain the following during the 7-day and 30-day testing and startup and submit originals to Engineer prior to acceptance of tests:

1. Lubrication and service records for each mechanical and electrical equipment item.

2. Hours of daily operation for each mechanical and electrical equipment item.

3. Equipment alignment and vibration measurement records.

4. Logs of electrical measurements and tests.

5. Instrumentation calibration and testing logs.

6. Testing and validation of status indications and alarms.

7. Factory and field equipment settings.

8. Log of problems encountered and adjustments made.

9. Other records, logs, and checklists as required by the Contract Documents.

10. Influent and effluent flow for each 24-hour period from midnight to midnight during the test.

11. Backwash flow for each 24-hour period from midnight to midnight during the test.

3.9 TRAINING

A. The Contractor shall coordinate the training periods with the Owner and manufacturer's representatives and shall submit a training schedule and detailed agenda for each piece of equipment or system for which training is to be provided. Said training schedule and agenda shall be submitted not less than 14 calendar days prior to the time that the associated training is to be provided. The Contractor shall confirm each training period a minimum of two days prior to scheduled time.

END OF SECTION 01 75 00

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SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Comply with requirements stated in conditions of the contract and in Specifications for administrative procedures in closing out the Work.

B. Furnish lien waivers, bond extensions, and other required data.

C. Satisfy conditions of the contract, fiscal provisions, legal submittals, and additional administrative requirements.

1.2 SUBSTANTIAL COMPLETION

A. When substantially complete, the Contractor shall submit to the Owner:

1. A written notice that the Work, or designated portion thereof, is substantially complete.

2. A list of items to be completed or corrected.

B. Within a reasonable time after receipt of such notice, Engineer will perform an inspection to determine the status of completion. If the Work is not deemed substantially complete, the following will occur:

1. Owner will promptly notify the Contractor in writing, giving the reasons therefore.

2. The Contractor shall remedy the deficiencies in the Work and send a second written notice of Substantial Completion to the Owner.

3. Owner will request the Engineer to re-inspect the Work.

4. Once the Work is deemed substantially complete and after review and approval, the Engineer will execute and deliver to the Owner and the Contractor, the Certificate of Substantial Completion with a final list of items to be completed or corrected prior to release of final payment.

1.3 PROJECT RECORD DOCUMENTS

A. Maintain at Project site, available to Owner and Engineer, one copy of the Contract Documents, shop drawings and other submittals, in good order.

1. Mark and record field changes and detailed information contained in submittals and change orders.

2. Record actual depths, horizontal and vertical location of underground pipes, duct banks and other buried utilities. Reference dimensions to permanent surface features.

3. Identify specific details of pipe connections, location of existing buried features located during excavation, and the final locations of piping, equipment, electrical conduits, manholes, and pull boxes.

4. Identify location of spare conduits including beginning, ending, and routing through pull boxes and manholes. Record spare conductors, including number and size, within spare conduits, and filled conduits.

5. Provide schedules, lists, layout drawings, and wiring diagrams.

6. Make annotations with erasable colored pencil conforming to the following color code:

   a. Additions - Red

   b. Deletions - Green

   c. Comments - Blue

   d. Dimensions - Graphite

7. Make all annotations on one set of drawings.

B. Maintain documents separate from those used for construction.

1. Label documents “RECORD DRAWINGS.”

C. Keep documents current.

1. Record required information at the time the material and equipment is installed and before permanently concealing.

2. During progress meetings, record documents will be reviewed to ascertain that changes have been recorded.

D. Submit record documents for review. Submittal shall be in accordance with Section 01 33 00 – Submittal Procedures.

1.4 FINAL SUBMITTALS

A. The Contractor, prior to requesting final payment, shall obtain and submit the following items to the Engineer for transmittal to the Owner:

1. Written guarantees, where required.

2. Technical Manuals and instructions.

3. New permanent cylinders and key blanks for all locks.

4. Maintenance stock items; spare parts; special tools.

5. Completed record drawings.

6. Bonds for roofing, maintenance, etc., as required.

7. Certificates of inspection and acceptance by local governing agencies having jurisdiction.

8. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

9. Letter from bonding company stating that bonds will be extended for one year after substantial completion.

B. Owner will prepare a final Change Order, reflecting approved adjustments to the contract sum which were not previously made by Change Orders.

1.5 FINAL CLEANUP

A. The Contractor shall promptly remove from the vicinity of the completed Work, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the Work by the Owner will be withheld until the Contractor has satisfactorily performed the final cleanup of the Site.

1.6 MAINTENANCE AND GUARANTEE

A. The Contractor shall comply with the maintenance and guarantee requirements contained in the General Conditions.

B. The Contractor shall make all repairs and replacements promptly upon receipt of written order from the Owner. If the Contractor fails to make such repairs or replacements promptly, the Owner reserves the right to do the Work, and the Contractor and its surety shall be liable to the Owner for the cost thereof.

1.7 FINAL PAY ESTIMATE

A. Submit final pay estimate and supporting data to Owner.

B. Final estimates shall reflect all adjustments to the contract sum:

1. The original contract sum

2. Additions and deductions resulting from:

a. Previous Change Orders

b. Allowances

c. Unit prices

d. Deductions for uncorrected work

e. Penalties and bonuses

f. Deductions for liquidated damages

3. Total contract sum, as adjusted

4. Previous payments

5. Sum remaining due

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 77 00

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall submit technical operation and maintenance information for each item of mechanical and electrical equipment in an organized manner in the Owner's Manual. It shall be written so that it can be used and understood by the Owner's operation and maintenance staff. The Owner's Manual information shall also be submitted in electronic format using a USB flash drive.

B. All manuals supplied to the Owner by suppliers of Owner-furnished equipment, shall be inserted into the Owner's Manual by the Contractor. The Contractor shall be responsible for providing all other information.

1.2 OWNER'S MANUAL

A. The Owner's Manual shall include the following for each item of mechanical and electrical equipment (as applicable):

1. Equipment Summary: A summary table shall include the equipment name and equipment number, the manufacturer's model number, serial number, and other nameplate information specific to the equipment provided.

2. Operational Procedures: Manufacturer-recommended procedures on the following shall be included:

   a. Installation

   b. Adjustment

   c. Startup

   d. Location of controls, special tools, equipment required, or related instrumentation needed for operation

   e. Operation procedures

   f. Load changes, Calibration, Shutdown

3. Troubleshooting, Disassembly, Reassembly

   a. Realignment

   b. Testing to determine performance efficiency

   c. Tabulation of proper settings for all pressure relief valves, low and high pressure switches, and other protection devices

d. List of all electrical relay settings including alarm and contact settings

4. Preventive Maintenance Procedures:

a. Procedures: Preventive maintenance procedures shall include all manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by leaving the equipment in place.

b. Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade, type, and temperature ranges, shall be covered.

5. Parts List and Drawings:

a. Parts List: A complete parts list shall be furnished, including a generic description and manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included.

b. Drawings: Cross-sectional or exploded view drawings shall accompany the part list.

6. Wiring Diagrams: Include complete internal and connection wiring diagrams for electrical equipment items.

7. Shop Drawings: Include approved shop or fabrication drawings, complete with dimensions. Include performance curves for pumps furnished.

8. Safety: This part describes the safety precautions to be taken when operating and maintaining the equipment or working near it.

9. Documentation: All equipment warranties, affidavits, and certifications required by the Technical Specifications shall be placed in this part.

10. Spare Parts: This part shall contain spare parts information for all mechanical, electrical, and instrumentation equipment. The spare parts list shall include the current list price of each spare part. The spare parts list shall be limited to those spare parts which each manufacturer recommends be maintained by the Owner in inventory at the plant site. Each manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts to facilitate the Owner in ordering. The Contractor shall cross-reference all spare parts lists to the equipment numbers designated in the Contract Documents.

B. If manufacturer’s standard brochures and manuals are used to describe operating and maintenance procedures, modify such brochures and manuals to reflect only the model or series of equipment used on this project and features provided. Cross out neatly or remove extraneous material, or otherwise annotate or eliminate.

1.3 TRANSMITTAL PROCEDURE

A. Provide three (3) original paper copies and one (1) electronic copy in PDF format of all operating and maintenance information. For ease of identification, label each manufacturer's brochure and manual with the equipment name. Organize the information in 3-ring binders and use an indexing feature within the PDF submission, in numerical order, per specification section number. Include in the manuals a table of contents and tab sheets to permit easy location of desired information. Each binder shall include a cover sheet and spine label giving the project name, Engineer's project number, DEQ loan number, Contractor name and contact information, applicable subcontractor name and contact information, and supplier name and contact information.

B. The Contractor shall submit to the Engineer three identical Owner's Manuals a minimum of 90 calendar days prior to the scheduled startup of the equipment.

C. The Engineer will review the Owner's Manuals within 30 days following their receipt by the Engineer. The Contractor shall then make any corrections and changes noted and compile all the corrected Owner's Manuals for final submittal to the Engineer.

1.4 PAYMENT

A. Acceptable operating and maintenance information for the project must be delivered to the Engineer prior to the project being 75 percent complete or at least two weeks prior to startup of any equipment. Progress payments for work in excess of 80 percent completion or 2 weeks prior to startup will not be made until the specified acceptable operating and maintenance information has been delivered to the Engineer.

1.5 FIELD CHANGES

A. Following the acceptable installation and operation of an equipment item, the item's instructions and procedures are to be modified and supplemented to reflect any field changes or information requiring field data.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 78 23

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SECTION 02 41 00 – DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTIONS

A. Work under this Section includes providing selective demolition of part of the existing facility shown on the drawing and as specified herein.

B. Work under this Section also includes EPA reporting, testing (unless previously provided to the Contractor), and disposal of structures containing asbestos. The EPA required reporting is required regardless if asbestos is encountered or not.

1.2 CONDITION OF STRUCTURES

A. Owner assumes no responsibility for actual conditions of items or structures to be demolished. Conditions existing at time of commencement of contract will be the responsibility of the Contractor.

1.3 PROTECTION OF FACILITIES

A. Protect from damage existing finish work that is to remain in place that becomes exposed during demolition operations.

B. Protect adjacent areas with suitable coverings when necessary to prevent surface damage, including protecting existing concrete and asphalt surfaces from concrete staining.

C. Remove protections at completion of work.

1.4 ENVIRONMENTAL CONTROLS

A. Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing regulations pertaining to environmental protection.

1.5 ASBESTOS REQUIREMENTS

A. Completing the National Emission Standards for Hazardous Air Pollutants (NESHAP) sampling, testing, submitting the EPA notification and any other required submittals as incidental to the Work.

B. The project includes structures with a potential for asbestos containing material (materials other than metal, glass, or PVC plastic). Comply with the following regulations:

1. (NESHAP Regulations 40 CFR 61

2. Toxic Substances Control Act – Asbestos 40 CFR 763

3. Asbestos Hazard Emergency Response Act (AHERA)

4. Relevant OSHA Standards

C. If asbestos is discovered in the course of the demolition Work that exceeds the threshold amounts as defined in NESHAP 40 CFR 61.145, comply with the requirements for asbestos containing materials in all of the above listed regulations and standards.

1.6 PERMITS

A. Obtain any permits for building, electrical, or plumbing demolition that may be required for the Work at no additional cost to Owner.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to commencement of selective demolition work, inspect areas in which work will be performed. Photograph existing conditions of surrounding area that could be misconstrued as damage resulting from selective demolition work.

3.2 ASBESTOS SAMPLING, TESTING, HANDLING, SHIPPING, AND DISPOSAL

A. Prior to any demolition or renovation, have a National Emissions Standards for Hazardous Air Pollution (NESHAP), Asbestos Hazard Emergency Response Act (AHERA) or Environmental Protection Agency (EPA) certified inspector inspect and collect appropriate samples to determine the presence of Asbestos Containing Material (ACM) in the structure.

B. Have the collected samples analyzed at a certified asbestos analytical laboratory.

C. Generate and submit a copy of the inspection report to the Engineer.

D. If ACM is found and is below the threshold quantities as defined in NESHAP 40 CFR 61.145 Standard for Demolition and Renovation, or if ACM is not present on structures being renovated, complete the EPA Notification requirements below.

E. If ACM is found and was not previously identified in the Contract and is above the threshold quantity as defined in NESHAP 40 CFR 61.145 Standard for Demolition and Renovation, stop Work on the affected structure and notify the Owner and Engineer. Do not proceed with Work on the affected structure until a Change has been issued by the Owner.

3.3 EPA NOTIFICATION REQUIREMENTS

A. Regardless if ACM is found or not, complete a Notification of Demolition/Renovation in writing and submit to the EPA at least 10 days prior to the start of demolition/renovation operations, as outlined in NESHAP 40 CFR 61.145. Use of the following form is recommended.

1. http://www.epa.gov/region10/pdf/asbestos/demolition-renovation-notification-form_fillable.pdf

B. Submit a copy of the notification to the Engineer for concurrence prior to the EPA submittal. Allow 10 working days for Engineer concurrence. Upon concurrence, submit notification to the EPA Region 10 office. At the following address:

Asbestos NESHAP Coordinator
U.S. Environmental Protection Agency
Region 10 Office of Compliance and Enforcement (OCE-101)
1200 Sixth Avenue, Suite 900
Seattle, WA 98101

3.4 PREPARATION

A. Provide shoring, bracing, or support to prevent movement, settlement, or collapse of adjacent facilities to remain.

B. Cease operations immediately if safety of structure or existing facility appears to be endangered. Take precautions to support structure/facilities until determination is made for continuing operations.

3.5 DEMOLITION

A. Demolish concrete flatwork only in areas shown on the drawings to be removed. However, the exact location may be adjusted in the field if required to avoid existing obstacles.

1. The line to be cut shall be marked on the surface along a string-line or straight edge with a marker that will not wash away from the action of the saw's cooling water. All cutting lines shall be marked along straight line prior to cutting.

2. Furnish and operate a power drive, self-propelled wheel mounted pavement sawing machine. The saw blade shall be either a wet cutting or dry cutting type. The depth of the saw shall be controlled by graduated positions set on the machine.

3. Concrete and asphalt slabs shall be cut by saw cutting the slab to full slab depth with one pass of the saw following exactly along the marked cutting line.

B. Where large power driven saws cannot be operated close enough to the end of the slab to completely cut it (i.e. at an abutting wall or foundation) use power driven impact tools and grinders to remove the slab and form a smooth neat joint.

C. Where slab thicknesses exceed the maximum depth of the cutting machine, cut a line as deep as possible with the machine and use power driven impact tolls and grinders to remove the slab and form a smooth neat joint.

D. Remove all foundations shown to be removed. Do not bury unless authorized by the Engineer at the time of demolition.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove debris, rubble and other materials resulting from demolition work. Haul all materials from demolition to a disposal site obtained by the Contractor.

3.7 CLEANUP AND REPAIR

A. Upon completion of demolition work, remove tools, equipment, and demolished materials from site.

3.8 REPAIR

A. Repair demolition performed in excess of that required. Return structures and surfaces to condition existing prior to commencement of selective demolition work. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

END OF SECTION 02 41 00

SECTION 03 11 00 – CONCRETE FORMING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide complete formwork design and required calculations.

B. Furnish all labor, materials, and equipment as required for forming cast-in-place concrete, including necessary shoring, bracing, and anchorage.

C. Construct openings in formwork as required for other related work.

D. Provide and install all form accessories such as snap ties, bracing, etc.

E. Stripping of forms from finished concrete.

1.2 REFERENCE STANDARDS

A. ACI 17 – Specifications for Tolerances for Concrete Construction and Materials

B. ACI 301 – Specifications for Structural Concrete

C. ACI 318 – Building Code Requirements for Structural Concrete and Commentary

D. ACI 347R – Guide to Formwork for Concrete

E. PS 1 – Structural Plywood

1.3 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Submit concrete forming plans stamped by a professional engineer registered in Idaho for review for all forming where the height of the concrete work exceeds four feet.

1. Submit shoring and reshoring designs for all concrete work where shoring or reshoring is required.

2. Design and provide forms for pressure resulting from placement of concrete and construction loads while maintaining the specified tolerances.

3. Forming shall have sufficient strength to support loads, lateral pressure, and allowable stresses outlined in ACI 347R and for design considerations including wind load, temporary construction loads, and construction equipment loads.

C. Calculations: Submit concrete form design calculations stamped by a professional engineer registered in Idaho.

1.4 QUALITY ASSURANCE

A. Designer's Qualifications: Professional engineer, licensed in State where Work is to be done and having experience in concrete formwork. The Contractor is responsible for the design and adequacy of formwork and shoring.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.

B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.

C. Comply with applicable State and local codes with respect to design, fabrication, erection, and removal of formwork.

D. Comply with ACI 347R, ACI 301, and ACI 318.

2.2 MATERIALS

A. Smooth Forms: Pre-manufactured forms or job fabricated forms using plyform faced with material which will produce smooth, hard, uniform texture on concrete.

1. Arrange facing materials orderly and symmetrical, keeping number of seams to a practical minimum.

2. Do not use material with raised grain, patches, or other defects which will impair texture of concrete surfaces.

B. Forming accessories:

1. Use fabricated wire.

2. Use form ties constructed so that ends or end fasteners can be removed without causing appreciable spalling of concrete faces.

3. After ends or end fasteners of form ties have been removed, embedded portion of ties to terminate not less than two diameters from formed faces of concrete, but in no case less than 3/4-inch.

4. When formed face of concrete is not to be permanently exposed to view, form ties may be cut off flush with formed surfaces.

5. Use ties with 3/4-inch diameter cones and a 1-1/2-inch break back on both ends for water retaining structures. Ties are to be furnished with a water seal or stop.

6. Snap ties, if used, shall not be broken until the concrete has reached the design concrete strength. Snap ties, designed so that the ends must be broken off before the forms can be removed, shall not be used. The use of tie wires as form ties will not be permitted. Fully threaded stub bolts may be used in lieu of smooth ties with waterstops.

7. Taper ties with plastic or rubber plugs of an approved and proven design may also be used. The plugs must be driven into the hole with a steel rod, placed in a cylindrical recess made for the plug. At no time shall plugs be driven on the flat area outside the cylindrical recess. Plugs shall be A58 Sure Plug as manufactured by Dayton Superior.

8. Form ties which remain in the corewall of water-retaining structures shall have waterstops and a one-inch minimum breakback or cone depth.

C. Form Release Agent: Colorless material which will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.

D. Fillets for Chamfered Corners: Wood or plastic strips attached to the inside of forms.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify lines, levels, and measurements before proceeding with formwork. Ensure dimensions agree with the Drawings.

3.2 CONSTRUCTION

A. Make forms sufficiently tight to prevent loss of cement paste.

B. Place chamfer strips in corners of forms to produce beveled edges on permanently exposed surfaces.

1. Interior corners on such surfaces and edges of formed joints will not require beveling.

C. To maintain specified finish tolerances, chamfer formwork to compensate for anticipated deflections.

D. Provide positive means of adjustment using wedges or jacks, or shores and struts, and take up all settlement during concrete placing operation.

E. Securely brace forms against lateral deflection.

F. Provide temporary ports in formwork to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain. Close ports with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be apparent in exposed concrete surfaces.

G. At construction joints, overlap forms over hardened concrete at least 6 inches. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain true surface.

H. Provide runways for moving equipment with struts or legs, supported directly on formwork or structural member without resting on reinforcing steel.

I. Anchor formwork to shores or other supporting surfaces or members so that upward or lateral movement of any part of formwork system is prevented during concrete placement.

J. The wall form design shall be such that wall sections can be poured full height without creating horizontal cold joints and without causing snapping of form ties which shall be of sufficient strength and number to prevent spreading of the forms during placement of concrete and which shall permit ready removal of the forms without spalling or damaging the concrete.

3.3 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for Work embedded in or passing through concrete.

B. Coordinate Work of other sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

C. Install accessories in accordance with manufacturer's instructions, level and plumb with templates where necessary. Ensure items are not disturbed during concrete placement.

D. Position embedded items accurately and support against displacement.

3.4 WALL FORM POURING OPENINGS

A. Pouring of walls may be done only through pouring openings on one of the wall sides, and may not be pumped or poured from the top through the use of "elephant trunks" or tremies.

B. Contractor shall either erect the complete form on one side of the wall and then erect the form panels on the other side of the wall while the concrete pour is in progress or remove form panels from either the inside or outside form assembly before concrete pouring starts.

C. The horizontal centerline distance between such openings shall not exceed 96 inches nor shall the distance between the nearest opening and the bulkhead for the vertical joint exceed 36 inches.

D. The vertical centerline distance between horizontal rows of openings shall not exceed 96 inches.

E. The minimum pouring opening size shall be 18 inches by 18 inches.

F. The bottom of the lower openings shall be no more than 48 inches from the top of the wall footing.

G. Under no circumstances shall forming be such that the drop of concrete in the wall forms will exceed 8 feet in any one place.

3.5 FORM FINISHES

A. Use smooth forms for natural plywood, grout cleaned, smooth rubbed, scrubbed, or sand floated finishes.

1. Fabricate true-to-line in order that surfaces produced will require little dressing to arrive at true surfaces.

2. Where an as-cast finish is required, no dressing shall be permitted in the finishing operation.

B. Install form panels in orderly arrangement with joints planned in approved relation to building elements.

3.6 FORM COATING

A. Unless otherwise specified or approved, treat surfaces of forms.

B. Cover surfaces of forms with form coating to aid in removal of forms with minimal damage to concrete.

3.7 REMOVAL OF FORMS

A. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.

B. Where no re-shoring is planned, leave forms and shoring used to support weight of concrete in beams, slabs, and other concrete members in place until concrete has attained its specified strength as determined by test cylinders.

C. Where reshoring is planned, supporting formwork may be removed when concrete has reached 70 percent of specified strength as determined by test cylinders, provided reshoring is installed immediately.

D. When shores and other vertical supports are so arranged that non-load carrying, form-facing material may be removed without loosening or disturbing shores and supports, facing material may be removed at an earlier age as permitted. Forms may not be removed prior to 24 hours after placement of concrete.

3.8 RESHORING

A. Design, engineering, and construction of reshoring is the responsibility of the Contractor.

B. While reshoring is under way, allow no live load on new construction.

C. During reshoring do not subject concrete in beam, slab, column, or any other structural member to combined dead and construction loads in excess of loads permitted by Engineer for developed concrete strength at time of reshoring.

D. Place reshores as soon as practicable after stripping operations are complete, but in no case later than end of working day on which stripping occurs.

E. Tighten reshores to carry required loads without over stressing.

F. Leave reshores in place until tests representative of concrete being supported have reached specified strength.

G. For floors supporting shores under newly placed concrete, level original supporting shore in place or reshore.

3.9 REUSE OF FORMS

A. Do not reuse forms if there is any evidence of surface wear or defect which would impair quality of surface.

B. Thoroughly clean and properly coat forms before reuse.

END OF SECTION 03 11 00

SECTION 03 15 58 – CONCRETE STRUCTURE HYDRAULIC LEAK TESTING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Perform leak tests on all new water-retaining concrete structures and precast concrete manholes and vaults as outlined in this specification.

B. Repair areas in the basins that do not comply with the test requirements, or that show locations of obvious leakage at no additional cost to the owner.

1.2 REFERENCE STANDARDS

A. ACI 350.1 Tightness Testing of Environmental Engineering Concrete Containment Structures

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Testing schedule, including proposed plan for water conveyance, control, and disposal shall be submitted for approval a minimum of 48 hours before testing is to start.

C. Proposed repair methods, materials, and modifications to the Work.

D. Submit information on changes in flow in any underdrain system after filling the containment structure.

E. Submit test results and final reports within 7 days of test completion.

PART 2 - PRODUCTS

2.1 MATERIAL & REQUIREMENTS

A. Temporary valves, bulkhead, or other appurtenant water control equipment and materials shall be determined by the Contractor subject to the Engineer’s review. No materials shall be used which would be injurious to the facility or its future function.

PART 3 - EXECUTION

3.1 GENERAL

A. Water for initial testing and disinfection will be furnished by the Owner; however, the Contractor shall make all necessary provisions for conveying the water from the Owner-designated source to the points of use.

B. The Contractor shall be responsible for purchasing all additional water for testing that is required due to failed hydraulic leak tests.

C. The Contractor shall regulate filling activities to not exceed the Owner's determined maximum withdraw rate from the Owner's water system.

D. All hydraulic structures and appurtenant pressure piping shall be hydraulically tested.

E. Release of water from structures, after testing has been completed, shall be in a manner acceptable to the Engineer and Owner.

F. Testing shall be performed after the structure is completed and prior to backfilling, except where otherwise acceptable to the Engineer. Testing shall not be performed sooner than 14 days after all portions of structure walls have been completed and concrete has reached full design compressive strength. Test shall consist of filling the structure with water to the maximum operating water surface.

G. Release of water from structures, after testing has been completed, shall be coordinated with Owner and Engineer. It is anticipated that water can be released into storm drains and conveyed to storm ponds. Contractor shall either have the new storm drains and piping constructed or provide necessary temporary piping to existing catch manhole prior to releasing water from structures.

H. Testing shall be performed prior to any coating being applied to exterior or interior walls or floor, except where otherwise deemed acceptable by the Engineer.

3.2 PRELIMINARY CLEANING, FLUSHING, AND INSPECTION

A. Prior to testing, all hydraulic structures shall be cleaned by thoroughly hosing down all surfaces with a high-pressure hose and nozzle of sufficient size to deliver a minimum flow of 50 gallons per minute. Water, dirt, and foreign material accumulated in this cleaning operation shall be discharged from the structure or otherwise removed. Preliminary cleaning and flushing shall provide unobstructed inspection of all concrete surfaces. If visual inspection is inhibited by dirt and debris, additional cleaning and flushing is required.

B. Prior to testing, the concrete surfaces and concrete joints shall be visually inspected by the Contractor for potential leakage points. Areas that the Contractor believes are areas of potential leakage shall be repaired before filling the containment structure with water.

3.3 TESTING OF HYDRAULIC STRUCTURES

A. The leak test shall consist of two parts: a qualitative test (Part 1) and a quantitative test (Part 2). The structure will not be accepted as completed until both Part 1 and Part 2 of the test are passed.

B. Close all basin outlets, inspection holes, or other openings below water level.

C. Fill the tank to the maximum working water depth and let set for 24 hours before an initial water level reading is taken. The rate of filling shall not exceed 24 inches of depth per hour. All visible leakage shall be repaired.

D. The structure being tested shall be kept full for at least 3 days before Part 2 of the test can begin. The exterior surfaces of the containment structure shall be observed in both the early mornings and late afternoons during the 3-day period. If any water is observed on the structure's exterior surfaces, including joints, cracks, and any other previously repaired locations, where moisture can be picked up on a dry hand, the containment structure shall be considered to have failed Part 1 of the leak test.

E. Wet areas on top of the wall footings shall not be the sole cause to fail Part 1 of the test unless the water can be observed to be flowing.

F. Although Part 2 of the test may begin prior to completion of repairs for Part 1, all defects causing the failure of Part 1 of the leak test shall be repaired before acceptance of the containment structure.

G. The test period for Part 2 of the leak test shall be 5 days. The containment structure shall continue to be observed in both the early mornings and late afternoons to verify compliance with Part 1 of the test during Part 2 of the test.

H. Five (5) days following the initial reading, a second reading shall be made. The structure shall be considered to have passed the test if water loss during the 5-day period, as computed from the two water level readings, does not exceed 0.05 percent of total volume of water in the structure, after allowance is made for evaporation loss.

I. Mark any leaks or damp areas for later repair.

J. If the drop in the water surface exceeds 0.05 percent of the basin volume over the 5-day period, drop the basin level in 1/4 of the volume increments, and retest. The test shall be repeated up to 3 additional 5-day test periods. If, at the end of 20 days, the structure still fails to pass the leakage test, the Contractor shall empty the structure as acceptable to the Engineer and shall examine the interior for evidence of cracking or other conditions that might be responsible for the leakage.

K. If intermediate reading or observed leakage indicate that the allowable leakage will be exceeded, the test may be terminated before the end of the 5-day period and appropriate action taken to correct the problem before commencing a new 5-day test period.

L. Repair all observed leaks or damp areas and retest until the basin passes.

M. Any cracks shall be sealed with polyurethane sealant.

N. Following these operations, the Contractor shall again test the hydraulic structure. The structure will not be accepted as completed until the water loss leakage test is passed and all visible leakage repaired.

END OF SECTION 03 15 58

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SECTION 03 20 00 – CONCRETE REINFORCING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and place reinforcing steel and reinforcing steel accessories in accordance with the drawings and as specified herein.

1.2 REFERENCE STANDARDS

A. ACI 318 – Building Code Requirements for Structural Concrete and Commentary

B. ACI SP-66 – ACI Detailing Manual

C. ASTM A615 – Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

D. ASTM A706 – Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement

E. ASTM A996 – Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

F. ASTM A1064 – Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

G. AWS D1.4 – Structural Welding Code – Reinforcing Steel

H. CRSI (DA4) – Manual of Standard Practice

1.3 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Comply with requirements of ACI SP-66. Indicate bar schedules, sizes, spacings, locations and quantities of reinforcing steel, shapes of bent bars, wire fabric, bending and cutting schedules, splicing locations, stirrup spacing, supporting, and spacing devices.

C. Manufacturer’s Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.

D. Welder’s Certificates: Submit certifications for welders employed on the project, verifying AWS qualification withing the previous 12 months.

E. Reports: Submit certified copies of mill test report of supplied reinforcement materials analysis indicating physical and chemical analysis.

1.4 QUALITY ASSURANCE

A. Fabrication tolerances:

1.	Sheared length	± 1 inch
2.	Overall for stirrups, ties, and spirals	± 1/2 inch
3.	All other bends	± 1 inch

B. Placement tolerance:

1.	Spacing	1/4 inch
2.	Clear distance	+ 1/4 inch
3.	Lengthwise location	2 inches

C. Submit shop fabrication drawings of reinforcement prior to placing concrete.

D. Perform work of this section in accordance with ACI 315 and ACI 318.

E. Welding: Qualify procedures and personnel according to AWS D1.4, “Structural Welding Code – Reinforcing Steel”.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Furnish steel reinforcing bars of the type and grade as shown on the contract drawings conforming to the following steel reinforcing bars specifications. If bar type and grade are not shown on the drawings, furnish bars conforming to paragraph B below.

B. Reinforcing Steel Bars: ASTM A615, Grade 60 billet-steel deformed bars, uncoated as shown on the plans.

C. Welded Steel Wire Fabric: ASTM A1064 plain type; in flat sheets or coiled rolls uncoated finish as shown on the plans.

D. Low Alloy Reinforcing Steel Bars: ASTM A706, Grade 60 low alloy steel deformed bars, uncoated as shown on the plans.

E. Smooth dowel bars for construction joints: ASTM A29, Grade 60.

1. Where indicated, provide metal dowel cap at one end of dowel to permit longitudinal movement of dowel within concrete section.

2. Provide for movement which equals joint width plus one-half inch.

F. Corrosion Resistant Steel Bars: ASTM A1035-16b, Low Carbon Chromium Steel Reinforcing Bars.

2.2 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gauge annealed type.

B. Chairs, Bolster, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete.

2.3 FABRICATION

A. Fabricate reinforcement in accordance with ACI 315 and CRSI (DA4) – Manual of Standard Practice.

B. Locate reinforcing splices only where shown on the drawings. Indicate location of splices on shop drawings.

C. Weld reinforcing bars only where shown on the drawings. Furnish ASTM A706 reinforcing steel only where welding is required. Weld reinforcing bars in accordance with AWS D1.4.

PART 3 - EXECUTION

3.1 GENERAL

A. Clean reinforcement of loose or thick rust and mill scale, dirt, paint, oil, grease, earth, ice, and other foreign materials that would reduce bond to concrete.

B. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover.

C. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.2 PLACING

A. Place all reinforcement in the exact position shown on the plans and approved shop drawings and secure in position during the placing and compacting of concrete. Wire bars together with No. 16 gauge wire with ties at all intersections except where spacing is less than 12 inches in each direction, in which case tie alternate intersections.

B. Maintain the distance from the forms and between layers of reinforcement by means of prefabricated chairs, precast mortar blocks, ties, hangers, or other approved devices. Placing and fastening of reinforcement in each section of the Work must be approved by the Engineer before any concrete is deposited in the section.

C. Do not tack weld reinforcing bars.

D. Overlap sheets of metal mesh 1 square plus 6 inches to maintain a uniform strength, and securely fasten at the ends and edges, and support to maintain clearances.

E. Support reinforcing steel for formed floor slabs on metal chairs or slab bolsters. Size chairs or bolsters to position the steel in the exact location shown on the plans. Space chairs for supporting the top steel and bolsters for supporting the bottom steel not more than 5 feet on centers in each direction. Plastic coat the portion of the metal support in contact with the forms to prevent rust. Tie down deck steel to beams or forms at regular intervals of not more than 5 feet on centers along the beams to prevent movement of the steel during placing of the concrete.

3.3 SPLICING

A. Furnish all reinforcement in the full lengths indicated on the plans unless otherwise permitted. Splicing of bars, except where shown on the plans, not permitted without written approval from the Engineer. Stagger splices as far as possible.

B. Do not use lap splices on No. 14 and 18 bars.

C. Weld reinforcing steel only if detailed on the drawings.

D. Do not bend reinforcement after embedding in hardened concrete.

E. Do not extend bars continuously through any expansion joint except expansion dowels.

3.4 FIELD QUALITIY CONTROL

A. An independent testing agency, as specified in the General Structural Notes – Special Inspection Tables or Section 01 45 00 – Quality Control, will inspect installed reinforcement for conformance to contract documents before concrete placement.

END OF SECTION 03 20 00

SECTION 03 30 00 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish all labor, materials, and equipment required for the construction of cast-in-place concrete as shown on the drawings and as specified herein.

1.2 DEFINITIONS

A. Cold Weather: When ambient temperature is below 40 degrees Fahrenheit or is approaching 40 degrees Fahrenheit and falling.

B. Contractor's Licensed Design Engineer: Individual representing Contractor who is licensed to practice engineering as defined by statutory requirements of professional licensing laws in state or jurisdiction in which Project is to be constructed.

C. Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than ¾-inch in diameter, cracks in liquid containment structures and below grade habitable spaces that are 0.005-inch wide and wider, and cracks in other structures that are 0.010-inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections. At exposed concrete, defective areas also include texture irregularities, stains, and other color variations that cannot be removed by cleaning.

D. Exposed Concrete: Concrete surface that can be seen inside or outside of structure regardless of whether concrete is above water, dry at all times, or can be seen when structure is drained.

E. Hot Weather: As defined in ACI 305.1.

F. Hydraulic Structure: Liquid containment structure.

G. New Concrete: Less than 60 days old.

H. Slurry Mixture: Mixture of sand, 3/8-inch maximum nominal aggregate size, cement, and water for wall construction joints with waterstop.

1.3 REFERENCE SPECIFICATIONS

A. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete

B. ACI 301 – Specifications for Structural Concrete

C. ACI 302.1R – Guide for Concrete Floor and Slab Construction

D. ACI 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete

E. ACI 305R – Guide to Hot Weather Concreting

F. ACI 306R – Cold Weather Concreting

G. ACI 308R – Guide to Curing Concrete

H. ACI 318 – Building Code Requirements for Structural Concrete and Commentary

I. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field

J. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

K. ASTM C94 – Specification for Ready-Mixed Concrete

L. ATM C109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch Cube Specimens)

M. ASTM C143 – Standard Test Method for Slump of Hydraulic Cement Concrete

N. ASTM C150 – Specification for Portland Cement

O. ASTM C157 – Standard Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete

P. ASTM C171 – Specification for Sheet Materials for Curing Concrete

Q. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete

R. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

S. ASTM C260 – Specification for Air-Entraining Admixtures for Concrete

T. ASTM C309 – Specification for Liquid Membrane-Forming Compounds for Curing Concrete

U. ASTM C494 – Specification for Chemical Admixtures for Concrete

V. ASTM C618 – Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

W. ASTM C881 – Specification for Epoxy-Resin-Base Bonding Systems for Concrete

X. ASTM C1059 – Specification for Latex Agents for Bonding Fresh to Hardened Concrete

Y. ASTM C1064 – Standard Test Method for Temperature of Freshly Mixed Hydraulic Cement Concrete

Z. ASTM C1107 – Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)

AA. ASTM C1240 – Specification for Silica Fume Used in Cementitious Mixtures

BB. ASTM C1315 – Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

CC. ASTM C1602 – Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

DD. ASTM D1751 – Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

EE. ASTM E1155 – Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers

FF. ASTM E1643 – Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs

GG. ASTM E1745 – Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs

HH. IBC – International Building Code

1.4 JOB CONDITIONS

A. In hot and cold weather, comply with the requirements of ACI 305 and 306.

B. Do not place concrete on frozen ground.

C. Unless adequate protection is provided, do not place concrete during rain, sleet, or snow.

D. Do not allow rainwater to increase mixing water or damage surface finish.

1.5 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Mix Design: Submit mix design to be used for each class of concrete.

1. Submit location of materials source, admixtures to be used, and other related data.

2. Submit test reports showing suitability of aggregates used in concrete mixes.

3. Test results of successful ASR mitigation using ASTM C1567.

C. Detailed plan for curing and protection of concrete: Detailed plan for curing and protection of concrete placed and cured in cold weather. Plan shall include, but not be limited to, the following:

1. Procedures for protecting sub grade from frost and accumulation of ice or snow on reinforcement, other metallic embeds, and forms prior to placement.

2. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.

3. Methods for temperature protection during placement.

4. Types of covering, insulation, housing, or heating to be provided.

5. Curing methods to be used during and following protection period.

6. Use of strength accelerating admixtures.

7. Methods for verification of in-place strength.

8. Procedures for measuring and recording concrete temperatures.

9. Procedures for preventing drying during dry, windy conditions.

D. Detailed plan for hot weather placements including curing and protection for concrete placed and cured in hot weather. Plan shall include, but not be limited to, the following:

1. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.

2. Use of retarding admixture.

3. Methods for controlling temperature of reinforcement and other embedded items and concrete materials before and during placement.

4. Types of shading and wind protection to be provided.

5. Curing methods, including use of evaporation retardant.

6. Procedures for measuring and recording concrete temperatures.

7. Procedures for preventing drying during dry, windy conditions.

E. Informational Submittals:

1. Preinstallation Conference minutes.

2. Manufacturer's application instructions for bonding agent and bond breaker.

3. Manufacturer's Certificate of Compliance to specified standards:

a. Bonding agent.

b. Bond breaker.

4. Statement of Qualification:

a. Batch Plant: Certification as specified herein.

b. Mix designer.

c. Installer.

d. Testing agency.

5. Field test reports.

6. Recorded temperature data from concrete placement where specified.

7. Tightness test results.

8. Concrete Delivery Tickets:

a. For each batch of concrete before unloading at Site.

b. In accordance with ASTM C94, including requirements 14.2.1. through 14.2.10.

c. Indicate amount of mixing water withheld and maximum amount that may be permitted to be added at Site.

1.6 QUALITY ASSURANCE

A. Concrete construction shall conform to requirements of ACI 117, ACI 301, & ACI 318, & ACI 350 except as modified herein.

B. Qualifications:

1. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.

2. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in jurisdiction of the Work. Requirement may be waived if individual is Contractor's Licensed Design Engineer.

3. Testing Agency: Unless otherwise permitted, an independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.

a. Where field testing is required of Contractor, personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-l or an equivalent certification program.

b. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade 1. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician – Grade II.

C. Preinstallation Conference:

1. Required Meeting Attendees:

a. Contractor, including pumping, placing, and finishing, and curing subcontractors.

b. Ready-mix producer.

c. Admixture representative.

d. Testing and sampling personnel.

e. Engineer who authored Statement of Special Inspection Plan or Engineer's designee.

2. Schedule and conduct prior to incorporation of respective products into Project. Notify Engineer of location and time.

3. Agenda shall include:

a. Admixture types, dosage, performance, and redosing at Site.

b. Mix designs, test of mixes, and Submittals.

c. Placement methods, techniques, equipment, consolidation, and form pressures.

d. Slump and placement time to maintain slump.

e. Finish, curing, and water retention.

f. Thermal control plan.

g. Protection procedures for weather conditions.

h. Other specified requirements requiring coordination.

4. Conference minutes as specified in Section 01 31 19 – Project Meetings.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement: Use Portland cement conforming to the requirements of ASTM C150 for Type II low alkali cement and ASTM C595 for Type IL cement.

B. General Admixtures: Admixtures, other than air-entraining agents, may be used when the type and amount to be used are approved. Calcium chloride will not be allowed as an admixture.

C. Air-Entraining Agents: Use air-entraining agents to the requirements of ASTM C260 added to the mixing water.

D. Water Reducing Agents: Water reducing or water reducing and retarding admixtures may be used to increase workability of the concrete when approved by the Engineer. Use only admixtures produced by a company approved by the Engineer. Use water reducing admixtures conforming to ASTM C494.

E. High Range Water Reducer: Conforming to ASTM C494, Type F or G. The preferred admixture shall be free of chlorides and alkalines. A second-generation-type high-range water reducer shall be Type G and be batch-plant-added.

F. Water: Use potable water for mixing concrete.

G. Coarse Aggregate: Use coarse aggregate that consists of gravel, crushed slag, crushed stone or other approved inert materials, composed of hard, strong and durable particles, free of injurious coatings, and conforming to the requirements of ASTM C33, except as modified herein.

1. Use only aggregates that include deleterious substances not exceeding the following:

	Percent Passing (by weight)
Soft Fragments	0.20
Coal and Lignite	0.30
Clay Lumps	0.30
Other Deleterious Substances	2.00
Minus 200 Material	1.75

2. Use coarse aggregate meeting the following gradations when tested in accordance to the requirements of ASTM C136.

	Percent Passing (by weight)				
Coarse Aggregate Size	1"	3/4”	3/8"	No. 4	No. 8
3/4” to No. 4	100	90-100	20-55	1-10	0-5

H. Fine Aggregate: Use aggregate of natural sand or other approved inert materials composed of hard, strong, and durable particles conforming to the requirements of ASTM C33 except as modified herein.

1. Use only aggregates that include deleterious substances not exceeding the following:

	Percent (by weight)
Clay Lumps	0.50
Coal and Lignite	0.30
Other Deleterious Substances	2.00
Minus 200 Material	1.75

2. Moisture content of fine aggregate shall not exceed 8 percent.

3. Use fine aggregate that is uniformly graded from coarse to fine within the following gradation, when tested in accordance to the requirements of ASTM C136.

Sieve Size	Percent Passing (by weight)
3/8"	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	2-10

I. Curing Compounds: Use curing compounds that meet the requirements of ASTM C309.

J. Chemical Hardener:

1. Colorless, aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent.

2. Not less than 2 pounds fluosilicate per gallon.

3. Provide materials which do not react with, inhibit, or otherwise interfere with adhesives and bonding of future floor finishes.

4. Acceptable Products: L&M Chem-Hard by Laticrete; MasterKure HD 300WB by BASF, or approved alternate.

K. Waterstops and Joint Fillers:

1. Waterstop of Joints: Extruded PVC waterstop, shape and size as shown on the drawings. Thermo bond all joints in PVC waterstops.

2. Expansive Water Stop: Expansive waterstop shall be a bentonite/butyl rubber based waterstop that expands on exposure to water. It shall be applied in accordance with manufacturer's recommendations.

3. Joint Filler: Type B: Provide closed cell polyvinyl chloride foam per ASTM D1752 requirements with resiliency recovery of 95 percent if not compressed more than 50 percent of original thickness.

L. Fly ash shall be Class F conforming to AASHTO M 295 with the additional requirement that the available alkalis in the fly ash shall not exceed 2 percent.

M. Concrete Sealer: Concrete sealer is intended to be used on concrete slabs to prevent dusting and staining. The products listed are not intended to be used as curing compounds or for sealing the slab against water leakage.

1. Manufacturers: One of the following or equal:

a. Euco Diamond Hard by Euclid Chemical

b. L&M Seal Hard by Laticrete

2.2 PROPORTIONING

A. In proportioning materials for mixing, use certified scales. Do not use volume measurement except for water and liquid admixtures.

B. Proportion the materials to produce concrete strengths and exposure categories indicated on the plans.

C. Fly ash may be used to replace a portion of the Portland cement in the concrete mix. The fly ash used shall not exceed 25 percent of the total cement material in the mix. The cement material in the mix includes both Portland cement and fly ash.

D. The proposed aggregate for the mix shall be tested for expansion and Alkali-Silica Reaction (ASR) in accordance with AASHTO T 303. Where testing indicates aggregates are reactive, the Contractor shall use fly ash, lithium compound admixtures or both to produce a concrete mix that successfully mitigates ASR. Contractor shall provide test results of successful mitigation using ASTM C1567, with results showing a linear expansion at 14 days not exceeding 0.10 percent when tested.

2.3 READY MIX CONCRETE

A. Ready-mixed concrete shall conform to the provisions in AASHTO M157 regarding batching, mixers and agitators, mixing and delivery, inspection, consistency and air content, and certification of batches.

2.4 GROUT

A. Where grout is shown for leveling, concrete (at least 3,000 pounds per square inch) shall be used.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify lines, levels, and dimensions before proceeding with Work of this section.

B. Coordinate placement of embedded items with erection of concrete formwork and placement form accessories.

C. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent according to bonding agent manufacturer's instructions.

1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.

2. Use latex bonding agent only for non-load-bearing applications.

D. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels, and pack with non-shrink grout.

3.2 CONVEYING

A. Handle concrete from mixer to location of final placing as rapidly as practicable by methods which prevent segregation or loss of ingredients and assure that quality is maintained.

B. Use only equipment conforming to ASTM C94.

C. Use only approved pumping equipment that is rated for the lift and the capacity required for placement.

1. Control pneumatic placement to prevent segregation.

2. Loss of slump in pumping or pneumatic conveying equipment shall not exceed 2 inches.

3. Do not use aluminum or aluminum alloy pipes.

3.3 PLACING CONCRETE

A. Notify Engineer not less than 24 hours prior to commencement of placement operations.

B. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

C. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

D. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer. Where approved, record the amount of water added on site and provide with the special inspection reports.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. Place concrete continuously or in layers of such thickness that no concrete is deposited on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within section.

1. If a section cannot be placed continuously, locate construction joints as indicated, or as approved by the Engineer.

2. If not indicated, locate construction joints not over 20 feet on center.

3. Place at such a rate that concrete which is being integrated with fresh concrete is still plastic.

4. Limit size of each placement to allow for strength gain and volume change as a result of shrinkage.

5. Make lifts not over 24 inches.

6. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.

7. Remove temporary spreaders in forms where concrete placing has reached an elevation rendering their service unnecessary.

8. Temporary spreaders may remain embedded in the concrete only if made of metal or concrete, and if prior approval has been obtained.

9. Do not allow concrete to fall over 6 feet, except when starting a wall pour. Do not drop concrete over 24 inches when starting a wall pour.

10. Joints in Footings and Slabs:

a. Ensure space beneath plastic waterstop is completely filled with concrete.

b. During concrete placement make visual inspection of entire waterstop area.

c. Limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, lift waterstop to confirm full consolidation without voids, and place remaining concrete to full height of slab.

d. Apply procedure to full length of waterstop.

F. Deposit concrete as nearly as practicable in its final position to avoid segregation due to rehandling or flowing.

G. Control placement to prevent segregation.

H. Pumping of Concrete:

1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to ensure completion of concrete placement without cold joints in case of primary placing equipment breakdown.

2. Minimum Pump Hose (Conduit) Diameter: 4 inches.

3. Replace pumping equipment and hoses (conduits) that are not functioning properly.

I. Minimum Time between Adjacent Placements:

1. Construction or Control Joints: 7 days unless otherwise specified.

2. Construction joint between top of footing or slab, and column or wall: As soon as can safely be done without damaging previously cast concrete or interrupting curing thereof, but not less than 24 hours.

3. Expansion or Contraction Joints: 1 day.

4. For columns and walls with a height in excess of 10 feet, wait at least 2 hours before depositing concrete in beams, girders, or slabs supported thereon.

5. For columns and walls 10 feet in height or less, wait at least 1 hour prior to depositing concrete in beams, girders, brackets, column capitals, or slabs supported thereon.

J. Hot Weather:

1. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 301, ACI 305.1, and as follows:

a. Maintain concrete temperature below 90 degrees Fahrenheit at time of placement, or furnish test data or other proof that admixtures and mix ingredients· do not produce flash set plastic shrinkage, or cracking as a result of heat of hydration. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.

b. Provide for windbreaks, shading, fog spraying, sprinkling, ice, wet cover, or other means as necessary to maintain concrete at or below specified temperature.

K. Cold Weather Placement:

1. Unless otherwise permitted, shall be in accordance with requirements of ACI 306.1 and as follows:

a. Cold weather requirements shall apply when ambient temperature is below 40 degrees Fahrenheit or approaching 40 degrees Fahrenheit and falling.

b. Do not place concrete over frozen earth or against surfaces with frost or ice present. Frozen earth shall be thawed to acceptance of Engineer.

c. Unless otherwise permitted, do not place concrete in contact with surfaces less than 35 degrees Fahrenheit; requirement is applicable to all surfaces including reinforcement and other embedded items.

d. Provide supplemental external heat as needed when other means of thermal protection are unable to maintain minimum surface temperature of concrete as specified in ACI 306.1.

e. Maintain minimum surface temperature of concrete as specified in ACI 306.1 for no less than 3 days during cold weather conditions.

1) Protect concrete from freezing until end of curing period and until concrete has attained a compressive strength of 3,500 pounds per square inch or design compressive strength if less than 3,500 pounds per square inch.

2. Provide maximum and minimum temperature sensors placed on concrete surfaces spaced throughout Work to allow monitoring of concrete surface temperatures representative of Work. Unless otherwise permitted, record surface temperature of concrete at least once every 12 hours during specified curing period.

3.4 CONSOLIDATION

A. Consolidate by vibration so that concrete is thoroughly worked around reinforcement, embedded items, and into corners of forms to eliminate air or stone pockets.

B. Use internal vibrators with minimum frequency of 8,000 vibrations per minute. Do not use “jitterbugs” or similar devices.

C. Do not use vibrators to transport concrete.

D. Insert vibrators approximately 18 inches apart. Leave in long enough to consolidate concrete without segregation; generally, from 5 to 15 seconds maximum. Insert vibrator through new lift into previous lift to ensure good bond between lifts.

E. Keep spare vibrator available during concrete operations.

F. Vibrate concrete in vicinity of joints to obtain impervious concrete.

G. Where concrete is to have an as-cast or smooth-rubbed finish, bring a full surface of mortar against form by vibration process, supplemented if necessary, by spading, to work coarse aggregate back from formed surface.

3.5 CONSTRUCTION JOINTS

A. Locate construction joints, if not indicated, so as to least impair strength of structure, subject to Engineer approval.

1. In general, locate near middle of the spans of slabs, beams, and girders unless a beam intersects a girder at this point. In this case, offset joint in girder a distance equal to twice the width of the beam.

2. Locate joints in walls and columns at underside of floors, slabs, beams or girders, and at tops of footings or floor slabs.

3. Place beams, girders, brackets, column capitals, haunches, drop panels, and slabs concurrently.

4. Make joints perpendicular to main reinforcement.

B. Continue reinforcement across joints.

1. Provide keys and inclined dowels as directed by Engineer.

2. Provide longitudinal keys at least 1-1/2 inches deep in all joints in walls and between walls and slabs or footings.

C. Clean concrete surface at joints.

D. Remove all laitance prior to placing adjoining concrete.

E. When required, obtain bond by one of the following:

1. Use of an approved adhesive.

2. Use of an approved chemical retarder which delays setting of surface mortar. Remove retarded mortar within 24 hours after placing to produce a clean, exposed aggregate bonding surface.

3. Roughen surface of concrete in an approved manner which will expose aggregate uniformly.

F. Dampen, but do not saturate, hardened concrete at construction joints, joints between footings and walls or columns, between walls or columns and beams or floors they support, joints in unexposed walls and all others not mentioned below immediately prior to placing fresh concrete.

G. Dampen, but do not saturate hardened concrete at joints in exposed Work; joints in middle of beams, girders, hoists, and slabs; and joints in Work designed to contain liquids.

1. Thoroughly cover with a coat of cement grout of similar proportions to mortar in concrete.

2. Use grout as thick as possible on vertical surfaces and at least 1/2 inch thick on horizontal surfaces.

3. Place fresh concrete before grout has attained its initial set.

H. Prepare joints receiving an adhesive and apply adhesive in accordance with manufacturer’s recommendations prior to placing of fresh concrete.

I. Prior to placing of fresh concrete, prepare surfaces of joints which have been treated with a chemical retarder in accordance with manufacturer's recommendations.

3.6 BLOCKOUTS FOR PIPE AND CONDUIT

A. Where pipe or conduit passes into or through concrete walls, floors, or roof slabs, the Contractor may, to facilitate proper alignment, leave holes through the concrete and pour the concrete opening after the pipe or conduit is in place. The size of such openings shall be 2 inches larger than the outside diameter of the bell, flange, or coupling, and shall conform to the special details for pipe openings shown on the plans. When the piping or conduit is entirely placed and securely anchored, the concrete openings through the walls will be poured in accordance with the requirements for bonding new concrete to old as set forth herein. Concrete used to pour these openings shall consist of 1 part cement, 1 part fine aggregate, 1 part non-shrinking aggregate, and 1-1/2 parts coarse aggregate of maximum size of 1/2 inch when the concrete is part of a basin which must hold liquids. Otherwise, the non-shrinking aggregate in these proportions shall be replaced by fine aggregate. Concrete poured in these openings shall be thoroughly vibrated or rodded to insure a watertight joint between the new and old concrete and the new concrete and the pipe or conduit. The form for the closure shall be constructed with a pouring funnel. A plug of concrete shall be left in the pouring funnel. After the concrete has taken its initial set, the plug shall be removed and the exposed, broken face ground smooth. Pouring of blockout holes shall be done from the pressure side whenever possible. Such joints shall be thoroughly cured by keeping them constantly wet for not less than 7 days.

B. Where approved by the Engineer, blockout holes may be dry packed using non-shrink grout for basins which must hold liquid, and normal grout in other places. Only sufficient water shall be added to make a dry, crumbling mass. When the mixture is pressed tightly together into a ball with the hands, there should not be sufficient water in the mixture to stain the hands, and when such a ball is broken, it should crumble. This mixture shall be tamped or rodded solidly into the space, preferably from the pressure side. A backing board or stop shall be provided at the back side of this space against which the mixture can be tamped. Curing shall be specified as above.

3.7 GROUTING MACHINERY FOUNDATIONS

A. Where machinery is to be secured by anchor bolts set in concrete and supported on foundations which are to be grouted in place, the original concrete pour shall be blocked out or finished off a sufficient distance below the bottom of the machinery foundation to provide for the thickness of grout specified on the plans. After the machinery has been set in position and wedged to the proper elevation by steel wedges, the space between the bottom of the machinery foundation and the original pour of concrete shall be caulked with a dry-tamped in mixture of non-shrink grout. When the mixture is pressed tightly together into a ball with the hands, there should not be sufficient water in the mixture to stain the hands; and when such ball is broken, it should crumble. This dry mixture shall be tamped or rodded solidly into the space between the machinery foundations and the original concrete. A backing board or stop shall be provided at the back side of this space against which the dry mixture can be tamped.

3.8 PLACING SLABS

A. Preparation of sub-grade for Slabs on Grade:

1. Reference the civil site plans and geotechnical report for all sub grade recommendations.

2. Keep subgrade free of frost.

3. If the temperature where concrete is to be placed is below freezing, enclose, heat, and maintain temperature above 50 degrees Fahrenheit, long enough to remove all frost from subgrade.

4. Keep subgrade moist at time of concreting. If necessary, dampen with water in advance of concreting. Allow no free-standing water or muddy or soft spots when concrete is placed.

B. Locate Joints in Slabs as Indicated:

1. If saw-cut joints in slabs on grade are required or permitted, time cutting to eliminate raveling during sawing and before shrinkage cracks develop.

2. Cut as soon as concrete has hardened sufficiently to prevent aggregates being dislodged by saw.

3. Compact before shrinkage stresses become sufficient to produce cracking.

C. Thoroughly Consolidate Concrete in Slabs:

1. Obtain consolidation of slabs with vibrating screeds, roller pipe screeds, internal vibrators, or other approved means.

3.9 PATCHING

A. Repair surface defects immediately after form removal. Coat all repaired areas with grey Sikagard 62.

B. Fill and finish tie holds with non-shrink grout and coat with grey Sikagard 62.

C. Repair defective areas.

1. Use of plaster coat embeco or calcium chloride is prohibited.

2. Remove honeycomb and defective concrete down to sound concrete.

3. Make edges perpendicular to surface or slightly undercut.

4. Featheredges are not permitted.

5. Dampen area to be patched and at least 6 inches surrounding it to prevent absorption of patching mortar water.

6. Prepare bonding grout of approximately 1 part cement to 1 part fine sand passing a No. 30 sieve.

D. Make patching mixture of same materials and of approximately same proportions as used for concrete, except omit coarse aggregate.

1. Mortar: 1 part cement to 2 parts sand by damp loose volume.

2. Mix white and gray Portland cement as required to match surrounding concrete.

3. Keep mixing water to a minimum.

4. Mix patching mortar in advance and allow to stand with frequent manipulation, without addition of water, until it has reached stiffest placeable consistency.

E. After surface water has evaporated from patch area, brush bond coat into surface.

1. When bond coat begins to lose water sheen, apply patching mortar.

2. Thoroughly consolidate mortar into place and strike-off so as to leave patch slightly higher than surrounding surface.

3. Leave undisturbed for at least 1 hour before final finish.

4. Keep patched area damp for 7 days.

5. Do not use metal tools in finishing an exposed patch.

F. Repair of concrete shall provide structurally sound surface finish, uniform in appearance or upgrade finish by other means until acceptable by Engineer.

G. Tie Holes: After being cleaned and thoroughly dampened, fill tie holes solid with non-shrink grout and coat with Sikagard 62. Round tie holes less than 1/4 inch diameter by 1-1/2 inch deep in rough form finished surfaces need not be filled.

H. Remove metal objects not intended to be exposed in as-built condition of structure including wire, nails, and bolts, by chipping back concrete to a depth of 1 inch and then cutting or removing metal object. Repair chipped out concrete as specified for defective areas.

3.10 SLAB FINISHES

A. Float Finish: After concrete has been placed, consolidated, struck-off, and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared, and surface has stiffness sufficient to permit operation. Re-float slab immediately to a uniform sandy texture.

B. Troweled Finish: Float finish surface first. Power or hand trowel to produce smooth surface relatively free of defects, but which may still show some trowel marks. Final trowel when a ringing sound is produced as trowel is moved over surface. Leave finished surface essentially free of trowel marks, uniform in texture and appearance.

C. Broom Finish: Immediately after concrete has been floated, apply coarse transverse scored texture by drawing broom or burlap belt across surface.

D. "Dry Shake" Finish: Give surface a float finish. Apply mineral aggregate with Portland cement in proportions recommended by manufacturer of aggregate. Begin floating immediately after application of “dry shake."

E. Nonslip Finish: Give surface a "dry shake" application, as specified above, using crushed ceramically bonded aluminum oxide particles. Apply at 25 pounds per 100 square feet.

F. Exposed Aggregate Finish: Immediately after the surface of the concrete has been leveled to tolerance and surface water has disappeared, spread aggregate of the color and size selected by the Engineer uniformly over surface to provide complete coverage to the depth of a single stone. Float surface until embedded aggregate is fully coated with mortar and surface has been brought to tolerance. Flow water, without force, over surface of concrete while matrix encasing aggregate is removed by brushing with a fine bristle brush.

G. Slab Finish Schedule: The slab finishes are shown on the drawings. Where finishes of slabs are not shown, provide broom finish on exterior slabs and trowel finish on interior slabs.

H. Finish Slab Elevation: Slope slabs to floor drains and gutters. Slabs shall adequately drain regardless of tolerances.

3.11 FORMED CONCRETE FINISH

A. Rough Finish: Patch defects, chip or rub off fins exceeding 1/4-inch in height.

B. Smooth Finish: Patch tie holes and defects and remove fins completely. When surface texture is impaired and form joints misaligned by more than 1/8-inch, grind or bushhammer. Slurry grout areas evidencing minor mortar leakage to match adjacent concrete.

C. Rubbed Finish: Remove forms and perform necessary patching as soon after placement as possible. Finish newly hardened concrete no later than day following form removal. Wet surfaces and rub with carborundum brick or other abrasive until uniform color and texture are produced. No cement grout to be used other than cement paste drawn from concrete by rubbing process.

D. Sacked Finish: Mix one-part Portland cement and 1-1/2 parts fine sand with sufficient water to produce grout having consistency of thick paint or use commercial premixed sacking grout. Wet surface of concrete sufficiently to prevent absorption of water from grout. Apply grout uniformly. Immediately after grouting, scrub surface vigorously with cork float or stone to coat surface and fill voids. While grout is still plastic, remove excess grout by working surface with rubber float or sack. After surface whitens from drying, rub vigorously with clean burlap. Keep damp for at least 36 hours after final rubbing.

E. Formed Concrete Finish Schedule. The finish required for formed concrete is shown on the drawings. Where finishes of formed concrete are not shown, provide rough finish for concrete not exposed to view and rubbed finish for concrete exposed to view

3.12 CURING AND PROTECTION

A. To preserve moisture in unformed concrete surfaces, apply one of the following immediately after placement and finishing.

1. Continuous mist spray.

2. Waterproof sheet materials, ASTM C171.

3. Curing compound, ASTM C309. Apply in accordance with recommendations of manufacturer immediately after water sheen has disappeared. Do not use on any surface against which additional concrete or other material is to be bonded or adhesively applied, unless it is proven that curing compound will not prevent bond, or unless positive measures are taken to remove it completely from areas to receive bonded applications. Provide curing compound compatible with hardener in areas where hardener is to be used.

B. Continue curing concrete for 7 days.

C. When mean daily outdoor temperature is less than 40 degrees Fahrenheit, maintain temperature of concrete between 50 degrees Fahrenheit and 70 degrees Fahrenheit for concrete placement.

D. Floors and slabs to receive concrete sealer as specified in the Contract Documents and Room Finish Schedule.

1. Apply concrete sealer at a coverage rate not to exceed 300 square feet per gallon.

2. Apply as soon as slab or floor will bear weight.

3. Before applying concrete sealer, sweep entire surface clean with very soft bristled brush that will not mark concrete finish and remove any standing water.

4. Apply concrete sealer with sprayer.

5. Use of paint rollers or mop is not acceptable.

6. Workmen shall wear flat soled shoes which will not mark or scar concrete surface.

7. Do not allow traffic on floors and slabs until concrete sealer has dried and hardened.

3.13 BACKFILL AGAINST STRUCTURES

A. Do not backfill against walls until concrete has obtained specified 28-day compressive strength.

B. Refer to General Structural Notes on the Drawings for additional requirements, including elevated slab and diaphragm completion prior to backfill.

C. Unless otherwise permitted, place backfill simultaneously on both sides of structure, where such fill is required, to prevent differential pressures.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by the Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer’s approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland Cement to two and one half parts fine aggregate passing No 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2-inch in any dimension in solid concrete, but not less than 1-inch in depth. Make edge of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Patch a test area at an inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by the Engineer.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.1-inches wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured for at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4-inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1-inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of the same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1-inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

8. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.15 FIELD QUALITY CONTROL

A. The Contractor shall obtain and pay for services of certified testing laboratory to perform sampling and testing of installed materials to assure that the requirements of this specification are met. Testing and analysis of concrete shall be performed under provisions of Section 01 45 00 – Quality Control.

B. Provide adequate facilities for safe storages and proper curing of concrete test specimens onsite for first 24 hours, and for additional time as may be required before transporting to test lab.

C. Unless otherwise specified, sample concrete for testing for making test specimens, from point of delivery.

D. When concrete is pumped, sample and test air content at point of delivery and at point of placement.

E. The frequency herein specified for each field control test is approximate. A greater or lesser number of tests may be made, as required by the Engineer, to verify compliance with these specifications.

F. Submit proposed mix design of each class of concrete to Engineer for review prior to commencement of Work.

G. Each 100 tons of fine aggregate and each 200 tons of coarse aggregate shall be sampled and tested in accordance with ASTM D75 and C136.

H. Entrained air: Test every load of concrete delivered to the project. Air content shall be determined in accordance with ASTM C231.

I. Slump: Test every load of concrete delivered to the project.

J. Pumped Concrete: Take concrete samples for slump, ASTM C143 and test specimens ASTM C31.

K. Strength characteristics: 1 set of 4 concrete test cylinders shall be made for every 40 cubic yards or less of each class of concrete placed each day. 1 additional set shall be taken from each additional 40 cubic yards, or major fraction thereof, placed in any 1 day. 1 cylinder of each set shall be tested at an age of 7 days and 2 cylinders shall be tested at an age of 28 days. The fourth cylinder of the sets shall be tested only if deemed necessary by the Engineer. Test results shall be evaluated in accordance with ACI 214 and 318.

L. 3 additional test cylinders will be taken during cold weather and shall be cured on site under the same conditions as the concrete it represents. 1 cylinder shall be tested at an age of 7 days and the other cylinder at an age of 28 days.

3.16 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Engineer and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances, or specified requirements.

C. Repair or replacement of defective concrete will be determined by the Engineer. The cost of additional testing shall be borne by the Contractor when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

END OF SECTION 03 30 00

SECTION 03 60 00 – GROUTING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish labor, materials and equipment as required for grouting as shown on the plans.

B. The following types of grout are covered in this Section:

1. Cement Grout
2. Non-Shrink Grout – Class I (cement based)
3. Non-Shrink Grout – Class II (cement based)
4. Non-Shrink Epoxy Grout
5. Epoxy Anchor Grout for Adhesive Anchors
6. Topping Grout and Concrete/Grout Fill

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

1. Certification of Materials:

a. Use bags of materials showing that the contents meet the Specifications.

b. Submit mill test certificates covering materials shipped as furnished by material manufacturers.

2. Certification that grouts used on the project contain no chlorides or other chemicals that cause corrosion.

3. Manufacturer’s literature containing instructions and recommendations on the mixing, handling, placement, curing and appropriate uses for each type of grout used in the Work, and locations of use. ICBO/ES report shall be submitted for epoxy anchor grout for adhesive anchors.

4. Manufacturer’s certification that its non-shrink grout does not contain aluminum, zinc, or magnesium powders as a method of expansion.

5. Contractor shall submit manufacturer’s written warranty.

1.3 QUALITY ASSURANCE

A. Construction Tolerances: Construction tolerances shall be as indicated in Section 03 30 00 – Cast-in-Place Concrete unless indicated otherwise.

B. Field Tests:

1. Compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the Engineer to ensure continued compliance with these specifications. The specimens will be made by the Engineer or its representative.

2. Compression tests and fabrication of specimens for concrete grout and cement based non-shrink grout will be performed in accordance with ASTM C1107 – Packaged Dry, Hydraulic-Cement Grout (Non-shrink), at intervals during construction selected by the Engineer. A set of 3 specimens will be made for testing at 7 days, 28 days, and each additional time period as appropriate.

3. Compression tests and fabrication of specimens for topping grout, and concrete/grout fill will be performed in accordance with Section 03 30 00 – Cast-in-Place Concrete, at intervals during construction as selected by the Engineer.

4. Compression tests and fabrication of specimens for epoxy grouts will be performed in accordance with ASTM C579 – Test Methods for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfaces and Polymer Concretes, Method B, at intervals during construction as selected by the Engineer. A set of 3 specimens will be made for testing at 7 days, and each earlier time period as appropriate.

5. The cost of laboratory tests on grout will be paid by the Contractor.

6. The Contractor shall assist the Engineer in obtaining specimens for testing and shall furnish materials necessary for fabricating the test specimens.

PART 2 - PRODUCTS

2.1 CEMENT GROUT

A. Cement grout shall be composed of 1 part cement, 3 parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white Portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 days shall be 5,000 pounds per square inch. At base of walls for consolidation around waterstops the minimum grout compressive strength at 28 days shall be 5,000 pounds per square inch.

B. Cement-based non-shrink grout shall be a prepackaged, inorganic, fluid, non-gas-liberating, non-metallic, cement type grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used.

C. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout indicated herein shall be that recommended by the manufacturer for the particular application.

D. Grout shall not contain chlorides or additives that may contribute to corrosion and shall be formulated to be used at any consistency from fluid to plastic.

E. Cement-based non-shrink grout shall have the following minimum properties when tested at a fluid consistency at 28 days:

1. Minimum tensile splitting strength of 500 pounds per square inch per ASTM C496 - Splitting Tensile Strength of Cylindrical Concrete Specimens.

2. Minimum flexural strength of 1,000 pounds per square inch per ASTM C580 - Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

3. Minimum bond strength (concrete to grout) of 1,900 pounds per square inch per modified ASTM C882 - Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.

4. Grout shall be certified for use in freeze/thaw environments.

2.2 NON-SHRINK EPOXY GROUT

A. Class I Non-Shrink Grout: Class I non-shrink grout shall have a minimum 28 day compressive strength of 5,000 pounds per square inch when mixed at a fluid consistency. Class I non-shrink grout shall meet the requirements of ASTM C1107, Grade B or C, when mixed to fluid, flowable and plastic consistencies.

1. Grout shall have a maximum early age height change of 4.0 percent expansion and shall have no shrinkage (0.0 percent) in accordance with ASTM C827 - Early Volume Change of Cementitious Mixtures. The grout when tested shall not bleed or segregate at maximum allowed water.

2. Grout shall have no shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C1090 - Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout.

3. Furnish certification that the non-shrink property of grout is not based on gas production or gypsum expansion.

4. Class I Non-Shrink Grout shall be MasterFlow 713 by BASF; Five Star Grout by Five Star Products; Sikagrout 212 by Sika Corporation; L&M Duragrout by Laticrete; High-Flow Grout by Euclid Chemical Company; or equal.

B. Class II Non-Shrink Grout: Class II non-shrink grout shall be a high precision, fluid, extended working time, grout. The minimum 28-day compressive strength shall be 7000 pounds per square inch, when mixed at a fluid consistency. Grout shall have a maximum early age height change of 4.0 percent expansion and shall have no shrinkage (0.0 percent) in accordance with ASTM C827. Class II non-shrink grout shall meet the requirements of ASTM C1107 Grade B or C when tested using the amount of water needed to achieve fluid consistency per ASTM C939.

1. Grout shall have no shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C1090.

2. Class II non-shrink grout shall have an extended working time of 30 minutes minimum when mixed to a fluid consistency as defined in ASTM C827 at temperature extremes of 45 to 90 degrees Fahrenheit in accordance with ASTM C1107.

3. The grout when tested shall not bleed or segregate at maximum allowed water content.

4. Provide certification that its non-shrink property is not based on gas production or gypsum expansion.

5. Class II non-shrink grout shall be Masterflow 928 by BASF; Five Star Fluid Grout 100 by Five Star Products; L&M Crystex by Latitcrete; or equal.

2.3 EPOXY ANCHOR GROUT

A. Epoxy anchor grout shall conform to ASTM C881 - Epoxy-Resin-Base Bonding Systems for Concrete, Type IV, Class A, Band C, Grade 3 with the exception of gel time.

B. Heat deflection temperature per ASTM D648 - Deflection Temperature of Plastics Under Flexural Load shall be a minimum 120 degrees Fahrenheit.

C. Manufacturer shall certify that the epoxy anchor grout will maintain 90 percent of its strength up to a temperature of 125 degrees Fahrenheit.

D. Grout shall come in a 2 chambered cartridge with a metering system that provides the proper ratio of hardener and resin. The grout shall also come with a static mixer nozzle to thoroughly mix the hardener and resin together.

E. Epoxy anchor grout shall be capable of being used in submersed applications once cured.

F. Compressive strength per ASTM D695 - Compressive Properties of Rigid Plastics shall be 10,000 pounds per square inch minimum.

G. If the average working or operating temperature will be over 100 degrees Fahrenheit or in a high fire risk area, use cement based non-shrink grout and oversized holes.

H. Overhead anchors and anchors in fire-resistive construction shall be cast-in anchors.

I. Embedment of adhesive anchors/rebar shall be deep enough to develop the anchor/rebar. Embedment shall not exceed 67 percent of the member depth.

J. Epoxy anchor grout shall be SET-XP by Simpson; Pure110+ by DeWalt; RE 500 V3 by Hilti, or equal.

2.4 TOPPING GROUT AND CONCRETE/GROUT FILL

A. Where fill is thicker than 2 1/2 inches, structural concrete, as indicated in Section 03 30 00 – Cast-in-Place Concrete, may be used when accepted by the Engineer.

B. Grout for topping of slabs and concrete/grout fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and be mixed as indicated herein. Materials and procedures indicated for normal concrete in Section 03 30 00 – Cast-in-Place Concrete shall apply unless indicated otherwise.

C. Topping grout and concrete/grout fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45.

D. Coarse aggregate shall be graded as follows:

U.S. Standard Sieve Size	Percent by Weight Passing
1/2	100
3/8	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

E. Final mix design shall be as determined by trial mix design as indicated in 03 30 00 – Cast-in-Place Concrete, except that drying shrinkage tests are not required.

F. Strength: Minimum compressive strength of topping grout and concrete/grout fill at 28 days shall be 4,000 pounds per square inch.

2.5 CURING MATERIALS

A. Curing materials shall be in accordance with Section 03 30 00 – Cast-in-Place Concrete and as recommended by the manufacturer of prepackaged grouts.

2.6 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where dry pack is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.

B. The slump for topping grout and concrete/grout fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

2.7 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurements shall not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 - EXECUTION

3.1 PRODUCT DELIVERY. STORAGE AND HANDLING

A. Grout shall be stored in accordance with manufacturer's recommendations.

3.2 GENERAL

A. Contractor shall arrange for the manufacturer of prepackaged grouts to provide on-Site technical assistance within 72 hours of request, as part of the Work.

B. Grout shall not be placed until base concrete or masonry has attained its design strength, unless authorized otherwise by the Engineer.

C. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement. Upon completion of the saturation period, excess water shall be removed with clean, oil free compressed air prior to grouting. Concrete substrate shall not be wet prior to placement of epoxy grouts.

D. Surface preparation, curing, and protection of cement grout shall be in accordance with Section 03 30 00 – Cast-in-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete unless otherwise indicated.

E. Surfaces that will be in contact with grout shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.

F. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable. Shade the Work from sunlight for at least 24 hours before and 48 hours after grouting.

3.3 APPLICATION

A. Unless indicated otherwise, grouts shall be provided as listed below:

Application	Type of Grout
Anchor bolts and reinforcing steel required to be set in grout in which the average working or operating temperature will be over 100 degrees Fahrenheit, or in high fire risk areas.	Non-Shrink – Class I
Anchor bolts and reinforcing steel required to be set in grout that is not high temperature or high fire risk areas.	Epoxy Anchor Grout
Beam and column (1 or 2 story) base plates less than 16 inches in the least dimension.	Non-Shrink Class I
Column base plates (greater than 2 story or larger than 16 inches in the least dimension).	Non-Shrink Class II
Storage tanks and other non-motorized equipment and machinery under 30 horsepower.	Non-Shrink Class I
Machinery over 30 horsepower and equipment under 30 horsepower but subject to severe shock load and high vibration.	Non-Shrink Epoxy
Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.	Non-Shrink Class I (Class II where placement time exceeds 20 min.)
Under precast concrete elements.	Non-Shrink Class II
Topping and concrete/grout fill greater than 3 inches thick.	Structural Concrete per Section 03 30 00 – Cast-in-Place Concrete
Surface repairs.	Cement Grout
Repair of holes and defects in concrete members which are not water bearing and not in contact with soil or other fill material.	Non-Shrink Class I
Repair of holes and defects in concrete members which are water bearing or in contact with soil or other fill materials.	Non-Shrink Class II
All application not listed above, where grout is called for on the drawings.	Non-Shrink Class I, unless noted otherwise.

3.4 GROUTING PROCEDURES

A. Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

B. Structural, equipment, tank, and piping support bases shall be grouted, unless indicated otherwise.

1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of grout, or a thickness as indicated.

2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for grout shall be tight against retaining surfaces, and joints shall be sealed as recommended by the grout manufacturer to be liquid-tight. Forms shall be coated as recommended by the grout manufacturer for easy form release. Where this method of placement is not practical or where required by the Engineer, alternate grouting methods shall be submitted for acceptance by the Engineer.

C. Drilled anchors and Reinforcing Bars: Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill and cleaned. Drilled anchors shall not be installed until the concrete has reached the required 28 day compressive strength. Anchors shall not be loaded until the grout has reached its indicated strength in accordance with the manufacturer's instructions.

1. The Contractor shall identify position of reinforcing steel and other embedded items prior to drilling holes. Care shall be exercised in coring and drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and communications conduit, and piping.

D. Epoxy Adhesive Anchors: Grout shall be proportioned and mixed with automatic equipment. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's recommendations but shall not be less than 8 diameters for threaded rod, or 12 diameters recommendations for reinforcing or smooth bars. Holes shall be dry.

E. Cement Based Non-Shrink Grout: In places of high temperature or fire hazard, anchor bolts shall be grouted in using cement based non-shrink grout, Class I. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICBO report but shall not be less than 16 diameters for threaded rod or 24 diameters for reinforcing or smooth bars.

1. When the bolt diameter is 1 inch or less, the hole diameter should be a minimum of 2-inches. When the bolt diameter is greater than 1 inch, the hole diameter should be at least twice the bolt diameter.

2. Drilled holes shall be saturated with water for not less than 24 hours before installation of anchor/rod/rebar.

3. The non-shrink grout should be placed in the holes in a non-sag (trowelable) consistency. The grout should be placed in the holes before the anchor and then the anchor inserted and vibrated to ensure proper coverage.

F. Topping Grout and Concrete/Grout Fill: Mechanical, electrical, and finish work shall be completed prior to placement of topping or concrete/grout fill. To ensure bonding to the base slab, the base slab shall be given an exposed aggregate finish. Alternatively, where accepted by the Engineer, the base slab shall be given a roughened textured surface by a close- spaced rake while the surface is green. After curing, high pressure washing shall expose the aggregates and produce not less than a 3/16 inch amplitude roughness. Jackhammers or chipping hammers shall not be used.

1. The minimum thickness of grout topping and concrete/grout fill shall be 1 inch. Where the finished surface of concrete/grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide by 1-1/2 inches deep.

2. The base slab shall be thoroughly cleaned and wetted to Saturated Surface Dry (SSD) condition per the International Concrete Repair Institute (ICRI) - Technical Guide for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays, prior to placing topping and fill. No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping or fill placement. The neat cement grout shall not be allowed to dry before topping placement. If it does dry, it must be immediately removed using wet stiff brooms and reapplied. The topping and fill shall be compacted by rolling or thorough tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade. Coat surface with evaporation retardant as needed to prevent plastic shrinkage cracks.

3. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.

4. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping or fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.

5. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by the Engineer, the tank shall be filled with sufficient water to cover the entire floor for 14 days.

3.5 CONSOLIDATION

A. Grout shall be placed in such a manner, for the consistency necessary for each application, to assure that the space to be grouted is completely filled.

3.6 CURING

A. Cement based grouts shall be cured per Section 03 30 00 – Cast-in-Place Concrete and per the manufacturer's recommendations.

3.7 GROUTING MACHINERY FOUNDATIONS

A. Where machinery is to be secured by anchor bolts set in concrete and supported on foundations which are to be grouted in place, the original concrete pour shall be blocked out or finished off a sufficient distance below the bottom of the machinery foundation to provide for the thickness of grout specified on the Plans. After the machinery has been set in position and wedged to the proper elevation by steel wedges, the space between the bottom of the machinery foundation and the original pour of concrete shall be caulked with a dry, tamped-in mixture of non-shrink grout. When the mixture is pressed tightly together into a ball with the hands, there should not be sufficient water in the mixture to stain the hands; and when such ball is broken, it should crumble. This dry mixture shall be tamped or rodded solidly into the space between the machinery foundations and the original concrete. A backing board or stop shall be provided at the back side of this space against which the dry mixture can be tamped.

END OF SECTION 03 60 00

SECTION 03 64 23 – EPOXY INJECTION GROUTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: The Contractor shall furnish all materials, tools, equipment, appliances, transportation, labor, and supervision required to repair cracks by the injection of an epoxy resin adhesive.

B. Qualifications:

1. Epoxy injection shall be performed by a certified applicator.

2. Contractor's operator engaged in the epoxy injection process shall have satisfactory operator experience in the methods of restoring concrete structures utilizing the specific epoxy injection process indicated. Operator's experience shall include previous repairs of cracked or damaged concrete structures, the technical knowledge of correct material selection and use, and the operation, maintenance and troubleshooting of equipment.

PART 2 - PRODUCTS

2.1 EPOXY RESIN ADHESIVE FOR INJECTION

A. Epoxy adhesive grout shall be a 100% solids 2-part water insensitive low-viscosity epoxy resin system. Epoxy shall be suitable for grouting both dry and damp cracks. Epoxy shall develop a minimum tensile strength (ASTM D695) of 6,000 pounds per square inch and a minimum compressive strength of 8,000 pounds per square inch.

2.2 SURFACE SEAL

A. The surface seal material is that material used to confine the injection adhesive in the fissure during injection and cure.

B. The surface seal material shall have adequate strength to hold injection fittings firmly in place and to resist injection pressures adequately to prevent leakage during injection.

2.3 EQUIPMENT FOR INJECTION

A. The equipment used to meter and mix the two injection adhesive components and inject the mixed adhesive into the crack shall be portable, positive displacement type pumps with interlock to provide positive ratio control of exact proportions of the two components at the nozzle. The pumps shall be electric or air powered and shall provide in-line metering and mixing.

B. The injection equipment shall have automatic pressure control capable of discharging the mixed adhesive at any pre-set pressure up to 200, plus or minus 5, pounds per square inch shall be equipped with a manual pressure control override.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface adjacent to cracks or other areas of application shall be cleaned of dirt, dust, grease, oil, efflorescence, or other foreign matter which may be detrimental to the integrity of the bond between the epoxy and the injection surface. Acids and corrosives shall not be permitted.

B. Entry ports shall be provided along the crack at intervals of not less than the thickness of the concrete at that location.

C. Surface seal material shall be applied to the face of the crack between the entry ports. For through cracks, surface seal shall be applied to both faces.

D. Enough time for the surface seal material to gain adequate strength shall pass before proceeding with the injection.

3.2 EPOXY INJECTION

A. Injection of epoxy adhesive shall begin at lower entry port and continue until there is an appearance of epoxy adhesive at the next entry port adjacent to the entry port being pumped.

B. When epoxy adhesive travel is indicated by appearance at the next adjacent port, injection shall be discontinued on the entry port being pumped, and epoxy injection shall be transferred to the next adjacent port where epoxy adhesive has appeared.

C. Epoxy adhesive injection shall be performed continuously until cracks are completely filled.

D. If port to port travel of epoxy adhesive is not indicated, the work shall immediately be stopped and the Engineer notified.

3.3 FINISHING

A. When cracks are completely filled, epoxy adhesive shall be cured to sufficient time to allow removal of surface seal without any draining or runback of epoxy material from cracks.

B. Surface seal material and injection adhesive runs or spills shall be removed from concrete surfaces.

C. The face of the crack shall be finished flush to the adjacent concrete showing no indentations or protrusions caused by the placement of entry ports.

3.4 PRESSURE TEST

A. The mixing head of the injection equipment shall be connected, and the equipment run until clear uniformly mixed material flows into the purge pail. The Operator shall engage the equipment shut-off nozzle valve and subsequently bump the on-off switch while monitoring pressure on psi gauge until the pressure reaches 200 pounds per square inch. Pressure gauge shall be monitored for one minute. If pressure is maintained between 190-200 pounds per square inch, check valves shall consider to be functioning properly and the injection may proceed. If pressure drops below 190 pounds per square inch, Contractor shall be required to have new seals installed on the check valves and the equipment shall be subsequently retested.

B. The pressure test shall be run for each injection unit at the beginning and after meal break of every shift that the unit is used in the work of crack repair.

C. The adequacy and accuracy of the equipment shall be solely the responsibility of the Contractor.

3.5 RATIO TEST

A. The epoxy mixture ratio shall be monitored continuously while injecting by placing a strip of masking tape on the sides of the A & B reservoirs full height. After filling reservoirs, the A & B levels shall be marked and monitored while running injection machine into purge pail for a period of one minute.

B. The ratio test shall be run for each injection unit at the beginning and after meal break of every shift that the unit is used in the work of crack repair.

3.6 PROOF OF RATIO AND PRESSURE TEST

A. At all times during the course of the work the Contractor shall keep complete and accurate records available to the Engineer of the pressure and ratio tests specified above.

B. In addition, the Engineer at any time without prior notification of the Contractor may request the Contractor to conduct the tests specified above in the presence of the Engineer.

END OF SECTION 03 64 23

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SECTION 04 22 00 – CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install concrete masonry units as shown on the Drawings and as specified herein.

1.2 REFERENCE STANDARDS

A. ASTM A153 – Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

B. ASTM A307 – Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength

C. ASTM A563 – Specification for Carbon and Alloy Steel Nuts

D. ASTM A615 – Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

E. ASTM A615 – Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

F. ASTM A666 – Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

G. ASTM A1064 – Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

H. ASTM C5 – Specification for Quicklime for Structural Purposes

I. ASTM C90 – Specification for Loadbearing Concrete Masonry Units

J. ASTM C91 – Specification for Masonry Cement

K. ASTM C129 – Specification for Nonloadbearing Concrete Masonry Units

L. ASTM C140 – Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units

M. ASTM C144 – Specification for Aggregate for Masonry Mortar

N. ASTM C150 – Specification for Portland Cement

O. ASTM C207 – Specification for Hydrated Lime for Masonry Purposes

P. ASTM C216 – Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)

Q. ASTM C270 – Specification for Mortar for Unit Masonry

R. ASTM C331 – Specification for Lightweight Aggregates for Concrete Masonry Units

S. ASTM C404 – Specification for Aggregates for Masonry Grout

T. ASTM C426 – Test Method for Linear Drying Shrinkage of Concrete Masonry Units

U. ASTM C476 – Specification for Grout for Masonry

V. ASTM C780 – Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

W. ASTM C1019 – Standard Test Method for Sampling and Testing Grout for Masonry

X. ASTM C1072 – Standard Test Method for Measurement of Masonry Flexural Bond Strength

Y. ASTM C1314 – Standard Test Method for Compressive Strength of Masonry Prisms

Z. ASTM D1970 – Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection

AA. ASTM E2178 – Standard Test Method for Air Permeance of Building Materials

BB. ASTM E514 – Standard Test Method for Water Penetration and Leakage Through Masonry

CC. BIA Technical Notes No. 7 – Water Penetration Resistance – Design and Detailing

DD. TMS 402/602 – Building Code Requirements and Specification for Masonry Structures

1.3 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Product Data: Provide data for each different masonry unit, fabricated wire reinforcement, mortar, accessories, and other manufactured product specified.

C. Shop Drawings: Provide shop drawings for reinforcing steel showing bar sizes, bends, and dimensions.

D. Information illustrating horizontal joint reinforcement.

E. Grout proportions.

F. Mortar proportions.

G. Material certificates for the following, signed by Manufacturer and Contractor, certifying that each material complies with requirements.

1. Each different cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.

2. Each material and grade indicated for reinforcing bars.

H. Samples:

1. One of each type of masonry to be used on Project.

2. Mortar colors for color selection.

I. Informational Submittals:

1. Method of placing grout.

2. Certified field test results within 5 days of performing specified tests.

3. Certified test reports showing compliance with specified performance tests.

4. Statement of acknowledgement of Quality Assurance Plan in accordance with IBC Section 1705.4

5. Method and materials for removal of efflorescence.

J. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, NCMA, and BIA, except where exceeded by the requirements of the contract documents.

B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum 5 years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

D. Mockups:

1. Layup sample panel for each type of masonry at Site.

2. Dimensions: Minimum 4 feet high by 4 feet long.

3. May be part of permanent construction.

4. Approved panels shall serve as basis of color, texture, bond, quality of finished joints, and for acceptance of permanent construction.

5. Demonstrate ability to keep insulation and grout isolated and in certain cells during any sequence of placement, and to demonstrate materials will be restricted to cells and bond beams intended to receive each material.

6. Construction shall show areas required to receive mortar, including webs on each side of each cell to prevent insulation from entering cells to receive grout or to prevent grout from entering cells to receive insulation.

7. Where bond beams are to be used, demonstrate proper placement of both insulation and grout to bond beam level, and proper placement of bond beam prior to placement of insulation and grout above bond beam level.

8. Demonstrate proper use of running bond.

E. Comply with the requirements and criteria of the NCMA, BIA, ASTM C90, ASTM C216, and ACI 530.1 for masonry finish and appearance, dimension tolerances, tolerances of construction, joint tolerances, and plumb tolerances.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

B. Storage and Protection: Keep lime and other ingredients dry.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Temperature: Do not lay masonry when ambient temperature is below 40 degrees Fahrenheit on a rising temperature, or below 45 degrees Fahrenheit on a falling temperature, or when there is a probability of such conditions occurring within 48 hours, unless written approval of procedures for protection from freezing is obtained from Engineer.

B. Moisture Protection: Protect masonry construction from loss of moisture during curing period of 7 days when ambient air temperature is 90 degrees Fahrenheit or greater and when relative humidity is less than 50 percent.

PART 2 - MATERIALS

2.1 COMPRESSIVE STRENGTH OF MASONRY

A. Minimum 28 Day Compressive Field Strength (f'm) of completed assemblage: 2,000 psi.

2.2 MATERIALS

A. Concrete Block: ASTM C90 load bearing, kiln-dried, mediumweight block. Block face shall be split-faced, smooth face and fluted block as shown on the Drawings. Blocks shall be steam-cured, manufactured with lightweight aggregate conforming to ASTM C331. Scoria and tuff are not permitted for aggregate in the CMU block. Units to be tested per ASTM C426 with linear shrinkage of 0.065 percent or less. Protect from moisture at site. Moisture content of block when laid in final position shall not exceed 30 percent of total moisture absorption. Block sizes and widths as noted on Drawings. Color shall be as shown on the Drawings. Use gray smooth face block where color and block face are not shown on the Drawings.

B. Compressive Strength: 2,000 psi minimum, in accordance with ASTM C90, Table 2

C. Portland Cement: ASTM C150, Type I.

D. Masonry Cement: ASTM C91, Type II.

E. Mason's Sand: ASTM C144, except that not less than 4 percent or more than 10 percent shall pass the No. 100 sieve.

F. Pea Gravel: ASTM C404 graded with not more than 5 percent passing the 3/8-inch sieve.

G. Hydrated Lime: ASTM C207, Type S.

H. Lime Putty: ASTM C5

I. Water: Clean and potable, from domestic supply.

J. Grout Admixture: Grace Concrete Products, "Zyla 630", "Daravair AT60", "Daracem 55", and "Recover", or equals.

K. Steel Reinforcing: Deformed steel bars shall conform to ASTM A615, Grade 60.

L. Horizontal joint masonry reinforcement shall be extra heavy, Hohmann & Barnard, 120 Truss-Mesh masonry wall reinforcing manufactured from wire conforming to ASTM A1064.

M. Anchor Bolts: Steel bent bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A153, Class C.

N. Expansion Anchors: One piece, three section wedge assembly of indicated sizes of stainless steel.

O. Preformed Control Joints: Rubber material designed to fit sash block and to maintain lateral stability in masonry wall. Provide size and configuration as applicable to masonry width and conditions, fused joints.

2.3 CONCRETE BLOCK MORTAR AND GROUT PROPORTIONS

A. Mortar: Type S consisting of one-part Portland Cement, 1/2-part lime putty, and 4 parts of Mason's sand by volume. Add only enough water to give mortar good working consistency. Mortar shall be used within 1/2 hour after mixing.

B. Grout: Grout shall be one-part Portland cement and three parts Mason's sand. Grout shall have 2,000 psi minimum strength by compression test at 28 days. Grout cores greater than 2-inch square may have two parts of 3/8 inch pea gravel added to the above.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that built-in items are in proper location, and ready for roughing into masonry work.

C. Direct and coordinate placement of metal anchors supplied for installation under other sections.

D. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

E. Select and arrange units for exposed masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

3.2 MIXING MORTAR AND GROUT

A. General: Determine all parts of mortar and grout by reasonably accurate volume measurement and mix in a mechanical mortar mixer in batches containing not less than one full sack of cement, unless otherwise approved. When partial batches are mixed, use extreme care in measuring all parts.

B. Order of Mixing: In mixing each batch of mortar or grout, mix the water, sand, and cement for not less than two minutes and until a smooth, plastic mass without lumps is obtained. Grout shall contain sufficient water to cause it to flow freely without segregation. Maintain mortar plastic and grout fluid continuously until used. Do not retemper or use mortar which has become harsh and non-plastic.

3.3 SETTING EMBEDDED ITEMS

A. All anchor bolts and miscellaneous metal work embedded in masonry shall be set in accordance with setting plans or instructions furnished by trades supplying the metal work. Exercise care to ensure that all anchors are completely surrounded by grout.

3.4 INSTALLATION OF BLOCK

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and where possible, at other locations.

B. The installation of concrete block shall be done using only mechanics skilled in the laying of masonry blocks. All necessary cutting of block on the job site shall be done with power tools in such manner to provide straight and true edges. No chipped or broken blocks shall be used. Lines shall be straight and true. Lay up concrete blocks in running bond in a full bed of mortar. Use channel blocks for lintels. Maintain alignment of cells containing reinforcement, remove projecting mortar and debris prior to grouting. Provide 3/8-inch joints, strike flush, and tool to smooth, concave, hard surface.

C. Provide cleanout openings at bottoms of all cells to be filled at each lift or pour of grout where such lift is in excess of 4 feet 8 inches in height. Any overhanging mortar or other obstruction or debris shall be removed from insides of such cell walls. The cleanouts shall be sealed before grouting, after inspection.

D. All units shall be laid with full face shell mortar beds. All head and end joints shall be filled solidly with mortar for a distance in from the face of the unit equal to the full thickness of the face shall of the unit. Walls shall be erected plumb and in line.

E. Except as shown on the Drawings, all joints shall be made approximately 3/8-inch-wide, cut flush, compressed, and firmly tooled to a tight, concave joint. Joints shall have full mortar coverage on vertical and horizontal faces as noted above. Vertical joints shall be shoved tight. Seal around all pipes or ducts and make airtight. Unless otherwise indicated, build in horizontal reinforcing every third course at all walls.

F. Where required by the Drawings, and unless otherwise shown, all block walls shall have reinforced bar steel set in vertical cell units and bonded with dowel steel which is to be set in the concrete foundation. Steel bars shall be centered and grouted solid into the cells of these unit and lintels or bond beams unless noted otherwise on plans.

G. All reinforced hollow masonry unit shall be built to preserve the unobstructed vertical continuity of the cells to be filled. Walls and cross webs forming such cells to be filled shall be full bedded in mortar to prevent leakage of grout. All head (or end) joints shall be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells.

H. Vertical cells to be filled shall have vertical alignment sufficient to maintain a clear, unobstructed, continuous vertical cell measuring not less than 2 inches by 3 inches.

I. Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding 192 diameters of the reinforcement.

J. All cells containing reinforcement shall be filled solidly with grout. Vertical cells containing reinforcement shall be filled solidly with grout in lifts not exceeding eight feet in height.

K. When the grouting is stopped for one hour or longer, horizontal construction joints shall be formed by stopping the pour of grout 1-1/2 inches below the top of the uppermost unit.

L. Protect finished Work from mortar stains. Remove excess mortar and mortar smears as work progressed. Clean immediately after completing adjacent masonry work.

M. Interlock intersections and external corners.

N. Contractor shall not erect masonry when ambient temperature has dropped below 45 degrees Fahrenheit unless it is rising, at no time when it has dropped below 40 degrees Fahrenheit, except by written permission. When masonry work is authorized during temperatures below 40 degrees Fahrenheit, make provisions for heating and drying materials; protect completed Work as per Structural Clay Products Institute, Technical Notes, Volume 1, Number 1. Do not build on frozen Work. Do not lay masonry having water film or frost on its surface. Do not lay masonry in the rain.

3.5 CONTROL JOINTS

A. Preformed Control Joints:

1. Omit mortar from vertical joints.

2. Place rubber control joint material as wall is built.

3. After wall is grouted, cured, and cleaned, install backing rod and sealant.

4. Place and tool sealant to match depth of typical joint.

3.6 SHORING AND BRACING

A. All concrete block lintel beams shall be adequately shored and braced before grouting in reinforcing. Shoring and bracing shall be left in place a minimum of 14 days after grouting beams. Do not place structural members or heavy loads on lintels without adequate shoring and bracing or until 28-day concrete strength is achieved.

3.7 PROTECTION

A. Protect corners subject to possible damage. Protect block from moisture at site. Tops of all exposed open cells of block to be covered with waterproof material to prevent being filled with moisture. Protect all masonry from cold or frost. Ensure that mortar will harden without freezing. No anti-freeze ingredient shall be used in the mortar.

B. During the progress of the project, and at the end of each day’s work, the tops of all exposed open cell block shall be fully covered with heavy unruptured sheets of polyethylene and weighted down with heavy plank or other suitable materials. Under no circumstances shall the interior cells of the block be allowed to fill with snow or moisture.

1. Extend cover a minimum of 24 inches down both sies of walls and hold cover securely in place.

2. After completion of walls, protect top of wall until permanent wall caps are installed.

C. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

D. Do not allow grout and mortar stains to dry on face of exposed masonry.

E. Protect tops of walls at all times. Cover tops of walls with waterproof paper when rain or snow is imminent and when the Work is discontinued.

F. Adequately brace walls until walls and roof are completed.

G. Provide sufficient bracing to protect walls against damage from elements, including wind and snow.

H. Protect masonry against freezing for minimum 72 hours after being laid.

I. Protect masonry from damage until final acceptance of the Work. Damaged units will not be accepted.

3.8 CLEANING

A. Clean off any mortar or grout stains on masonry work immediately. Any masonry showing stains from mortar, concrete, or grout at completion of Work shall be replaced. All imperfect jointing, chipped edges or corners, and similar defects shall be corrected or replaced.

B. Upon completion of the Work, point up masonry, fill holes and joints, remove loose mortar, cut out defective joints, and repaint where necessary. Leave surfaces free from mortar and other stains at completion of Work.

C. Replace defective mortar, match adjacent work.

D. Clean masonry with specified cleaners applied according to manufacturer’s written instructions.

3.9 WATER REPELLENT MASONRY SEALER

A. Remove efflorescence prior to applying water repellents. Dispose of waste generated.

B. Apply to weather exposed exterior concrete masonry walls.

C. Repoint loose, cracked, or disintegrating mortar at least 7 days prior to application. Ensure joint sealants and caulking are fully cured and wall surfaces are clean, dry, and free of chemical cleaners, efflorescence, dirt, oils, mortar smears, and other surface contaminants.

D. Follow manufacturer's recommendations for weather conditions during application.

E. Test a 5-foot by 5-foot wall area to assure proper coverage, desired water repellency properties, and desired surface appearance when sealer is fully dried.

F. Apply with spray, brush, or roller following manufacturer's recommendations, at a coverage rate of 50 square feet to 150 square feet per gallon, as determined by testing. Use two coat application where recommended by manufacturer.

3.10 FIELD QUALITY CONTROL

A. Special Inspection of masonry in accordance with IBC Section 1705.4. Refer to Structural Drawings for Special Inspection Tables.

B. Masonry shall be tested by and independent testing agency retained by Contractor, in accordance with ASTM C1314, Method B, as modified by TMS 402/602. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

C. Masonry test prisms, when required, shall be constructed onsite with same materials and workmanship to be used for Project.

D. Provide adequate facilities for safe storage and proper curing of masonry prisms, mortar samples, and grout samples, as applicable, onsite for first 24 hours, and for additional time as may be required before transporting to test lab.

E. Inspections:

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.

3. Place grout only after inspectors have verified proportions of site-prepared grout.

F. Masonry Testing:

1. Unit Strength Method:

a. Method and frequency for mortar, grout, and masonry unit sampling and testing in accordance with IBC 2105.2.2.1.

b. Provide masonry units for test samples required.

G. Corrective Action:

1. If compressive strength tests made prior to construction of permanent structure fail to meet Specifications, adjustments shall be made to mix designs for mortar, or grout, or both, as needed to produce specified strength. Masonry units shall also be tested to verify compliance to requirements of ASTM C90, Type 1.

2. If strength tests performed on materials representative of in-place construction fail to meet Specifications, prisms or cores shall be cut from constructed walls in sufficient locations to adequately determine strength in accordance with IBC 2105.3.

H. Performance Test: Masonry using concrete masonry units and mortar with integral water repellent additives, and water repellent masonry sealer, shall achieve a Class E rating when evaluated in accordance with ASTM E514, with the test extended to 72 hours.

3.11 TOLERANCES

A. Maximum Variation from Alignment of Columns: 1/4-inch.

B. Maximum Variation from Unit to Adjacent Unit: 1/16-inch.

C. Maximum Variation from Plane of Wall: 1/4-inch in 10 feet and 1/2-inch in 20 feet or more.

D. Maximum Variation from Plumb: 1/4-inch per story non-cumulative; 1/2-inch in two stories or more.

E. Maximum Variation from Level Coursing: 1/8-inch in 3 feet and 1/4-inch in 10 feet; 1/2-inch in 30 feet.

F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4-inch, plus 3/8-inch.

G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4-inch.

END OF SECTION 04 22 00

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SECTION 05 12 00 – STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials and equipment as required to erect all structural steel framing members, structural steel support members, struts, and miscellaneous structural steel members with required bracing, welds, and fasteners.

B. Furnish all baseplates, shear stud connectors, expansion joint plates, and related structural steel items.

1.2 REFERENCES STANDARDS

A. AISC – Steel Construction Manual

B. AISC – Code of Standard Practice for Steel Buildings and Bridges

C. AISC – Specification for Architecturally Exposed Structural Steel

D. AISC 303 – Code of Standard Practice for Steel Buildings and Bridges

E. AISC 360 – Specification for Structural Steel Buildings

F. ASTM A6 – Specification for General Requirements for Delivery of Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

G. ASTM A36 – Specification for Carbon Structural Steel

H. ASTM A53 – Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless

I. ASTM A108 – Specification for Steel Bar, Carbon and Alloy, Cold Finished

J. ASTM A123 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

K. ASTM A153 – Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

L. ASTM A307 – Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength

M. ASTM A500 – Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

N. ASTM A501 – Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

O. ASTM A502 – Specification for Rivets, Steel, Structural

P. ASTM A563 – Specification for Carbon and Alloy Steel Nuts

Q. ASTM A572 – Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

R. ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

S. ASTM A992 – Specification for Structural Steel Shapes

T. ASTM C1107 – Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

U. ASTM E94 – Standard Guide for Radiographic Examination

V. ASTM E164 – Standard Practice for Contact Ultrasonic Testing of Weldments

W. ESTM E165 – Standard Test Method for Liquid Penetrant Examination for General Industry

X. ASTM E709 – Standard Guide for Magnetic Particle Testing

Y. ASTM F3125 – Specification for High Strength Structural Bolts, Steel and Alloy teel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength

Z. ASTM F436 – Specification for Hardened Steel Washers

AA. ASTM F1554 – Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

BB. AWS D1.1 – Structural Welding Code – Steel

CC. AWS D1.8 – Structural Welding Code – Seismic Supplement

DD. IBC – International Building Code

EE. RCSC (HSBOLT) – Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections

FF. SSPC-PA 1 – Shop, Field, and Maintenance Painting of Steel

GG. SSPC-SP 2 – Hand Tool Cleaning

HH. SSPC-SP 3 – Power Tool Cleaning

II. SSPC-SP 6 – Commercial Blast Cleaning

JJ. SSPC-SP 11 – Power Tool Cleaning to Bare Metal

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC S303, “Code of Standard Practice for Steel Buildings and Bridges”.

B. Lateral-Force-Resisting-System: Elements of structural steel frame designated as “LFRS” or along gridlines designated “LFRS” on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A6 with flanges thicker than 1-1/2-inches.

2. Welded built-up members with plates thicker than 2-inches.

3. Column base plates thicker than 2 inches.

1.4 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Shop Drawings/Erection Drawings: Show fabrication of structural steel components. Shop drawings shall conform to AISC recommendations and specifications and shall show all holes, etc. required for other work. Drawings shall include complete details showing all members and their connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams showing the sequence of erection.

1. Indicate profiles, sizes, spacing and locations of structural members, connections, attachments, fasteners, cambers, loads, and any special details.

2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.

3. Include embedment drawings.

4. Include welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.

5. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.

6. Identify members and connections of the seismic-load-resisting-system.

7. Indicate locations and dimensions of protected zones.

8. Identify demand critical welds.

9. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed by others.

C. Manufacturer’s Mill Certificate: Certify that products meet or exceed specified requirements.

D. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.

1. Structural Steel

2. Bolts, nuts, and washers.

E. Welder's Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Fabricate structural steel in accordance with AISC (MAN) "Steel Construction Manual".

B. Fabricator: Company specializing in performing the work of this section with minimum 5 years of documented experience.

C. Erector: Company specializing in performing the work of this section with minimum 5 years of documented experience.

D. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in Idaho.

E. Welding Qualifications: Quality procedures and personnel according to AWS D1.1 "Structural Welding Code – Steel".

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing. FCAW-S and FCAW-G shall be considered separate processes for welding personnel certification.

F. Supplementary Tests: The Owner reserves the right to require or make additional mill and laboratory tests. "Identifiable stock" is material for which authentic records of the chemical and physical properties are available. Cut and machine test specimens in accordance with the ASTM Specifications for the material to be tested. Except that in the case of failure of the material to comply with the ASTM requirements, more tests may be made, or the material rejected. The number of such additional tests will be limited as follows:

1. Structural Steel - One complete test for each heat number or each 10 tons of identifiable stock

2. Rivets - One complete test for each size

3. Bolts - One complete test for each lot

G. Stock Material: When fabrication is to be done using material already in stock, obtain the approval of the Engineer prior to fabrication.

H. Mill Tolerances: Furnish steel with rolling and cutting tolerances, permissible variations in weight and dimensions, defects, and imperfections that meets the limits contained in ASTM A6.

1.6 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturer's recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 GENERAL

A. For fabrication of Work which will be exposed to view, use only materials which are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove such blemishes by grinding or by welding and grinding prior to cleaning, treating, and application of surface finishes.

B. All steel members in contact with aluminum shall be galvanized per Section 05 50 00 – Metal Fabrications, unless indicated otherwise.

C. All structural members shall be furnished full length without splices unless otherwise indicated or approved by the Engineer.

2.2 MATERIALS

A. Stock Materials: Select the material intended for use from stock and place it in a location apart from other stock material and accessible for inspection. Select the material from as few heat numbers as possible and furnish certified mill test reports for each of the heat numbers.

B. See General Structural Notes in Drawings for specification and grade

C. Schedule: All structural steel materials shall comply with the following:

Structural Steel Shapes, Plates, and Bars	ASTM A36, except where other type steel is indicated
High Strength Low-Alloy Structural Steel	ASTM A242, A572, A606, A653, or A1008 (Grades C, D, or E) as specified
Cold-Formed Steel Tubing:	ASTM A500, Grade B
Steel Pipe	ASTM A53, Type E or S, Grade B with black finish, except where indicated to be galvanized
Steel Angles, Plates, Channels, S Shapes, M Shapes, and HP Shapes	ASTM A992 unless otherwise indicated
Rolled Steel Structural Shapes	ASTM A992
Copper Bearing Structural Steel	Copper bearing structural steel shall conform to the requirements of ASTM A36, A570, A653, or A1011 as specified
Steel Castings	ASTM A27, Grade 65-35, medium strength carbon steel
All wide flange shapes (W shapes) and Tees	ASTM A992 unless otherwise indicated
Shear Stud Connectors	Made from ASTM A108 Grade 1015 bars
Structural Bolts and Nuts	Carbon steel, ASTM A307, Grade A and galvanized in compliance with ASTM A153, Class C
High-Strength Structural Bolts, Nuts, and Washers	ASTM F3125, Type 1, with matching compatible ASTM A563 nuts, and ASTM F436 Type 1 washers
Tension Control Bolts	Twist-off type; ASTM F3125
Unheaded Anchor Rods	ASTM F1554, Grade 36, plain, with matching ASTM A563 nuts, and ASTM F436
Headed Anchor Rods	ASTM F1554, Grade 36, plain
Tension-Control, High-Strength Bolt-Nut-Washer	ASTM F1852, Type 1, round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers, plain finish

2.3 ACCESSORIES

A. All fasteners inside hydraulic structures and where shown on drawings shall be stainless steel.

B. Anchor Bolts: Provide non-headed type bolts that satisfy all requirements of ASTM A307, unless otherwise indicated.

C. Unfinished Threaded Fasteners: ASTM A307, Grade A, regular low carbon steel bolts and nuts with hexagonal heads and nuts for all connections.

D. High Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers. Quenched and tempered medium carbon steel bolts, nuts and washers complying with ASTM F3125. For high strength low alloy steel provide Type 3 fasteners of similar composition as members to be connected.

E. Welding Materials: Material shall comply with AWS D1.1 and shall be of type required for materials being welded. For high strength, low alloy steel provide electrodes, welding rods, and filler metals equal in strength and compatible in appearance with parent metal joined.

F. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A108, Grade 1035.

G. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A108, Grade 1030.

H. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A108, Grade 1018.

I. Shop and Touch-Up Primer:

1. Concealed Interior Steel in Non-Corrosive Environments: Fabricator’s standard, complying with VOC limitations of authorities having jurisdiction.

2. Exposed Interior Surfaces: Either Tnemec Series 27 Typoxy WB at 3 to 4 mils DFT or primer specified in Section 09 90 00 – Painting and Coating.

J. Primer and Touch-Up Primer for Galvanized Surfaces: Either Tnemec Series 27 Typoxy WB at 2 to 2.5 mils or primer specified in Section 09 90 00 – Painting and Coating, complying with VOC limitations of authorities having jurisdiction.

K. Primer: All structural steel shall have red primer applied.

L. Grout: ASTM C107; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.

1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.

2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.

2.4 FABRICATION

A. Fabricate structural steel members in accordance with AISC Specifications, and as indicated on the final shop drawings.

B. Fabricate and assemble structural members in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.

1. Provide camber in structural members where indicated.

2. Fabricate beams with rolling camber up.

3. Identify heigh strength structural steel according to ASTM A6 and maintain markings until structural steel has been erected.

4. Properly mark and match-mark materials for fixed assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.

5. Where finishing is required, complete assembly, including welding of units before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning".

F. Connections: Weld or bolt shop connections as indicated. Bolt field connections except where welded connections or other connections are indicated. Provide high strength, threaded fasteners for principal bolted connections, except where unfinished bolts are indicated.

1. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

2. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

G. High Strength Bolted Construction: Install high strength, threaded fasteners in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts.

H. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds and methods used in correcting welding work. For high strength, low alloy steels, follow welding procedures as recommended by steel producer for exposed and concealed connections.

I. Holes for Other Work: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members as shown on final shop drawings. Provide threaded nuts welded to framing and other specialty items as indicated to receive other work. Cut, drill or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

J. Continuously seal joined members by continuous welds. Grind exposed welds smooth.

K. Fabricate connections for bolt, nut, and washer connectors.

2.5 FINISH

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches. Hold back is not required for Tnemec Series 394.

2. Surfaces to be field welded.

3. Surfaces to be high-strength bolted with slip-critical connections. Hold back is note required for Tnemec Series 394.

4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing). Hold back is not required for Tnemec Series 394.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. Concealed Interior Steel in Non-Corrosive Environments: SSPC-SP 3, “Power Tool Cleaning”.

2. Exposed Interior Surfaces: SSPC-SP 3, “Power Tool Cleaning”.

3. Exterior Steel and Steel in Corrosive Environments: SSPC-SP 6, “Commercial Blast Cleaning”.

C. Preparing Galvanized Steel for Shop Priming: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

1. Clean surfaces of weld seams according to SSPC-SP 11, “Power Tool Cleaning to Bare Metal”, unless otherwise recommended by coating manufacturer for substrate and exposure conditions.

D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at a rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

E. Galvanize all exterior structural steel members to comply with ASTM A123. Provide minimum 1.85 ounces per square foot galvanized coating.

1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.

2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

F. Do not paint surfaces which are to be welded or high strength bolted with friction type connections. Do not paint surfaces of exposed high strength, low alloy steel members.

G. All protective coatings shall be applied per requirements listed in Section 09 90 00 – Painting and Coating, unless noted otherwise.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

A. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete or masonry in ample time to not delay that work.

B. Store materials to permit easy access for inspection and identification. Keep steel members off the ground using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

C. Do not store materials in a manner that might cause deterioration or damage to members or supporting structures. Repair or replace damaged materials or structures as directed by Engineer.

3.2 EXAMINATION

A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of Work. The Contractor shall review the Drawings, and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

B. Verify with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

3.3 INSPECTION

A. Examine areas and conditions under which structural steel work is to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

B. Testing & Inspection Schedule: The Contractor shall engage inspectors to inspect welded connections and high-strength bolted connections, to perform tests and prepare test reports per the following:

1. 10 percent of all butt and bevel welds which extend continuously for 24 inches or less shall be completely tested in accordance with AWS D1.1, Chapter 6, Part E, Radiographic Testing Groove Welds in Butt Joints. All butt and bevel welds which extend continuously for more than 24 inches shall be spot tested at intervals not exceeding 36 inches.

2. Welds that are required by the Engineer to be corrected shall be corrected or redone and retested as directed, at the Contractor's expense and to the satisfaction of the Engineer and/or approved independent testing lab.

3. The Contractor shall test to failure three bolts from each heat lot of bolts furnished to the job to verify compliance with this Specification. The testing laboratory shall be approved by the Engineer and all test reports shall be supplied to the Engineer in accordance with Section 01 33 00 – Submittal Procedures. In addition, high-strength bolts shall be inspected using one of the methods set forth in the RCSC Specification for Structural Joints Using High-Strength Bolts.

C. The costs for all initial testing will be paid by the Contractor. The Contractor shall pay for all costs for any additional testing and investigation on Work which does not meet Specifications. The Contractor shall supply material for testing at no cost to the Owner and shall assist the Engineer in obtaining material for test samples.

3.4 ERECTION

A. Erect structural steel in accordance with AISC 303. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds. Level and plumb individual members of structure within specified AISC tolerances.

B. Do not use gas cutting torches in field for correcting fabrication errors in structural framing. Do not field cut or alter structural members without approval of the Engineer. Have all torque wrenches or impact wrenches certified by a testing laboratory prior to starting construction. Splice members only where indicated and accepted on shop drawings. Do not enlarge unaligned holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

C. Make provision for erection loads and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing. Establish required leveling and plumbing measurements on mean operating temperature of structure. Tighten anchor bolts after supported members have been positioned and plumbed.

D. Clean concrete and masonry bearing surfaces. Clean bottom surface of base and bearing plates. Set loose and attached base plates and bearing plates for structural members on jack nuts for leveling adjustments.

E. Pack non-shrink grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials and allow to cure.

F. Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming a part of a complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

G. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on Drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) “Specification for Structural Joints Using High-Strength Bolts”.

H. On exposed welded construction, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.

I. Maintain erection tolerances of structural steel within AISC’s “Code of Standard Practice for Steel Buildings and Bridges”.

J. Align and adjust various members that form part of a complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

K. Splice members only where indicated.

L. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.

M. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

N. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer’s written instructions.

O. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.5 SETTINGS BASES AND BEARING PLATES

A. Prior to the placement of non-shrink grout beneath base and bearing plates, the bottom surface of the plates shall be cleaned of all bond-reducing materials, and concrete and masonry bearing surface shall also be cleaned of all bond-reducing materials and roughened to improve bonding.

B. Loose and attached baseplates and bearing plates for structural members shall be set on wedges, leveling nuts, or other adjustable devices.

C. Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.

D. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

E. Anchor bolts shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its indicated strength.

F. Weld plate washers to top of baseplate, unless noted otherwise.

3.6 FIELD CONNECTIONS WELDED CONSTRUCTION

A. High-Strength Bolts: Install high-strength bolts according to RCSC (HSBOLT) for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, weld procedure specifications, weld quality, and methods used in correcting welding work.

1. All welded architectural metal work where exposed to view shall have welds ground smooth.

2. Shielded metal is welding method or gas metal arc welding methods shall be used for welding structural steel.

3. Comply with AISC S303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

4. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.

5. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

6. Unless otherwise shown, all butt and bevel welds shall be complete penetration.

3.7 TOUCH-UP PAINTING

A. Immediately after erection, field welds, bolted connections, and abraded areas shall be cleaned of the shop paint primer. Touch-up paint primer shall be applied by brush or spray which is the same thickness and material as that used for the shop paint. Galvanized surfaces which have been field-welded or damaged shall be repaired in accordance with Section 09 90 00 – Painting and Coating.

3.8 TOLERANCES

A. Maximum Variation from Plumb: 1/4-inch per story, non-cumulative.

B. Maximum Offset from True Alignment: 1/4-inch.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections. Refer to Structural Drawings for Special Inspection Program.

B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC (HSBOLT) “Specification for Structural Joints Using High-Strength Bolts”.

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.

1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency’s option:

a. Liquid Penetrant Inspection: ASTM E165.

b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.

c. Ultrasonic Inspection: ASTM E164.

d. Radiographic Inspection: ASTM E94.

D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.10 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A780.

1. Repair galvanizing prior to installation where repair areas will be inaccessible.

2. Clean surfaces of weld seams according to SSPC-SP 11 “Power Tool Cleaning to Bare Metal”.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 05 12 00

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SECTION 05 21 00 – STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Furnish and install steel joists as shown on drawings, including basic layout and type of joists required.

1.2 QUALITY ASSURANCE

A. Provide joists fabricated in compliance with the following, as herein specified.

1. SJI “Standard Specifications” for: K-Series, LH-Series or DLH-Series Open Web Steel Joists

B. Qualification of Field Welding: Quality welding processes and welding operators in accordance with the AWS “Standard Qualification Procedure”. Joists welded in place are subject to inspection and testing.

1.3 SUBMITTALS

A. Qualifications: Joist fabricator shall provide a signed certification by a Professional Registered Engineer in the state where the project is located that steel joists provided meet design and fabrication requirements.

B. Products Data: Submit manufacturer’s specifications and installation instructions for each type of joist and accessories. Include manufacturer’s certification that joists comply with SJI “Specifications”.

C. Shop Drawings: Submit detailed drawings showing layout of joist units, special connections, jointing and accessories. Include mark, number, type, location, and spacing of joists and bridging. Show all temporary bracing required during erection to comply with OSHA Safety Standards for Steel Erection.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle steel joists as recommended in SJI “Specifications”. Handle and store joists in a manner to avoid deforming members and to avoid excessive stresses.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel: Comply with SJI “Specifications”.

B. Unfinished Threaded Fasteners: ASTM A307, Grade A, a regular hexagon type, low carbon steel. Nuts: ASTM A563.

C. High-Strength Threaded Fasteners: ASTM F3125 heavy hexagon structural bolts with nuts and hardened washers.

D. Steel Prime Paint: Comply with SJI "Specifications" except asphalt type paint not permitted.

2.2 FABRICATION

A. General: Fabricate steel joists in accordance with SJI "Specifications".

B. Holes in Chord Members: Provide holes in chord members where shown for securing other work to steel joists: however, deduct area of holes from the area of chord when calculating strength of member.

C. Bridging: Provide horizontal or diagonal type bridging for "open web" joists, complying with SJI "Specifications".

D. Provide bridging anchors for ends of bridging lines terminating at walls or beams.

E. End Anchorage: Provide end anchorages to secure joists to adjacent construction, complying with SJI "Specifications", unless otherwise indicated.

F. Shop Painting: Remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories before application of shop paint. Apply one shop coat of primer to steel joists and accessories by spray, dipping, or other method to provide a continuous dry paint film thickness of not less than 0.50 mil.

PART 3 - EXECUTION

3.1 INSPECTION

A. Erector must examine areas and conditions under which steel joists are to be installed and notify contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until satisfactory conditions have been corrected in a manner acceptable to Engineer.

3.2 ERECTION

A. Place and secure steel joists in accordance with SJI "Specifications", final shop drawings, and as herein specified:

1. Anchors: Furnish anchor bolts and other devices to be built into concrete and masonry concrete. Furnish templates for accurate location of anchors in other work. Furnish unfinished threaded fasteners for anchor bolts, unless otherwise indicated.

2. Placing Joists: Do not start placement of steel joists until supporting work is in place and secured. Place joists on supporting work, adjust, and align in accurate locations and spacing before permanently fastening. Provide temporary bridging, connections, and anchors to ensure lateral stability during construction.

3. Bridging and Bracing: Install bridging simultaneously with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords where termination is at walls or beams. Comply with OSHA Safety Standards for Steel Erection.

4. Fastening Joists: Field weld joists to supporting steel framework in accordance with SJI "Specifications" for type of joists used. Coordinate welding sequence and procedure with placing of joists. Bolt joists to supporting steel framework in accordance with SJI "Specifications" for type of joists used. Provide unfinished threaded fasteners for bolted connections, unless otherwise indicated.

5. Touch-Up Painting: Unexposed areas and top of deck. After joist installation, paint field bolt heads, nuts, welded areas, abraded or rusty surfaces on joists and steel supporting members. Wire brush surfaces and clean with solvent before painting. Use same type of paint as used for shop painting.

6. Touch-Up Painting: Exposed areas. Cleaning and touch-up painting of field welds, abraded areas, and rust spots of shop painting is included under Division 9 painting work, where joists are to be exposed to finished view.

END OF SECTION 05 21 00

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SECTION 05 31 00 – STEEL DECKING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Furnish and install metal decking as shown on the drawings and as specified herein, including basic layout and type of deck units required.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following codes and standards, except as otherwise shown or specified.

1. AISI "North American Specification for the Design of Cold-Formed Steel Structural Members"

2. AWS "Structural Welding Code"

3. SDI "Design Manual for Floor Decks and Roof Decks"

B. Qualification of Field Welding: Quality welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".

C. Underwriters' Label: Provide Metal floor deck units listed in Underwriters' Laboratories "Fire Resistance Directory", with each deck unit bearing the UL label and marking for specific system detailed.

1.3 SUBMITTALS

A. Product Data: Submit manufacture's specifications and installation instructions for each type of decking and accessories. Included manufacturer's certification as may be required to show compliance with these specifications.

B. Shop Drawings: Submit detailed drawings showing layout and types of deck panels, anchorage details and conditions requiring closure panels, supplementary framing, sump pans, cant strips, cut openings, special jointing or other accessories.

C. Insurance Certification: Assist Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended insurance.

1.4 DELIVERY AND STORAGE

A. General: Do not deliver materials to the job site before erection is imminent. Following manufactures and Steel Deck Institute's recommendations for storage and handling.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Metal Roof Deck Units:

a. United Steel Deck, Inc.

b. Vulcraft-Div, Nucor Corp.

c. Wheeling Corrugation Co.

d. ASC Pacific

e. Verco, Inc.

f. Or equal

2.2 MATERIALS

A. Steel for Painted Metal Deck Units: ASTM A1008, Grade C.

B. Steel for Galvanized Metal Deck Units: ASTM A653, Graded A.

C. Miscellaneous Steel Shapes: ASTM A36.

D. Sheet Metal Accessories: ASTM A653, commercial quality, galvanized.

E. Galvanizing: ASTM A653, G60.

F. Galvanizing Repair Paint: High zinc-dust content paint for repair of damaged galvanized surfaces.

G. Paint: Manufacturer’s backed on, rust-inhibitive paint, for application to metal surfaces which have been chemically cleaned and phosphate chemical treated.

1. Shop prime galvanized deck in preparation for final painting by Division 9.

H. Flexible Closure Strips: Manufacturer’s standard vulcanized, closed-cell, synthetic rubber.

2.3 FABRICATION

A. General: Form deck units in lengths to span 3 or more supports, with nested 2” laps at ends and nested side laps, unless otherwise indicated.

B. Deck Units: Provide deck configurations complying with SDI "Roof Deck Specifications", of metal thickness, depth and sections as follows unless shown otherwise on the drawings. If the drawings do not show depth and thickness of deck units, provide 1-1/2 inch deep, 20 gauge decking.

C. Metal Cover Plates: Fabricate metal cover plates for end-abutting floor deck units of not less than same thickness as decking. Form to match contour of deck units and approximately 6" wide.

D. Metal Closure Strips: Fabricate metal closure strips, for cell raceways and opening between decking and other construction, of not less than 0.045" min. (18 gage) sheet steel. Form to provide tight-fitting closures at open ends of cells or flutes and sides of decking.

PART 3 - EXECUTION

3.1 INSPECTION

A. Installer must examine areas and conditions under which metal decking is to be installed and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION

A. General: Install deck units and accessories in accordance with manufacture's recommendations and final shop drawings, and as specified herein.

1. Place deck units on supporting steel framework and adjust to final position with ends accurately aligned and bearing on supporting members before being permanently fastened. Do not stretch or contract side lap interlock.

2. Place deck units in straight alignment for entire length or run of cells and with close alignment between cells at ends of abutting units.

3. Place deck units flat and square, secured to adjacent framing without warp or excessive deflection.

B. Fastening Deck Units: Fasten deck units to steel joists or structural steel supporting members by not less than 3/4" diameter arc puddle welds. Weld metal shall penetrate all layers of decking and have good fusion to the supporting members. Along outside edge, weld to ledgers at 12" center. At joints lay 2" minimum, and lap at supports only. At supports, weld both edge corrugations and interior corrugations (36/7 Pattern) at 12" maximum spacing. Fasten side Laps by 1-1/2" top seam welds at 12" on centers. Use welding washers only when recommended by the deck manufacturer. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.

1. Fasten deck to light gauge metal framing or light gauge metal trusses using screw sizes, configuration and spacing as shown on the drawings.

2. Uplift Loading: Install and anchor roof deck units resist gross uplifting of 20 lbs. Per sq. Ft.

C. Cutting and Fitting: Cut and neatly fit deck units and accessories around other work projecting through or adjacent to decking, as shown.

D. Reinforcement at Openings: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking and support of other work shown.

E. Hanger Slots or Clips: Provide UL approved punched hanger slots between cells or flutes of lower elements where floor deck units are to receive hanger for support of ceiling construction, air ducts, diffusers, or lighting fixtures.

1. Hanger clips designed to clop over male side lap joints of floor deck units may be used instead of hanger slots.

2. Locate slots or clips at not more than 14” o.c. in both directions, not over 9” from wall at ends, and not more than 12” from walls at sides, unless otherwise shown.

3. Provide manufacturer’s standard hanger attachment devices.

F. Joint Covers: Provide metal joint covers at abutting ends and changes in direction of floor deck units, except where taped joints are required.

G. Closure Strips: Provide metal closure strips at open uncovered ends and edges of roof decking, and in voids between decking and other construction. Weld into position to provide a complete decking installation.

H. Touch-Up Painting - Unexposed Areas: Top of deck and galvanized deck only. After decking installation, wire brush, clean and paint scarred areas, welds and rust spots on top and bottom surfaces of decking units and supporting steel members.

1. Touch-up galvanized surfaces with galvanizing repair paint applied in accordance with manufacture’s instruction.

END OF SECTION 05 31 00

SECTION 05 40 00 – COLD–FORMED METAL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install light gauge metal framing as shown on the drawings and specified herein.

1.2 SUBMITTALS

A. General: Submit the following:

1. Product data and installation instructions for each item of cold-formed metal framing and accessories.

2. Shop drawings for framing members showing size and gage designations, number, type, location, and spacing. Indicate supplemental strapping, bracing, splices, bridging, accessories, and details required for proper installation.

1.3 QUALITY ASSURANCE

A. Welding: use qualified welder and comply with American Welding Society (AWS) D1.3, “Structural Welding Code - Sheet Steel.”

B. Fire-Rated Assemblies: Where framing units are components of assemblies indicated for a fire-resistance rating, including those required for compliance with governing regulations, provide units that have been approved by governing authorities that have jurisdiction.

PART 2 - PRODUCTS

2.1 METAL FRAMING

A. System Components: Manufacturer’s standard load-bearing steel studs and joists of type, size, shape, and gage as indicated. With each type of metal framing required, provide manufacture’s standard, steel tracks and reinforcements, fasteners, and accessories for applications indicated, as needed to provide a complete metal framing system.

B. Materials and Finishes:

1. For 16-gage and heavier units, fabricate metal framing components of structural quality steel sheet with a minimum yield point of [50,000] psi; ASTM A653, A1011, or A1008.

2. For 18-gauge and lighter units, fabricate metal framing components of commercial quality steel sheet with a minimum yield point of [33,000] psi; ASTM A653, A1011, or A1008.

3. Provide galvanized finish to metal framing components complying with ASTM A653 for minimum G60 coating.

4. Fasteners: Provide nuts, bolts, washers, screws, and other fasteners with corrosion-resistant plated finish.

5. Electrodes for Welding: Comply with AWS code and as recommended by stud manufacturer.

6. Galvanizing Repair: Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A780.

2.2 FABRICATION

A. General: Framing components may be prefabricated into assemblies before erection. Fabricate panels plumb, square, true to line, and braced against racking with joints welded. Perform lifting of prefabricated units to prevent damage or distortion.

B. Fabricate units in jig templates to hold members in proper alignment and position and to assure consistent components placement.

C. Fastenings: Attach similar components by welding. Attach dissimilar components by welding, bolting, or screw fasteners, as standard with manufacturer.

D. Wire tying of framing components is not permitted.

E. Fabrication Tolerances: Fabricate units to a maximum allowable tolerance variation from plum, level, and true to line of 1/8-inch in 10 feet.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install metal framing system in accordance with manufacturer’s printed or written instructions and recommendations.

B. Runner Tracks: Install continuous tracks sized to match studs. Align tracks accurately to layout at base and tops of studs. Secure tracks as recommended by stud manufacturer for type of construction involved, except do not exceed 24 inches on center spacing for nail or power-driven fasteners or 16 inches on center for other types of attachment. Provide fasteners at corners and ends of tracks.

C. Installation of Wall Studs: Secure to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges.

D. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

E. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure.

F. Install supplementary framing, blocking, and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations and industry with stud manufacturer's recommendations and industry standard in each case, considering weight of loading resulting from item supported.

G. Frame wall openings larger than 2 feet square with double stud at each jamb of frame except where more than two are either shown or indicated in manufacturer's instructions. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs on wall. Secure stud system wall opening frame in manner indicated.

H. Install horizontal stiffeners in stud system, spaced (vertical distance) at not more than 54 inches on center. Weld at each intersection.

I. Erection Tolerances: Bolt or weld wall panels (at both horizontal and vertical junctures to produce flush, even, true-to-line joints.

1. Maximum variation in plane and true position between prefabricated assemblies should not exceed 1/16 inch.

J. Installation of Joists: Install level, straight, and plumb, complete with bracing and reinforcing as indicated on drawings. Provide not less than 1-1/2-inch end bearing.

K. Reinforce ends with end clips, steel hangers, steel angle clips, steel stud section, or as otherwise recommended by joist manufacturer.

END OF SECTION 05 40 00

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SECTION 05 50 00 – METAL FABRICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install miscellaneous metal items as shown on the drawings and specified herein.

B. Provide shop fabricated and manufactured steel and aluminum, including, but not limited to the following:

1. Metal ladders.

2. Ledge angles, shelf angles, channels, and plates not attached to structural framing.

3. Lintels.

4. Door frames for overhead doors.

5. Steel framing and supports for overhead doors.

6. Pipe downspouts.

1.2 STANDARDS

A. AISC “Code of Standard Practice.”

B. ANSI A14.3 – American National Standard for Ladders – Fixed – Safety Requirements

C. ASTM A36 – Specification for Carbon Structural Steel

D. ASTM A53 – Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

E. ASTM A153 – Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

F. ASTM A283 – Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

G. ASTM A500 – Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

H. ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

I. ASTM A786 – Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates

J. ASTM B209 – Specification for Aluminum and Aluminum-Alloy Sheet and Plate

K. ASTM B221 – Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wires, Profiles, and Tubes

L. ASTM B429 – Specification for Aluminum-Alloy Extruded Structural Pipe and Tube

M. ASTM B663 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel

N. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

O. ASTM D1187 – Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal

P. ASTM F1941 – Specification for Electrodeposited Coatings on Threaded Fasteners.

Q. ASTM F3125 – Specification for High Strength Structural Bolts, Steel, and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength

R. AWS D1.1 – Structural Welding Code – Steel

S. AWS D1.2 – Structural Welding Code – Aluminum

T. SSPC-SP 11 – Power Tool Cleaning to Bare Metal

U. SSPC-SP 2 – Hand Tool Cleaning

V. SSPC-SP 6 – Commercial Blast Cleaning

1.3 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Provide certification that steel materials comply with AIS requirements.

C. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

1. Prepare shop drawings from field measurements where possible.

2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

E. Welder’s Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance of Ladders: Ladders shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3

1. Ladders accessing equipment on roofs or elevated structures shall comply with the requirements of Section 306.5 of the International Mechanical Code.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 degrees Fahrenheit, ambient; 180 degrees Fahrenheit, material surfaces.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Quality procedures and personnel according to the following:

1. AWS D1.1 – Structural Welding Code – Steel.

2. AWS D1.2 – Structural Welding Code – Aluminum

1.6 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in the General Structural Notes – Special Inspection Tables – or – Section 01 45 00 – Quality Control, will inspect installed shop fabricated and manufactured steel and aluminum items for conformance to contract documents.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Transport, handle, store and protect products with special custom wrapping and handling procedures to protect and touch-up shop primers at every stage of shipping.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.9 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturer’s written recommendations to ensure that shop primers and topcoats are compatible with one another.

PART 2 - PRODUCTS

2.1 MATERIALS - STEEL

A. HSS (Hollow Structural Shapes): ASTM A500 Grade B

B. Bars, plates, miscellaneous shapes: ASTM A36

C. Aluminum: Alloy 5052-H32, mill finish

D. Plates: ASTM A283

E. Checkered Plate (Diamond Plate): ASTM A786, galvanized rolled steel floor plate; diamond pattern. Provide 1/4-inch thickness unless otherwise indicated.

F. Pipe: Steel pipe shall be ASTM A120 Galvanized Steel.

1. Provide steel pipe supports for downspouts.

a. Available Products, or equal:

1) Adjustable Pipe Saddle manufactured by Anvil International

2) Fig. 315 – Adjustable Pipe Support manufactured by Tolco

G. Fasteners: Provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

H. Welding Materials: AWS D1.1; type required for materials being welded.

I. Shop and Touch-Up Primer for Galvanized Surfaces: Either Tnemec Series 27 Typoxy WB at 2 to 2.5 mils or primer specified in Section 09 90 00 – Painting and Coating, complying with VOC limitations of authorities having jurisdiction.

2.2 MATERIALS – ALUMINUM

A. Extruded Aluminum: ASTM B221, 6063 alloy, T6 temper, 6061 alloy, T6 temper, or 6005 alloy, T5 temper, as standard with manufacturer.

B. Sheet Aluminum: ASTM B209, 5052 alloy, H32 or H22 temper, or 5005 alloy, H34 temper, as standard with manufacturer.

C. Extruded Structural Pipe and Round Tubing: ASTM B429, Alloy 6063-T6, standard weight, Schedule 40 pipe, unless otherwise required to meet performance requirements.

D. Bolts, Nuts, and Washers: Stainless steel.

E. Welding Materials: AWS D1.2; type required for materials being welded.

F. Miscellaneous Bolts and Nuts: ASTM A307

G. High Strength Bolts and Nuts: ASTM F3125 Grade A325

H. Concrete Anchors: Use cast in anchor bolts where cast in anchor bolts are shown on the drawings. Provide attachment to concrete with concrete anchors where shown on the drawings conforming to the following types. Use only type of concrete anchor shown on the drawings.

1. Expansion Anchors: Expansion anchors shall be wedge type with a single piece three section wedge to anchor the stud in the hole. The stud nut and wedge shall be ANSI 304 stainless steel.

2. Adhesive Anchors: Adhesive anchors shall be an all thread rod with a nut. The all thread rod and nut shall be ANSI 304 stainless steel. The rod shall be anchored in the hole using a premeasured adhesive capsule consisting of vinyl urethane methacrylate adhesive.

3. Undercut Anchors: Undercut anchors shall be an undercut style with a brazed tungsten carbide edge on the undercutting end to perform the self-cutting undercut as the anchor is installed. The anchor shall cut and undercut bearing area of at least 2.5 times the nominal anchor bolt size. The anchor stud shall be ANSI 316 stainless steel.

I. Stainless Steel Bolts and Nuts: Type 316 Stainless Steel

2.3 BOLTS AND ANCHORS

A. Standard Service (Non-Corrosive Application): Unless otherwise indicated, bolts, anchor bolts, washers, and nuts shall be steel as indicated herein. Threads on galvanized bolts and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing. Except as otherwise indicated, steel for bolt material, anchor bolts and cap screws shall be in accordance with the following:

Structural Connections	ASTM A307, Grade A or B, hot-dip galvanized
Anchor Rods	ASTM A36, hot-dip galvanized
High Strength Bolts	ASTM F3125 Grade 325
Pipe and Equipment Flange Bolts	ASTM A193, Grade B-7

B. Stainless steel bolts and nuts for corrosive service

1. Corrosive Service: All bolts, nuts, and washers in the locations listed below shall be stainless steel as indicated below.

a. All buried locations.

b. All submerged locations.

c. All locations subject to seasonal or occasional flooding.

d. Inside hydraulic structures below the top of the structure.

e. Inside buried vaults, manholes, and structures which do not drain through a gravity sewer or to a sump with a pump.

f. All chemical handling areas, except in areas where stainless steel is not compatible with the chemicals being stored.

g. Inside trenches, containment walls, and curbed areas.

h. Locations indicated by the Contract Documents or designated by the ENGINEER to be provided with stainless steel bolts.

2. Unless otherwise indicated, stainless steel bolts, anchor bolts, nuts, and washers shall be Type 316 stainless steel, Class 1, conforming to ASTM A193 for bolts and to ASTM A194 for nuts. All threads on stainless steel bolts shall be protected with an antiseize lubricant suitable for submerged stainless steel bolts, to meet government specification MIL-A-907E. Buried bolts in poorly drained soil shall be coated the same as the buried pipe.

a. Antiseize lubricant shall be classified as acceptable for potable water use by the NSF.

b. Antiseize lubricant shall be "PURE WHITE" by Anti-Seize Technology, Franklin Park, IL, 60131, AS-470 by Dixon Ticonderoga Company, Lakehurst, NJ, 08733, or equal.

C. Bolt Requirements: The bolt and nut material shall be free-cutting steel. The nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. All bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.

D. Bolts and nuts shall be installed with washers fabricated of material matching the base material of bolts, except that hardened washers for high strength bolts shall conform to the requirements of the AISC Specification. Lock washers fabricated of material matching the bolts shall be installed where indicated.

E. The length of each bolt shall be such that after the joint is made up, the bolt extends through the entire nut, but in no case more than 1/2-inch beyond the nut.

F. Adhesive Anchors: Unless otherwise indicated, all drilled, concrete or masonry anchors shall be adhesive anchors. No substitutions will be considered unless accompanied with ICBO report verifying strength and material equivalency.

1. Adhesive anchors are required for drilled anchors for indoor installations, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring reinforcing bars. Threaded rod shall be stainless steel Type 316. Epoxy adhesive shall be Hilti HIT RE 500 V3.

2. Unless otherwise indicated, glass capsule, polyester resin adhesive anchors will be permitted in locations not included above and shall be Hilti HVA or Cobra Anchors. Threaded rod shall be galvanized steel.

G. Expanding-Type Anchors: Expanding-type anchors if indicated or permitted, shall be galvanized steel expansion type ITW Ramset/Redhead "Trubolt" anchors; Hilti "Kwik-Bolt;" or equal. Lead caulking anchors will not be permitted. Size shall be as indicated. Embedment depth shall be as the manufacturer recommends for the load to be supported. Expansion type anchors which are to be embedded in grout may be steel. Non-embedded buried or submerged anchors shall be stainless steel.

H. Overhead Applications: Use Hilti HDA undercut anchors.

I. Miscellaneous Bolts and Nuts: ASTM A307

J. High Strength Bolts and Nuts: ASTM F3125 Grade A325

K. Concrete Anchors: Use cast in anchor bolts where cast in anchor bolts are shown on the drawings. Provide attachment to concrete with concrete anchors where shown on the drawings conforming to the following types. Use only type of concrete anchor shown on the drawings.

1. Expansion Anchors: Expansion anchors shall be wedge type with a single piece three section wedge to anchor the stud in the hole. The stud nut and wedge shall be ANSI 304 stainless steel.

2. Adhesive Anchors: Adhesive anchors shall be an all thread rod with a nut. The all thread rod and nut shall be ANSI 304 stainless steel. The rod shall be anchored in the hole using a premeasured adhesive capsule consisting of vinyl urethane methacrylate adhesive.

3. Undercut Anchors: Undercut anchors shall be an undercut style with a brazed tungsten carbide edge on the undercutting end to perform the self-cutting undercut as the anchor is installed. The anchor shall cut and undercut bearing area of at least 2.5 times the nominal anchor bolt size. The anchor stud shall be ANSI 316 stainless steel.

2.4 POWDER-DRIVEN PINS

A. Power-driven pins to be installed in concrete or steel shall be heat-treated steel alloy. If the pins are not inherently sufficiently corrosion-resistant for the conditions to which they are to be exposed, they shall be protected in an acceptable manner. Pins shall have capped or threaded heads capable of transmitting the loads the shanks are required to support. Pins that are connected to steel shall have longitudinal serrations around the circumference of the shank. Complete information describing pin capacities, connections, and proposed use locations shall be submitted to the Engineer.

2.5 IMPACT ANCHOR

A. Impact anchors shall be an expansion type anchor in which a nail type pin is driven to produce the expansive force. The pin shall have a zinc sleeve with a mushroom style head and stainless steel nail pin. Anchors shall be Metal HIT Anchors, manufactured by Hilti, Inc., Rawl Zamac Nailin, manufactured by the Rawlplug Company; or equal.

2.6 MISCELLANEOUS MATERIALS

A. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

B. Nonshrink, Metallic Grout: Factory packaged, ferrous-aggregate grout complying with ASTM C1107, specifically recommended by manufacturer for heavy-duty loading applications. Refer to Section 03 60 00 – Grouting for further requirements.

2.7 FABRICATION

A. Workmanship: Conform to accepted shop practices. Form work true to details, with clean, straight, sharply defined profiles.

B. Fit and shop assemble items in largest practical sections, for delivery to site. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

C. Use materials of size and thickness indicated or, if not indicated, as required to produce strength and durability in finished product for intended use and, where applicable, to meet performance requirements.

D. Fabricate items with joints tightly fitted and secured.

E. Continuously seal joined members by continuous welds, unless otherwise indicated on Drawings.

F. Joints and Connections: Weld all joints, unless other fastening methods are shown, specified or specifically approved. Close fit exposed joints; making joints where least conspicuous. Unless otherwise shown or specified, use flat and countersunk beaded bolts or screws in exposed connections.

G. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

H. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

I. Cutting, Drilling; Perform cutting, drilling, punching required for accurate fitting and assembly work. In addition, perform similar operations as required for attachment of work of other trades, provided that directions for such work are supplied prior to shop drawing approvals.

J. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

1. Provide anchor bolts for connecting to other work.

a. Drill and tap steel as required to receive bolted connections.

b. Make bolt holts 1/16-inch larger than nominal bolt diameter.

K. Provisions for Attachment to Structure: Furnish miscellaneous metal items complete with framing, supports, hangers, bracing, anchors, and other devices shown specified or necessary for reinforcement and proper, secure setting or attachment to building construction.

L. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

M. Dissimilar Materials Protection: Insulate aluminum surfaces in contact with metals other than galvanized or stainless steel, or with plaster or concrete, by means of chromate gasketing or heavy coat of alkali-resistant bituminous paint.

N. Workmanship: Fabricate all items neatly and rigidly in accordance with details in first-class finished, workmanlike manner. Form curved work neatly to radii indicated. Provide members of sizes indicated and weld, bolt, or rivet securely together. Furnish bolts, nuts, washers, and other fastening devices required for anchoring and securing work.

O. Welding: Use electric shielded-arc process in accordance with Welding Specifications of American Welding Society. Use only welding operators properly trained and highly skilled in arch welding. Grind smooth surface welds exposed to view.

2.8 SHOP FINISHING

A. Steel Metal Items: Galvanize all iron or steel items. Prior to galvanizing, all items after fabrication shall be cleaned thoroughly, removing scale, flux deposits, rust, oil, dirt, and other foreign matter. Except as otherwise indicated, iron or steel items specified to be galvanized shall be hot-dip galvanized after fabrication in accordance with ASTM A123. Fabricate units complete or in largest practical sections before galvanizing.

B. Aluminum Metal Items: Aluminum guardrail and handrails shall be finished with a 0.7 mil clear anodized finished, unless noted otherwise. Other aluminum items shall be mill finish.

2.9 METAL LADDERS

A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; galvanized finish.

1. Side Rails: Tube steel members of size detailed spaced at 24 inches, unless otherwise indicated on Drawings.

a. Extend rails 42 inches above top rungs or landing and return rails to wall or structure unless other secure handholds are provided.

b. At roof ladders over parapets, extend rails as detailed.

2. Rungs: 3/4-inch diameter solid round bar spaced 12 inches on center.

a. Provide nonslip surfaces on top of each rung either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.

b. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.

3. Diamond Plate Landing: At roof to roof ladders over parapets, provide 1/4-inch thick galvanized diamond plate landing full width of ladder centered above parapet, welded to side rails. Provide nonslip surface as indicate for rungs.

4. Space rungs 7 inches from wall surface with 3/8-inch by 3-inch steel angle brackets to support rails.

a. Drill bracket to receive wall anchors.

b. Weld brackets at 12 inches from each end of rails, unless otherwise indicated, and at not more than 60 inches on center at intermediate points.

c. Galvanize exterior ladders, including brackets and fasteners.

d. Shop prime interior ladders.

2.10 MISCELLANEOUS FRAMING AND SUPPORTS

A. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking, joists, and masonry; prime paint finish.

B. Lintels: As detailed, galvanized finish.

1. Size loose lintels to provide bearing length at each side of opening equal to 1/10 of clear span but not less than 8 inches, unless otherwise indicated.

C. Door Frames for Overhead Door Openings: Channel sections, prime paint finish, unless otherwise indicated.

D. Overhead Door Supports: Fabricate supports for overhead doors from steel of sizes and shapes recommended by door manufacturer and with attached anchors as recommended by door manufacturer.

2.11 FINISHES – STEEL

A. Galvanizing and prime paint all exterior steel items.

B. Prime paint all steel items.

1. Exceptions: Galvanized items to be embedded in concrete and items to be embedded in masonry.

C. Prepare surfaces to be primed in accordance with SSPC-SP 2 where indicated to receive manufacturer's standard primer.

D. Prepare surfaces to be primed in accordance with SSPC-SP 6 where indicated to receive high-performance coating finish.

E. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

F. Prime Painting: One coat of specified primer applied in strict accordance with primer manufacturer's instructions.

1. Provide one coat of manufacturer's standard primer for the following items:

a. Interior ladders.

G. Galvanizing: Galvanize after fabrication to ASTM A123 requirements.

2.12 FINISHES – ALUMINUM

A. Mechanical Finish: AA-M12 (Mechanical Finish: nonspecular as fabricated).

2.13 FABRICATION TOLERANCES

A. Squareness: 1/8-inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16-inch.

C. Maximum Misalignment of Adjacent Members: 1/16-inch.

D. Maximum Bow: 1/8-inch in 48 inches.

E. Maximum Deviation from Plane: 1/16-inch in 48 inches.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Clean and strip primed steel items to bare metal where site welding is required.

C. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

D. Embedded Items: Deliver miscellaneous metal items to be embedded or installed in concrete with setting instruction to concrete contractor for setting. Verify grade and line positioning of items as set, report errors or deviations in order that corrective adjustments may be made before placement of concrete or laying of masonry.

E. Coat all aluminum surfaces in contact with concrete with an approved bituminous coating or zinc chromate primer.

3.2 GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, thru bolts, lag screws, wood screws, and other connectors.

C. Concrete Anchors: Install concrete anchors in cast in place concrete and masonry according to the details shown on the drawings and as recommended by the anchor manufacturer. When installing concrete anchors in masonry always install anchors in masonry cells that have been grouted solid. Do not install anchors into hollow cell masonry.

D. Install items plumb and level, accurately fitted, free from distortion or defects.

E. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

F. Field weld components as indicated.

G. Perform field welding in accordance with AWS D1.1

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

H. Obtain approval prior to site cutting or making adjustments not scheduled.

I. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

J. Expansion, Contraction: Assemble and install work with adequate provisions to prevent objectionable distortion and overstressing from expansion, contraction. Where necessary, provide properly designed expansion joints, construct to be weather tight if to be exposed to the weather.

K. Field Touch-up: After installation of miscellaneous metal items, tough-up field bolts, field welds, uncoated connections and abrasions with ship protective coatings. Clean items of mud, dirt, and other objectionable foreign matter.

L. Finishing: Where indicated, metal fabrication items shall be painted after installation in accordance with Section 09 90 00 – Painting and Coating.

3.3 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. Install framing and supports to comply with requirements of items being supported, including manufacturer's written instructions and requirements indicated on Shop Drawings.

3.4 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.

2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

1. Clean surfaces of weld seams according to SSPC-SP 11, "Power Tool Cleaning to Bare Metal".

3.6 TOLERANCES

A. Maximum Variation from Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset from True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch

END OF SECTION 05 50 00

SECTION 05 51 19 – METAL GRATING STAIRS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials and equipment as required to install metal grating stairs as shown on the Plans. Coordinate Work with other contractors.

1.2 STANDARDS

A. 2018 International Building Code

B. AISC “Code of Standard Practice.”

C. AWS “Code for Welding in Building Construction.”

1.3 SUBMITTALS

A. Submit Shop Drawings and product date in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Prepare and submit shop drawings for handrail, grating, stringers and miscellaneous metal items prior to fabrication. Identify items with location and drawing or specifications reference. Layout drawings for grating shall be submitted showing the direction of span, type and depth of grating and details of grating hold down fasteners. Load and deflection table shall be submitted for each style and depth of grating used. Show connections, anchors, anchor or fastener spacing dimensions and details. Submit design calculations for all stairs, grating, and handrail and guardrail shop drawings stamped by a professional engineer in the State where Work is to be done.

C. Welders’ Certificates.

D. Fabricator’s Qualification Statement: Provide documentation showing steel fabricator is certified under AISC 201.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.

1. Handrails: Comply with applicable accessibility requirements of ADA Standards and in accordance with Section 05 52 00 – Metal Railings.

2. Dimensions: As indicated on the drawings.

3. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.

4. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.

5. Separate dissimilar metals using paint or permanent tape.

6. Welded Joints: Welded on backside wherever possible.

7. Welds Exposed to View: Ground smooth.

8. Bolts Exposed to View: Countersunk flat or oval head bolts; no exposed nuts or screw threads.

9. Metal Surfaces to be Painted: Sanded smooth, suitable for satin or matte finish.

10. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

11. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.2 STAIR TREADS

A. Provide steel treads where steel stairs are shown on the drawings and provide aluminum treads where aluminum stairs are shown on the drawings.

1. Steel Stair Treads: Provide welded steel rectangular bar grating type stair treads. Bearing bars shall be 1-1/2 inch deep and 3/16 inch wide with serrations on the top side of the bearing bars. The nose of the tread shall have an abrasive cast iron nosing attached to the tread. The width and length of the tread shall be as detailed on the drawings.

2. Aluminum Stair Treads: Provide rectangular aluminum bar grating stair treads. Bearing bars shall be 1-3/4 inch deep and 3/16 inch wide. The treads shall be non-serrated. The nose of the tread shall have a corrugated aluminum angle nosing attached to the tread.

B. Load/Deflection Requirements: Treads shall be capable of spanning the distances indicated with a minimum safety factor of 3 for all stresses and without exceeding a deflection equal to the lesser of 1/4 inch or the span divided by 180. The loading used for determining stresses and deflections shall be the uniform live load of the adjacent floor area or 100 pounds per square foot, whichever is greater, and/or a concentrated load of 300 pounds at the center of the span, whichever is greater unless otherwise indicated.

2.3 HANDRAILS AND GUARDS

A. Provide handrails and guards where required by Code and where shown on the drawings and in accordance with Section 05 52 00 – Metal Railings. Provide steel handrails and guards where shown on the drawings and provide aluminum handrails and guards where shown on the drawings.

B. Wall-Mounted Rails: Round pipe or tube rails unless otherwise indicated.

1. Outside Diameter: 1-1/4 inch, minimum, to 1-1/2 inches, maximum.

C. Guards:

1. Top Rails: Round pipe or tube rails unless otherwise indicated.

a. Outside Diameter: 1-1/4 inch, minimum, to 1-1/2 inches, maximum.

2. Infill at Pipe Railings: Pipe or tube rails sloped parallel to stair.

a. Outside Diameter: 1 inch, minimum, to 1-1/2 inches, maximum.

b. Material: Steel pipe or tube, round.

c. Vertical Spacing: Maximum 12 inches on center.

d. Jointing: Welded and ground smooth and flush.

3. End and Intermediate Posts: Same material and size as top rails.

a. Horizontal Spacing: As indicated on drawings.

b. Mounting: Welded to top surface of stringer.

2.4 METAL GRATING

A. Metal grating shall be of the design, sizes, and types indicated and in accordance with Section 05 53 00 – Metal Grating and Floor Plates. Grating shall be completely banded at all edges and cutouts using material and cross section equivalent to the bearing bars. Such banding shall be welded to each cut bearing bar. Grating shall be supported on all sides of an opening by support members.

2.5 SHOP FINISHING

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Prime Painting: Use specified shop and touch up primer.

1. Preparation of Steel: In accordance with SSPC-SP 2, Hand Tool Cleaning, one coat.

D. Galvanizing: Hot-dip galvanized to minimum requirements of ASTM A123.

1. Galvanize all iron or steel items. Prior to galvanizing, all items after fabrication shall be cleaned thoroughly, removing scale, flux deposits, rust, oil, dirt, and other foreign matter. Fabricate units complete or in largest practical sections before galvanizing.

2. Touch up abraded areas after fabrication using specified touch-up primer for galvanized surfaces.

PART 3 - EXECUTION

3.1 GENERAL

A. Install gratings and stairs as shown on the Plans.

B. Coat all aluminum surfaces in contact with concrete with an approved bituminous coating or zinc chromate primer.

C. When field welding is required, clean and strip primed steel items to bare metal.

D. Supply items required to be cast into concrete and embedded in masonry with setting templates.

3.2 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1.

D. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.

E. Obtain approval prior to site cutting or creating adjustments not scheduled.

F. After erection, prime all welds, abrasions, and surfaces that have not been shop primed or galvanized, except surfaces to be in contact with concrete.

3.3 TOLERANCES

A. Maximum Variation from Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset from True Alignment: 1/4 inch.

END OF SECTION 05 51 19

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SECTION 05 52 00 – METAL RAILINGS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials and equipment as required to install all aluminum pipe and tube handrails, balusters, and fittings, as shown on the Plans.

1.2 REFERENCE STANDARDS

A. ADA Standards – Americans with Disabilities Act (ADA) Standards for Accessible Design

B. ASTM B429 – Specification for Aluminum-Alloy Extruded Structural Pipe and Tube

C. ASTM A53 – Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

D. ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

E. ASTM C1107 – Specification for Packaged, Dry, Hydraulic-Cement Grout (Nonshrink)

F. AWS D1.2 – Structural Welding Code – Aluminum

G. AWSD1.1 – Specification for Welding Code – Steel

H. IBC – International Building Code

I. OSHA Safety Requirements.

J. SSPC-PA-1 – Shop, Field, and Maintenance Painting of Steel

K. SSPC-SP 1 – Solvent Cleaning

L. SSPC-SP 11 – Power Tool Cleaning to Bare Metal

M. SSPC-SP 6 – Commercial Blast Cleaning

1.3 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Shop drawings: Indicate profiles, railing layouts, post locations, and gate locations. Indicate component details, materials, finishes, connection and joining methods, attachment to supporting structure, and the relationship to adjoining work.

1. Submit design calculations for all handrail and guardrail shop drawings stamped by a professional engineer in the State where Work is to be done.

2. Submit design calculations for anchorage of railing stamped by a professional engineer in the State where Work is to be done.

C. Submit manufacturer's instructions for installation and connecting methods.

D. Samples: Submit color samples for Owner review and approval.

PART 2 - PRODUCTS

2.1 RAILINGS – GENERAL REQUIREMENTS

A. Allow for expansion and contraction of members and building movement without damage to connections or members.

B. Dimensions: See drawings for configurations and heights.

C. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated.

2.2 STRUCTURAL PERFORMANCE

A. Code Requirements: All railings, guardrails and handrails shall conform to the code requirements for IBC and the State-approved OSHA. Railings, guardrails, and handrails, when part of the means of egress as defined by the governing codes, shall conform to the requirements of the most stringent of the codes or reference standards. The whole project areas shall be limited public use areas. The other areas of the project shall conform to the code and State-approved OSHA for industrial-commercial, non-public use unless otherwise indicated.

2.3 MATERIALS

A. Rail Section: Railing and handrails shall be round pipe design railing system unless otherwise indicated. Provide three (3) rails plus kickplate matching the railing material.

B. Rail Material: Aluminum Railing shall be U.S. Alloy 6061 or 6063, T-5 or T-6. Aluminum pipe rail shall be not less than 1-1/2-inch diameter, Schedule 40 pipe. Aluminum pipe posts shall be not less than 1-1/2-inch diameter, Schedule 80 pipe, and Steel Railing shall be ASTM AB3 Grade B Steel pipe posts shall be not less than 1-1/2-inch diameter, Schedule 80 pipe unless noted otherwise.

C. Aluminum Welding Materials: AWS D1.2; type required for materials being welded.

D. Steel Welding Materials: AWS D1.1; type required for materials being welded.

E. Sleeves: Sleeves shall be formed with galvanized steel or PVC. Sleeves for removable posts shall be of steel, hot-dip galvanized after fabrication. Galvanizing of steel sleeves shall be done after fabrication to prevent raw steel from being exposed to the elements.

F. Fasteners: Fasteners, screws, and bolts shall be of stainless steel or aluminum. Handrail bracket fasteners and fasteners over water basins shall be stainless steel.

G. Brackets: Handrail brackets shall be aluminum with a finish that matches the handrail or railing of which they are a part.

H. Toeboards: Where required, toeboards shall be extruded (match railing system) aluminum or steel of not less than 4-inches in height. Toeboards for pipe railing shall be channel section for strength.

I. Socket Grout: Non-shrink grout for handrail post sockets shall consist of an inorganic, non-metallic, premixed grout with a minimum 2-day compressive strength of 4,000 psi.

2.4 FINISHES

A. Aluminum Pipe railing system includes handrails, railing, tube caps, and other miscellaneous parts of rails shall be provided with a 0.7-mil clear anodized finish.

B. Coat all aluminum surfaces in contact with concrete with bituminous compound or zinc chromate primer.

C. Steel Pipe Railing system includes handrails. railing, tube caps, and other miscellaneous parts of rails shall be hot dipped galvanized and painted.

2.5 MANUFACTURERS OR EQUAL

A. “C-V Pipe Rail” by CraneVeyor Corp.

B. “Wesrail” by Moultrie Manufacturing Co.

2.6 FABRICATION

A. Verify dimensions on site prior to shop fabrication. Fit and shop assemble sections in largest practical sizes for delivery and installation at site.

B. Supply components required for secure anchorage or handrails and railings.

C. Grind exposed welds smooth and flush with adjacent surfaces.

D. Make exposed joint butt tight, flush, and hairline.

E. Accurately form components required for anchorage of railings to each other and to building structure.

F. Galvanize all iron or steel items. Prior to galvanizing, all items after fabrication shall be cleaned thoroughly, removing scale, flux deposits, rust, oil, dirt, and other foreign matter. Except as otherwise indicated, iron or steel items specified to be galvanized shall be hot-dip galvanized after fabrication in accordance with ASTM A123. Fabricate units complete or in largest practical sections before galvanizing.

PART 3 - EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken packages, containers, or bundles bearing the label of the manufacturer.

B. Storage: All materials shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

3.2 PREPARATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Supply items to be mounted to concrete, embedded in masonry, or place in partitions with setting templates and erection drawings to appropriate sections.

3.3 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Anchor hand railings to structure. Install in accordance with shop drawings and manufacturer's instructions.

D. All exposed welds shall be ground smooth and flush and shall be polished and anodized. Discoloration on exposed aluminum surfaces, whether or not due to welding, shall constitute a basis for rejection of the entire assembly.

E. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780.

1. Clean surfaces of weld seams according to SSPC-SP 11, “Power Tool Cleaning to Bare Metal”.

3.4 GATES AND REMOVABLE SECTIONS

A. Gates shall be provided with self-closing hinges and self-closing latch bolts. Removable handrails sections shall be provided where indicated. The gate and removable railing hardware’s color shall match the railing system of which it is a part.

3.5 TOLERANCES

A. Maximum Variation from Plumb: 1/4-inch per floor level, non-cumulative.

B. Maximum Offset from True Alignment: 1/4-inch.

C. Maximum Out-of-Position: 1/4-inch.

END OF SECTION 05 52 20

SECTION 05 53 00 – METAL GRATINGS AND FLOOR PLATES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials and equipment as required to install all grating, floor plates and seats, as shown on the Plans. Coordinate Work with other contractors.

B. Furnish seats for all grating and floor plates, as shown on the Plans.

1.2 SUBMITTALS

A. Shop Drawings: Shop Drawings of all miscellaneous metalwork shall be submitted in accordance with Section 01 33 00 – Submittal Procedures.

B. Prior to ordering or fabrication of grating, floor plates, or seats, submit shop drawings of all pieces with positioning diagram to the Engineer for approval. Layout drawings for grating shall be submitted showing the direction of span, type and depth of grating, size and shape of grating panels, seat angle details, and details of grating hold down fasteners. Load and deflection table shall be submitted for each style and depth of grating used. Submit design calculations for all drawings stamped by a professional engineer licensed in the State where Work is to be done.

PART 2 - PRODUCTS

2.1 GENERAL

A. Dissimilar Materials Protection: Insulate aluminum surfaces in contact with metals other than galvanized or stainless steel, or with plaster or concrete, by means of chromate gasketing or heavy coat of alkali-resistant bituminous paint.

B. Where grating depth is not given, grating shall be provided which shall not exceed a deflection of 1/4-inch at uniform load of 100 pounds per square inch.

2.2 METAL GRATING

A. Provide steel grating where steel grating is shown on the drawings. Provide aluminum grating where aluminum grating is shown on the drawings.

1. Steel Grating: Provide galvanized steel rectangular welded steel non-slip bar grating. Bearing bars shall be 1-1/2” deep and 3/16” wide. Spacing of bearing bars shall be 1-3/16”, UNO.

2. Aluminum Grating: Provide aluminum non-slip rectangular bar grating fabricated from 6063 T6 aluminum. Bearing bars shall be 1-3/4” wide and 3/16” thick. Spacing of bearing bars shall be 1-3/16” UNO.

B. Load/Deflection Requirements: Grating shall be capable of spanning the distances indicated with a minimum safety factor of 3 for all stresses and without exceeding a deflection equal to the lesser of 1/4 inch or the span divided by 180. The loading used for determining stresses and deflections shall be the uniform live load of the adjacent floor area or 100 pounds per square foot, whichever is greater, and/or a concentrated load of 1000 pounds at the center of the span, whichever is greater unless otherwise indicated.

C. Metal grating shall be of the design, sizes, and types indicated. Grating shall be completely banded at all edges and cutouts using material and cross section equivalent to the bearing bars. Such banding shall be welded to each cut bearing bar. Grating shall be supported on all sides of an opening by support members.

D. Where grating is supported on concrete, embedded support angles matching grating material shall be used on all sides, unless indicated otherwise. Such angles shall be mitered and welded at corners. Make provisions for attachment of grating in two locations of each support.

2.3 CHECKERED PLATE

A. Provide steel plate where shown on the drawings. Provide aluminum plate where shown on the drawings.

1. Steel Plate: Furnish floor plates fabricated from ASTM A36 galvanized steel checkered pattern 1/4-inch thick steel plate where steel floor plate is shown on the drawings unless noted otherwise.

2. Aluminum Plate: Furnish floor plates fabricated from 6063 T6 aluminum checkered pattern 1/4-inch thick plate where aluminum floor plate is shown on the drawings unless noted otherwise.

B. Load/Deflection Requirements: Plate shall be capable of spanning the distances indicated with a minimum safety factor of 3 for all stresses and without exceeding a deflection equal to the lesser of 1/4 inch or the span divided by 180. The loading used for determining stresses and deflections shall be the uniform live load of the adjacent floor area or 100 pounds per square foot, whichever is greater, and/or a concentrated load of 1000 pounds at the center of the span, whichever is greater unless otherwise indicated.

PART 3 - EXECUTION

3.1 GENERAL

A. Install gratings, floor plates and seats, as shown on the Plans.

B. Coat all aluminum surfaces in contact with concrete with an approved bituminous coating or zinc chromate primer.

C. Set all embed seats during the placing of concrete so that clearances are maintained.

D. Workmanship: Fabricate all items neatly and rigidly in accordance with details in first-class finished, workmanlike manner. Form curved work neatly to radii indicated. Provide members of sizes indicated and weld, bolt or rivet securely together. Furnish bolts, nuts, washers, and other fastening devices required for anchoring and securing work.

E. Galvanizing: Galvanize all iron or steel items. Prior to galvanizing, all items after fabrication shall be cleaned thoroughly, removing scale, flux deposits, rust, oil, dirt, and other foreign matter. Except as otherwise indicated, iron or steel items specified to be galvanized shall be hot-dip galvanized after fabrication in accordance with ASTM A123. Fabricate units complete or in largest practical sections before galvanizing.

END OF SECTION 05 53 00

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Contract Documents & Specifications

CITY OF ABERDEEN WWTP IMPROVEMENTS

Division 06 – Division 26

Volume 2

JUNE 2024

PROJECT NO. 222032

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SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials and equipment as required to construct all rough carpentry work, which is generally not exposed and is covered by finish work.

1.2 REFERENCES STANDARDS

A. AWC (WFCM) – Wood Frame Construction Manual for One and Two-Family Dwellings

B. APA PRP-108 – Performance Standards and Qualification Policy for Structural-Use Panels (Form E445)

C. ASTM A153 – Specification for Zinc-Coating (Hot-Dip) on Iron and Steel Hardware

D. ASTM A653 – Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process

E. ASTM D2898 – Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing

F. AWPA U1 – Use Category System: User Specification for Treated Wood

G. IBC – International Building Code

H. NFPA – National Design Specification for Stress Grade Lumber and its Fastenings

I. PS 1 – Structural Plywood

J. PS 2 – Performance Standard for Wood-Based Structural-Use Panels

K. PS 20 – American Softwood Lumber Standard

L. WCLIB (GR) – Standard Grading Rules for West Coast Lumber No. 17

M. WWPA G-5 – Western Lumber Grading Rules

1.3 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Product Data: Provide technical data on wood preservative materials and application instructions.

1. For composite-wood products, provide documentation indicating that product contains no urea formaldehyde.

1.4 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

PART 2 - PRODUCTS

2.1 LUMBER MATERIALS

A. Lumber Materials

1. General: Factory mark each piece of lumber with type, grade, mill and grading agency.

2. Species: See General Structural Notes in Drawings.

3. Provide dimensioned lumber as required by PS 20.

4. Use S4S lumber, unless otherwise indicated.

5. Use seasoned lumber with 19 percent maximum moisture at time of use.

6. Use No. 2 grade Douglas Fir or Larch, or any species and grade meeting the following requirements, unless otherwise noted; see General Structural Notes in Drawings:

a. Fb: 900 psi minimum

b. E: 1,600,000 psi minimum

B. Pressure-Treated Lumber: All wood nailing blocks, sills, and plates resting on or embedded in concrete or masonry within 18 inches of grade shall be pressure-treated in accordance with AWPA C1. Preservative shall conform to American Wood Preservers Assn. and American Wood Preservers Bureau Standard Specifications. Creosote shall not be used.

2.2 PLYWOOD MATERIALS

A. Plywood: Plywood shall conform to the requirements of U.S. Product Standard PS-1 as specified herein. All plywood panels shall be marked with grade mark of the American Plywood Association. The mark shall identify the plywood as to species, glue type, and grade in compliance with the applicable commercial standard. Plywood shall be Douglas Fir, Exterior, C-D, S1S.

B. Hardboard: Hardboard shall be temper-treated panels manufactured from interfelted ligno-cellulose fibers consolidated under heat and pressure in a hot press to produce a smooth, hard-surfaced material which is resistant to water and stains. Hardboard shall conform to the requirements of ANSI/AHA A 135.4.

C. Oriented Strand Board (OSB): Where shown on Plans, OSB shall conform to American Plywood Association Sturd-I-Floor and conform to the Council of American Building Officials NER 108. Use edge sealed tongue and groove OSB for flooring. Use glue nail application approved by the American Plywood Association for Sturd-I-Floor construction

2.3 ACCESSORIES

A. Nails, Spikes and Staples: Galvanized for exterior locations, high humidity locations; plain finish for other interior locations; size and type to suit application.

B. Bolts, Nuts, Washers, Lags and Screws: Medium carbon steel; size and type to suit application; galvanized for exterior locations, high humidity locations, and treated wood; plain finish for other interior locations.

C. Fasteners: Expansion shield and lag bolt type for anchorage to concrete. Bolts or power activated type for anchorage to steel.

D. Metal Framing Devices: Provide metal framing devices as shown on the Drawings. Acceptable products include “Strong-Tie” by Simpson Company, Silver Metal Products, or equivalent by approval.

E. Plyclips shall be extruded aluminum clips, manufactured from 6063-T6 aluminum alloy, and designed for intended use. Size shall be as required for plywood or shall be as shown.

PART 3 - EXECUTION

3.1 GENERAL

A. Discard units of material with defects which might impair quality of Work, and units which are too small to use in fabricating work with minimum joints or optimum joint arrangement.

B. Set carpentry work accurately to required levels and lines with members plumb and true and accurately cut and fitted.

C. Securely attach carpentry work to substrate by anchoring and fastening as shown, and as required by recognized standards. Countersink nail heads and fill holes in exposed carpentry work.

D. Use common wire nails, except as otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood and pre-drill as required.

E. Rough Hardware: All rough hardware not otherwise specified and which is necessary for the satisfactory execution of framing, including nails, spikes, dowels, fasteners, and similar incidentals shall be provided and installed by the Contractor. Rough hardware shall be coordinated, furnished, installed, and embedded as shown and as required for a complete Work.

F. Framing: Framing members and assemblies shall be closely fitted, accurately set, and rigidly secured to required lines, levels, and arrangements shown. Framing shall be accurately and neatly cut and shall be securely nailed, spiked, or otherwise fastened in place in a workmanlike manner. Timber connectors and installation thereof shall conform to applicable requirements of AITC 104 and AITC 105.

3.2 INSTALLTION – GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including shims, bracing, and blocking.

C. Where treated wood is used on interior; provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.3 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.

B. Make provisions for temporary construction loads and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

C. Install structural members full length without splices unless otherwise specifically detailed.

D. Comply with member sizes, spacing and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWI (WFCM) Wood Framing Construction Manual.

E. Install horizontal spanning members with crown edge up and not less than 1-1/2-inches of bearing at each end.

F. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise specified.

G. Provide bridging at joists in excess of 8 feet span as detailed. Fit solid blocking at ends of members.

H. Frame wall openings with two or more studs at each jamb; support headers on cripple studs. See structural details for further information.

3.4 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. Plate and Sill Installation: Bottom plates and sill plates which are secured to concrete shall be located as shown. The anchor bolts shall be located as shown or as required by Referenced Standard if not shown. The plates and sills shall be leveled with shims. Washers shall be placed and nuts shall be tightened to level bearing, after which the spaces (1/2-inch minimum) between the sill and concrete shall be dry packed with concrete.

C. Blocking and Backing: All blocking and backing in walls and ceilings shall be nominal 2-inch-thick material of a depth as needed and shall be accurately located around light fixtures, ceiling registers, grilles, and other required mechanical and electrical items. The blocking shall fit snugly and shall be spiked into the supporting framing members. Wood blocking (backing) to receive sheathing, siding, metal lath, and gypsum board shall be provided wherever necessary for securing the facing materials.

D. Plywood Sheathing: Plywood sheathing shall be installed with face grain across supports and end joints shall be over joists and shall be staggered. Blocking shall be provided at all unsupported edges.

E. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.

F. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

G. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

H. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

I. Fire Stops: Fire stops shall be not less than 2-inch nominal thickness and of the same width as the studs. Strips of full-thickness fiber glass or rock wool shall be installed around pipes, ducts, conduits, and other penetrations through fire stops.

3.5 FRAMING DEVICES

A. Metal Framing Devices: Metal framing devices shall be furnished and installed where shown. Nails for the framing devices shall be as furnished or recommended by the manufacturer of the anchor device. All nails shall be driven to their full depth at all holes in anchors. Bolt and lag fasteners shall be drawn tight.

3.6 INSTALLATION OF PANELS

A. Roof Nailers and Fascia Backing: Secure panels with long dimension perpendicular to framing members with ends staggered and over firm bearing.

B. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.

1. Provide a 1/8-inch space between panel edge and end joints to allow for expansion.

2. Follow sheathing schedule in the Drawings for nailing patterns, staples are not permitted.

C. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered.

1. Protect sheathing from moisture. Do not cover wet sheathing materials. Remove and replace wet materials.

2. Provide a 1/8-inch space between panel edge and end joints to allow for expansion.

3.7 TOLERANCES

A. Framing Members: 1/4-inch from true position, maximum.

B. Variation from Plane (Other than Floors): 1/4-inch in 10 feet maximum, and 1/4-inch in 30 feet maximum.

END OF SECTION 06 10 00

SECTION 06 17 53 – SHOP - FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Finish and install wood roof trusses as indicated on the Drawings and as specified herein.

1.2 SUBMITTALS

A. Shop Drawings: Contractor shall submit shop drawings for approval showing complete details of wood trusses. Show the following information:

1. Design and fabrication data.
2. Thickness, nominal sizes and location of metal connectors at all joints.
3. Pitch span and spacing of trusses.
4. Species and stress grades of lumber to be used as members.
5. Design loading of trusses and allowable stress increase.
6. Force analysis in each member.
7. Any bracing required to prevent compression buckling of truss members.
8. Camber and deflection.
9. Final truss plans shall be stamped by a registered Professional Engineer licensed in the State where the Work is to be done.

1.3 QUALITY ASSURANCE

A. Standards: The design and fabrication of wood trusses shall comply with the following standards latest edition:

1. "National Design Specifications for Stress-Grade Lumber and Its Fastenings" by NFPA.
2. "Timber Construction Standards" by AITC.
3. "Design Specifications for Light Metal Plate Connected Wood Trusses" by Truss Plate Institute.

1.4 DESIGN STANDARDS

A. The truss manufacturer is responsible for the design and fabrication of the truss system and its bracing requirements.

B. Design trusses to support the loads indicated on the plans

(See General Structural Notes - Basis of Design, on Construction Drawings for Additional Loading Requirements, I.E. Wind, Seismic and Importance Factors)

C. Truss design shall conform to the requirements of the current edition of IBC Section 1608 and ASCE 7 Section 7. These requirements shall include, but are not limited to, the following:

1. Partial loading.

2. Unbalanced snow loads.

3. Drifts on lower roofs and roof projections.

4. Sliding snow.

5. Ice dams and Icicles along eaves (double eave loads).

6. Wind Loading

7. Deflection

D. The truss manufacturer shall consider the effects of eccentric loading in the design of heel joints.

E. No stress increase for plate connectors will be allowed.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Fabricated trusses shall be handled with care so that they are not subject to damage. If trusses are stockpiled prior to erection, they shall be set in vertical position, resting on temporary supports, and braced to prevent unusual bending or tipping over.

PART 2 - PRODUCTS

2.1 MATERIALS OF CONSTRUCTION

A. All lumber used for the truss members shall be Douglas Fir Dense No. 1 Grade. All lumber used for truss members shall conform to the published stress ratings for the species and grades as set out in the official grading rules of the Lumber Association.

1. Moisture content of lumber shall not exceed 19 percent nor be less than 7 percent at the time of fabrication.

2. Lumber shall be uniformly sized S4S and conform to the nominal sizes shown on the shop drawings.

3. All members shall be cut from lumber which bears the proper grademarks stamp of a recognized grading association.

2.2 CONNECTORS

A. All truss connector plates shall be fabricated from galvanized sheet steel which has minimum uncoated thickness of 0.0359 inches 20 gauge and a minimum yield strength of 33,000 psi. Corrosion-resistant coating shall be 1.25 oz. per square foot commercial class hot-dipped galvanized.

B. All truss to truss to truss connections / hangers shall be designed and supplied by the truss manufacturer.

2.3 FABRICATION

A. Trusses shall be fabricated in a properly equipped manufacturing facility. They shall be manufactured by experienced workmen using proper truss fabricating equipment.

B. Truss members shall be accurately cut to length, angle and be true to line to assure tight joints in finished trusses.

C. Truss members and connector plates shall be properly placed in special jigs and the members tightly clamped in place until the connector plates have been pressed into the lumber simultaneously on both sides of the joints.

PART 3 - EXECUTION

3.1 ERECTION

A. During erection, care shall be taken to keep horizontal bending of the trusses to a minimum.

B. Proper erection bracing shall be installed to hold the trusses true and plumb until the permanent truss bracing system is solidly nailed in place.

C. Erection of permanent bracing shall be installed before application of any leads.

END OF SECTION 06 17 53

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SECTION 06 40 00 – ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install casework, cabinetry and finish trim work as shown on the drawings and specified herein.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop drawings for the casework and cabinetry shall be complete and show all details, lumber sizes, and type and grade of materials to be used.

C. Shop drawings, samples of hardware and literature shall be submitted. Color samples and literature on laminated plastic shall be submitted for review and color selection.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Softwoods: Softwoods shall be vertical grain Douglas fir or white pine, meeting AWI Premium Grade requirements.

B. Hardwoods: Hardwood shall be ash or birch, with a transparent finish conforming to AWI Custom Grade. Hardwood species shall not be mixed within a project.

C. Plywood: Softwood plywood shall conform to the requirements of the U.S. Product Standards PS-1, Grade A for pine plywood. Hardwood plywood shall conform to the requirements of HPVA HP-1, Grade AA. Plywood backboards and plywood wainscots shall be APA Grade trademarked A-C-INT -APA. Backing for countertops shall be 3/4-inch thick particle board or plywood in accordance with written recommendations of the laminated plastic manufacturer.

2.2 PLASTIC LAMINATES

A. Laminated plastic shall be high-pressure-laminated plastic conforming to NEMA LD-3.

B. Color and textures shall be selected by the Owner from the manufacturer’s full product range.

2.3 PANEL PRODUCTS

A. Core shall be medium density fiberboard with minimum weight of 37 pound per cubic foot. Optional material is plywood meeting APA standards for custom casework. Moisture content shall be same as specified for lumber.

B. Edgings: To be bullnosed laminate finish. Aluminum trim shall be used in the laboratory. Trim shall be extruded aluminum with clear anodized finish and shall have PVC edging or 'T' molding. Shelving in casework shall have melamine facings and shall have PVC edging or "T' molding. Color to be selected by owner.

C. Facings: Exposed faces of cabinets shall have plastic laminate finish.

2.4 CABINET AND CASEWORK

A. Cabinet and casework shall conform to AWI Premium grade, with face frame and flush overlay type door and drawer construction. Cabinet WORK shall receive laminated plastic finish unless otherwise shown.

B. Laboratory casework shall conform to AWI Premium grade, with face frame and flush overlay type door and drawer construction. Cabinet Work shall receive chemical-resistive laminated plastic finish unless otherwise shown. Countertops, splashes, curbs and cup sinks shall be cast epoxy resin. Cabinet Work shall be of standard sizes approximately equal to those shown with filler panels where required or shown.

1. Refer lab sink refer to Division 22 - Plumbing

C. Cabinet Component Thickness & Material: Use plastic laminate facing except, cabinet interiors and shelving faces behind cabinet doors.

1. Ends, Divisions, Bottoms, Tops: Use 3/4-inch panel product with hardwood veneer on outside and melamine interior faces.

2. Rails: Use 3/4-inch edge-banded panel product with melamine interior face.

3. Shelves: Use edge-banded panel product with melamine faces, 3/4-inch thick for spans up to 36 inches and 1-inch thick for spans 36 to 48 inches. Provide Hafele or equal center supports for spans over 48 inches.

4. Backs: Use 1/4-inch nominal panel product with melamine faces.

5. Doors: Use 1/4-inch panel product with melamine interior face.

6. Drawer Sides, Backs, & Subfronts: Use 1/2-inch panel product with melamine faces.

7. Drawer Bottoms: Use 1/4-inch nominal panel product with melamine face.

8. Drawer Front: Use 1/4-inch faced panel product with melamine face.

9. Hardboard Shelves: Use 1/4-inch thick, smooth both sides. Color to match cabinet interior.

D. All drawers shall have guides.

E. Laminated plastic countertops, splashes, curbs, and shelves shall be of the same grade as cabinet and casework.

2.5 HARDWARE

A. Cabinet & Drawer Pulls: Provide satin nickel flush Pulls as manufactured by Sugatsune America, Inc. or equal.

B. Cabinet Hinges: Provide European style, self-closing as manufactured by Grass or equal.

C. Guides: Provide full extension, steel ball bearings with 100-pound load rating for standard and pencil drawers and 150-pound load rating for lateral file. Guides shall be manufactured by Accuride or equal.

D. Hinges: Provide heavy duty hinges that have wrap-around 2-1/4-inch minimum width and butts of 0.083-inch thick steel. Provide off-set for overlay door installation with a minimum of 5 No.8 full thread screws to the jamb and 4 No.8 full thread screws to the door. Loose pin butts of 0.083-inch-thick steel shall be National 8-377 or equal.

E. Aluminum Trim: Aluminum trim where specified or shown, shall be extruded aluminum with clear anodized finish as manufactured by Eagle Aluminum or equal.

2.6 ACCESSORIES

A. Aluminum Trim: Aluminum trim where specified or shown, shall be extruded aluminum with clear anodized finish as manufactured by Eagle Aluminum or equal.

B. Hardboard: Hardboard shall conform to AHA A 135.4, tempered type. Where hardboard is shown for tool boards it shall be 1/4-inch thick and shall be perforated on 1-inch centers to accept pegboard hooks.

C. Nails for exterior millwork and siding shall be stainless steel where exposed to the elements and galvanized where concealed.

D. Lag screws, wood screws, and other rough hardware shall be per AWI standards for grade(s) specified.

E. Wood screws shall conform to FS FF-S-111D (1). Cadmium plated screws, bolts and washers shall be used on exposed interior work. Screws for exterior use shall be stainless steel.

PART 3 - EXECUTION

3.1 GENERAL

A. Millwork, cabinets and casework shall be manufactured, fabricated and installed in accordance with the AWI Standards for Millwork.

B. The Contractor shall verify drawing dimensions in the field and shall inspect related Work and adjacent surfaces. Any conditions, which will prevent proper execution of the Work, shall be reported to the Engineer.

3.2 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Materials shall be delivered in original, unbroken packages, containers, or wrappings, bearing the name of the manufacturer, along with identification markings. Materials shall be protected during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

B. All materials and products shall be carefully stored in conformance with referenced standards, in an area that is protected from the deleterious elements, and in a manner recommended by the material manufacturer.

3.3 INSTALLATION

A. Casework shall not be installed until painting, wet Work, grinding and similar operations which could damage, soil or deteriorate woodwork have been completed in the installation areas and the building is fully enclosed, with sufficient heat provided, dust generating activities have terminated, and overhead mechanical and electrical Work is completed, tested, and approved.

B. All Work shall be true and straight, with edges clean cut, and assembled with members properly housed together and tightly jointed. Joints subject to strain shall be reinforced with screws or bolts to assure their tightness. The method of joining and reinforcing shall be as indicated on the shop drawings. Work shall be accurately positioned and installed plumb and level, with separate parts fitted and properly aligned. Single lengths of wood shall be used whenever practicable. Trim shall have plowed backs unless otherwise shown.

C. Countertops, box curbs, splashes, and ends shall be installed true, level, straight and aligned. Sections shall be properly housed together, tightly jointed, and clamped. Shop drawings shall show the jointing pattern, method of jointing, and reinforcement. Countertops shall be installed in sections as large as possible with the fewest joints. They shall be accurately positioned and installed plumb and level with hairjoints and no rises or bumps at joints. Epoxy items shall be installed by experienced epoxy craftsmen or under the direct supervision of experienced craftsmen.

D. Holes and cutouts shall be provided in casework as required for plumbing, conduits, and other penetrations, or inserts shall be provided as part of the Work.

E. Provisions shall be made for access to plumbing valves and cleanouts, and connections of electrical Work.

F. Casework shall be installed plumb, level, true and straight, with no distortions. Shimming shall be accomplished as required, using concealed shims. Where laboratory casework abuts other finished Work, scribe and apply filler strips for accurate fit with fasteners concealed where practicable.

G. Base cabinets shall be set straight, plumb, and level. Sub-tops shall be adjusted within 1/16-inch of a single plane.

1. Each individual base cabinet shall be fastened to the floor at the toe space, with fasteners spaced no more than 2 feet on center. Where individual cabinets do not adjoin other cabinets, they shall be secured with not less than two fasteners into the floor.

2. Continuous cabinets shall be bolted together. Where required, units shall be assembled into one integral unit with joints flush, tight, and uniform. Similar adjoining doors and drawers shall be aligned to a tolerance of 1/16-inch.

H. Wall cabinets shall be securely fastened to solid supporting material, not plaster, lath, or wallboard. Wall cabinets shall be anchored, adjusted, and aligned as indicated for base cabinets. Coordinate accurate location and sizing of reinforcement in substrate walls during their erection, as required to properly support wall-mounted cabinets.

I. Casework and finish hardware shall be adjusted so that doors and drawers operate smoothly without warp or bind. Operating hardware shall be lubricated as recommended by the manufacturer.

3.4 TOP INSTALLATION

A. Tops and splashes shall be provided in sections as large as possible, with the fewest possible joints. Where necessary, field jointing shall be accomplished in the same manner as factory jointing, using dowels, splines, adhesives, and fasteners as recommended by the manufacturer. Field joints shall be located as shown on shop drawings and shall be factory prepared so there is no site processing of top and edge surfaces.

3.5 CLEANING AND PROTECTION

A. At the completion of the installation, defective Work shall be repaired or removed and replaced as directed by the Engineer at no additional cost to the owner.

B. Protection: Take all procedures and precautions necessary to properly protect the completed installation from damage and soiling by subsequent construction, until final acceptance.

END OF SECTION 06 40 00

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SECTION 06 64 00 - PLASTIC PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plastic sheet paneling.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

2.2 PLASTIC SHEET PANELING

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Crane Composites, Inc.
    b. Marlite.
    c. Nudo Products, Inc.
    d. Panolam Surface Systems.

2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E84. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 450 or less.

3. Nominal Thickness: Not less than 0.09 inch.
4. Surface Finish: Molded pebble texture.
5. Color: White As selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, and caps as needed to conceal edges.

    1. Color: Match panels.

B. Adhesive: As recommended by plastic paneling manufacturer.

C. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

B. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

D. Lay out paneling before installing. Locate panel joints where indicated and to provide equal panels at ends of walls not less than half the width of full panels.

1. Mark plumb lines on substrate at trim accessory locations for accurate installation.
2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install trim accessories with adhesive.

D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 06 64 00

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SECTION 06 70 00 – STRUCTURAL COMPOSITES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials and equipment as required to install glass fiber and resin fabrications, as shown on the Plans. Coordinate work with other contractors.

1.2 REFERENCE STANDARDS

A.	ASTM E84	Surface Burning Characteristics of Building Materials
B.	ASTM D256	Determining the Pendulum Impact Resistance of Notched Specimens of Plastics.
C.	ASTM D570	Water Absorption of Plastics
D.	ASTM D635	Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
E.	ASTM D638	Tensile Properties of Plastics
F.	ASTM D696	Coefficient of Linear Thermal Expansion of Plastics Between – 30 Degrees C and 30 Degrees C with a Vitreous Silica Dilatometer
G.	ASTM D790	Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
H.	ASTM D2344	Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
I.	ASTM D2583	Indentation Hardness of Rigid Plastics by means of a Barcol Impressor.
J.	ANSI/AWWA F102	Matched Die-Molded, Fiberglass-Reinforced Plastic Weir Plates, Scum Baffles, and Mounting Brackets

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Shop Drawings for every Fiberglass Resin Plate (FRP) item. Include plans, elevations, and profiles that clearly show material sizes, types, styles, parts or catalog numbers. Drawings shall include complete details for the fabrication and erection of components, including location, dimensions, lengths, joining method, type and size of fasteners, clip angles, member sizes, and connection details.

1. Layout drawings for grating shall show the direction of span, type and depth of grating, size and shape of grating panels, seat angle details, and details of grating hold down fasteners.

C. Product Literature: Manufacturer's published literature including structural design data, structural properties, and load and deflection tables for each style and depth of grating used, corrosion resistance tables, certificates of compliance, test reports (as applicable), and anchoring systems and allowable load tables and ICBO reports.

D. Calculations: Structural calculations shall be submitted for beams, grating, and fasteners or anchors. Calculations shall be signed and sealed by a professional engineer registered in the State of Idaho.

1.4 QUALITY ASSURANCE

A. Manufacturer's Experience: Items provided under this Section shall be furnished only by manufacturers having experience in the manufacture of similar products, with a record of 5 similar successful installations in the last 5 years.

B. Quality: All fiberglass items shall be constructed of new, first-class, commercial-quality, fiberglass fabric-reinforced polyester or vinyl ester resin laminate material of the strength, thickness, and dimensions indicated herein. Weirs and baffles shall be manufactured using the matched die-molded method. All other structural fiberglass members, gratings, and structural shapes shall be manufactured by open mold or pultrusion methods.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. FRP items shall be composed of fiberglass reinforcement and resin in quantities, qualities, properties, arrangements, and dimensions as necessary to meet the design requirements and dimensions indicated.

B. Fiberglass reinforcement shall be continuous roving, continuous strand mat, and surfacing veil or a combination thereof in sufficient quantities for the application and physical properties required.

C. Unless indicated otherwise, resin shall be fire retardant isophthalic polyester or vinyl ester with chemical formulation as necessary to provide the corrosion resistance, strength, and other physical properties as required. FRP items used in chemical storage or containment areas shall be vinyl ester resin, with chemical formulations as necessary to provide the corrosion resistance, strength, and other physical properties required in those areas.

D. Finished surfaces of FRP items and fabrications shall be smooth, resin-rich, free of voids, and without dry spots, cracks, or unreinforced areas. Glass fibers shall be well covered with resin to protect against exposure from wear or weathering.

E. Resin for all FRP items shall include an UltraViolet (UV) inhibitor additive. FRP products located in exterior locations exposed to the weather or in UV facilities shall also have an additional 1 mil UV coating applied.

F. FRP products shall have a tested flame spread rating of 25 or less per ASTM E84. Gratings and stair treads shall also meet the self-extinguishing requirements of ASTM D635.

G. Supports and Fasteners: The Contractor shall provide all bolts, anchor bolts, nuts, washers, and supports as required for the WORK of this Section in accordance with the requirements of the manufacturers of the items. Bolts, anchor bolts, washers and supports shall be of Type 316 stainless steel. Concrete anchor systems shall be in accordance with Section 05 50 00 – Metal Fabrications.

H. All cut or machined edges, holes, scratches, gouges, and abrasions shall be sealed with a resin compatible with the resin matrix used in the original item.

I. Load/Deflection Requirements: Grating, Covers, and Treads shall be capable of spanning the distances indicated with a minimum safety factor of 3 for all stresses and without exceeding a deflection equal to the lesser of 1/4 inch or the span divided by 180. The loading used for determining stresses and deflections shall be the uniform live load of the adjacent floor area or 100 pounds per square foot, whichever is greater, and an independent concentrated load of 1000 pounds for grating and an independent concentrated load of 300 pounds for stair treads at the center of the span, unless otherwise indicated on plans.

2.2 MOLDED COVERED FIBERGLASS GRATING

A. Design: The covered fiberglass grating shall be of modular construction, capable of being removed in sections for inspection or to gain access to the structure below. Each module shall not weigh more than 80 lbs. and shall be provided with a recessed Type 316 SS lifting handle.

B. Manufacture: Grating shall be of a one-piece molded construction with tops and bottoms of bearing bars and cross bars in the same plane. Grating shall have a square mesh pattern. Grating shall be reinforced with continuous rovings of equal number of layers in each direction. The top layer of reinforcement in the grating panel shall be no more than 3/16" below the top surface of the grating so as to provide maximum stiffness and prevent resin chipping of unreinforced surfaces. Percentage of glass (by weight) shall not exceed 35% so as to achieve maximum corrosion resistance, and as required to maintain the structural requirements of the Contract.

C. After molding, no dry glass fibers shall be visible on any surface of bearing bars or cross bars. All bars shall be smooth and uniform with no evidence of fiber orientation irregularities, resin rich or resin starved areas.

D. The grating cover plate shall be attached to the completed panel of grating by chemical means to ensure integral action of the panel and plate. The panel and grating shall be uniformly clamped together to ensure that all contact surface remain in contact throughout the curing process.

E. Non-slip surfacing: Covered grating shall have a gritted surface.

F. Grating bar intersections are to be filleted to a minimum radius of 1/16” to eliminate local stress concentrations and the possibility of resin cracking at these locations.

G. Fire rating: Grating shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E84. Certifications shall be dated within the past two years and test data performed only on the resin shall not be acceptable.

H. Resin system: The resin system used in the manufacture of the grating shall be Vi-Corr®. Manufacturer may be required to submit corrosion data from tests performed on actual grating products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of grating product corrosion resistance and shall not be accepted.

I. Color: As selected by Owner.

J. Depth: As shown on the drawings and as required to meet design load requirements with a tolerance of plus or minus 1/16".

K. Mesh Configuration of grating: 2" x 2” with a tolerance of plus or minus 1/16" centerline to centerline.

L. Grating Fabrication:

1. Measurements: Grating supplied shall meet the dimensional requirements and tolerances as shown or specified. The Contractor shall provide and/or verify measurements in field for work fabricated to fit field conditions as required by grating manufacturer to complete the work. When field dimensions are not required, contractor shall determine correct size and locations of required holes or cutouts from field dimensions before grating fabrication.

2. Layout: Each covered grating section shall be tied down with appropriate anchors or clips. Manufacturer to provide openings and holes where located on the contract drawings. Grating openings which fit around protrusions (pipes, cables, machinery, etc.) shall be field cut or, when shop fabricated, discontinuous at approximately the centerline of opening so each section of grating is readily removable.

3. Sealing: All shop fabricated grating cuts shall be sealed to provide maximum corrosion resistance. All field fabricated grating cuts shall be coated similarly by the contractor in accordance with the manufacturer's instructions.

4. Hardware: Type 316 stainless steel hold-down clips shall be provided and spaced at a maximum of four feet apart with a minimum of four per piece of grating, or as recommended by the manufacturer.

M. Covered molded grating shall be by Fibergrate Composite Structures Inc. or equal.

2.3 FIBERGLASS GRATING

A. Pultruded FRP grating shall be fabricated from bearing bars and cross rods manufactured by the pultrusion process. The glass fiber reinforcement for the bearing bars shall have a core of continuous glass strand ravings wrapped with a continuous strand glass mat. The outermost layer covering shall be a surface veil to provide a resin-rich surface. Bearing bars shall be interlocked and chemically bonded into place to provide a panel that resists twist forces and prevents internal movement of the bearing bars.

B. Seat Angles: Where grating is supported on concrete members, continuous embedded seat angles shall be provided on all sides. Grating seat angles shall be made of FRP and be as detailed on the Drawings; except that specially manufactured pultruded FRP seat angles intended to be cast in concrete may be submitted for acceptance by the Engineer.

C. Raised Floor Grating: Wherever raised floor grating is indicated, provide a complete system of FRP grating. FRP support legs and seat angles, fastening devices, and other accessories necessary for a complete installation. Grating and supports shall be designed to fit together tightly with no movement when subjected to the design loading. The support legs and grating shall be produced by the same manufacturer and be intended to work together as a unit. The spacing of the legs shall be determined so as not to interfere with piping and equipment and to meet the requirements indicated herein.

D. Color: The color of the grating and seat angles shall be determined by the Owner. The color selected shall result in no additional cost to the Owner.

E. The top surface of all grating shall be provided with a non-slip surface by embedding or bonding grit to the FRP.

F. Penetrations: Cutouts shall be provided where needed for penetrations through the grating. The grating shall be reinforced where necessary to meet the load/deflection requirements despite the cutouts.

G. Dimensional Requirements: When grating is designed to span primarily in one direction, the grating shall be fabricated to span in the shorter span direction, unless indicated otherwise. Individual pieces of grating shall not exceed 80 pounds in weight, unless noted otherwise.

H. Mechanical grating clips shall be manufactured of Type 316 stainless steel. Grating hold-down clips shall be provided, spaced at a maximum of 4 feet apart or as recommended by the manufacturer, whichever is less. A minimum of 4 clips per piece of grating is required.

I. Pultruded FRP grating shall be Safe-T-Span by Fibergrate Composite Structures, Inc.; Corgrate by IKG Industries; Duradek by Strongwell; or equal

2.4 FRP STAIR TREADS

A. Where indicated on the Plans, stair treads shall be of a one-piece molded construction reinforced with continuous rovings.

B. Non-slip surfacing: Stair treads shall be manufactured with either a concave profile on the top of each bar or shall have grit bonded or embedded to provide maximum slip resistance. For additional safety and to meet OSHA requirements, stair treads shall be manufactured with a minimum 1-1/2 inch molded nosing. Nosing shall be bonded with angular grit.

C. Hardware: Type 316 stainless steel hold-down clips shall be provided and spaced as recommended by the manufacturer. A minimum of four hold-down clips shall be required for each tread.

D. FRP stair treads shall be Fibertred by Fibergrate Composite Structures, Inc.; Molded Cortreads by IKG Industries; Duradek Stair Treads by Strongwell; or equal.

2.5 STRUCTURAL SHAPES

A. All structural shapes shall be manufactured by the pultrusion process and have a maximum of 55 percent and a minimum of 45 percent glass content (by weight).

B. Pultruded structural shapes are to have the minimum longitudinal mechanical properties listed below:

Property	Method	Minimum Value	Units
Tensile Stress (Lengthwise)	ASTM D638	30,000	psi
Tensile Modulus (Lengthwise)	ASTM D638	2.5×10^6	psi
Flexural Stress (Lengthwise)	ASTM D790	30,000	psi
Flexural Modulus (Lengthwise)	ASTM D790	1.6×10^6	psi
Short Beam Shear (Lengthwise)	ASTM D2344	4,500	psi
Shear Modulus (Lengthwise)	N/A	0.42×10^6	psi
Coefficient of Thermal Expansion (Lengthwise)	ASTM D696	4.4×10^{-6}	In/in/°F

C. FRP structural shapes shall be Dynaform Fiberglass Structural Shapes by Fibergrate Composite Structures, Inc; Extren by Strongwell; CorLight by IKG Fiberglass Systems; or equal.

PART 3 - EXECUTION

3.1 PRODUCT DELIVERY AND STORAGE

A. Manufactured materials shall be delivered in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer. Adhesives, resins, catalysts, and hardeners shall be crated or boxed separately.

B. All materials shall be carefully handled to protect them from abrasion, cracking, chipping, twisting, deformations, and other types of damage. Store items in an enclosed area and free from contact with soil and water. Store adhesives, resins, catalysts, and hardeners in dry indoor storage facilities between 70 and 85 degrees Fahrenheit. There shall be labels on the outside of the boxes indicating that the products shall be stored as described above.

3.2 GENERAL

A. FRP products shall meet the dimensional requirements and tolerances indicated. The Contractor shall verify measurements and determine correct size and locations of required holes or cutouts from field dimensions before fabrication.

B. FRP products shall be fabricated free from warps, twists, or other defects which affect appearance and serviceability.

C. The Contractor shall give ample notice prior to the beginning of any fabrication work so that the Engineer can perform shop inspections.

D. The Contractor shall install FRP structures in accordance with the manufacturer's assembly drawings. Field cut and drill FRP products with carbide or diamond tipped bits and blades. Seal cut or drilled surfaces in accordance with manufacturer's instructions. Follow manufacturer's instructions when cutting or drilling fiberglass products or using resin products.

E. Bonding of FRP items shall be through the use of an epoxy adhesive recommended by the manufacturer of the particular item. The surfaces to be bonded shall be solvent cleaned and abraded sufficiently to remove the surface gloss and to remove any mold release agent or other contaminants which may interfere with proper bonding. The adhesive manufacturer's instructions and recommendations shall be followed. The items bonded shall not be stressed until at least 48 hours have passed.

3.3 GRATING

A. Layout: Each grating section shall be readily removable, except where indicated. As much as possible, manufacturer shall provide openings and holes where indicated on the Contract Drawings. Grating openings which fit around protrusions (pipes, cables, machinery, etc.) shall be discontinuous at approximately the centerline of opening so each section of grating is readily removable. Gaps between the grating and adjacent walls or equipment shall not be greater than 2-inches.

B. Install the grating with a minimum 1-1/2 inch bearing surface at the support ends.

C. Tolerances between sections shall provide for not more than 1/4 inch clearance between adjacent sections or between grating and frames. Adjacent sections shall line up to form an uninterrupted straight line, where possible.

D. The grating shall be as free, as commercially possible from visual defects such as foreign inclusions, delamination, blisters, resin burns, air bubbles, and pits. The surface shall have a smooth finish (except for non-slip surfaces).

E. Seat angles shall be mitered and bonded at corners to produce smooth, even, level seating surface.

F. Grating shall be installed so that the top surface is level and even with adjacent walking surfaces. There shall be no protrusions above the top surface.

G. All grating shall be fastened to supports.

3.4 STRUCTURAL SHAPES

A. Measurement: The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of Work. The Contractor shall review the Drawings, and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

B. Fabrication: Structural FRP shall be fabricated in accordance with the Drawings and as indicated on the Shop Drawings. Materials shall be properly marked and match-marked for field assembly. Where finishing is required, assembly shall be completed including bolting before starting of finishing operations.

C. Connections: Shop and field connections shall be bonded and bolted as indicated. Unless indicated otherwise, connections shall develop full strength of members joined.

D. Holes for other Work: Holes shall be provided as necessary or as indicated for securing other work to FRP framing, and for the passage of other Work through FRP members. Threaded nuts shall be epoxied to framing, and other specialty items as indicated to receive other Work. Field cuts and drilled edges shall be sealed with a resin compatible with the original resin and recommended by the manufacturer. The sealing of the edges shall prevent premature fraying at the field cut edges.

E. Erection: Anchor bolts and other connectors required for securing structural FRP to in-place Work and templates and other devices for presetting bolts and other anchors to accurate locations shall be furnished by the Contractor. The Contractor shall be responsible for designing and installing any temporary bracing required for the safe erection of all structural FRP members.

F. Setting bases and bearing plates: Prior to the placement of non-shrink grout beneath base and bearing plates, the bottom surface of the plates shall be cleaned of all bond-reducing materials. Concrete and masonry bearing surface shall also be cleaned of all bond-reducing materials and be roughened to improve bonding.

1. Loose and attached base plates and bearing plates for structural members shall be set on wedges, leveling nuts, or other adjustable devices.

2. Anchor bolts shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its required strength.

3. Base plates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure.

G. Field Assembly: Structural frames shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before permanent fastening. Bearing surfaces and other surfaces that will be in permanent contact shall be cleaned before assembly. Necessary adjustments to compensate for discrepancies in elevations and alignments shall be performed. Individual members of the structure shall be leveled and plumbed within required tolerances. The Contractor shall provide and install all temporary bracing required until the structure is complete.

H. Misfits at Bolted Connections: Where misfits in bolting are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated. Methods of remedy may include, but are not limited to the following:

1. Reaming holes that must be enlarged to admit oversized bolts.

2. Drilling additional holes in the connection, to conform to manufacturer's standards for bolt spacing, end, and edge distances, and adding additional bolts.

3. Rejecting the improperly fabricated member and fabricating a new member to ensure proper fit.

4. Mid-sized or misaligned holes in members shall not be enlarged by burning of by the use of drift pins.

5. The Contractor shall pay costs associated with the repair of misfits.

END OF SECTION 06 70 00

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SECTION 07 11 13 – BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and apply cold-applied asphalt emulsion damp-proofing at all below grade structures, including precast structures used for wetwells, manholes and valve/meter vaults, as specified herein.

1.2 REFERENCE STANDARDS

A.	ASTM D449	Standard Specification for Asphalt Used in Dampproofing and Waterproofing
B.	ASTM D1187	Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal
C.	ASTM D1227	Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing
D.	NRCA (WM)	The NRCA Waterproofing Manual

1.3 SUBMITTALS

A. Submit manufacturer's technical product data in accordance with Section 01 33 00 – Submittal Procedures. Shop drawing information shall include installation instructions, and recommendations for each damp-proofing material required. Provide properties of primer, bitumen, and mastics.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Applier shall be a firm which has specialized for no less than three years in installation of types of damp-proofing required for this project and which is acceptable to manufacturer of primary materials.

B. Warranty: Furnish a written warranty for unconditional water-tightness for a period of two years from the date of substantial completion.

1.5 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees Fahrenheit for 24 hours before and during application until dampproofing has cured.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Bituminous Dampproofing: Cold-applied water-based emulsion; asphalt with mineral colloid or chemical emulsifying agent; with or without fiber reinforcement; asbestos-free; suitable for application on vertical and horizontal surfaces.

1. Composition – Vertical Application: ASTM D1227 Type III or ASTM D1187 Type I

2. VOC Content: Not more than permitted by Local, State and Federal Regulations

3. Applied Thickness: 1/16-inch, minimum, wet film.

B. Dampproofing Protection Course: multi-ply, semi-rigid core manufactured in accordance with ASTM D6506.

1. Thickness: 0.220-inch minimum.

2. Puncture Strength: 82 pound minimum.

3. Bituminous dampproofing and protection course to be by same manufacturer or dampproofing manufacturer’s recommendations.

2.2 MANUFACTURER

A. The approved manufacturer shall be subject to compliance with specified requirements:

1. Celotex Corporation

2. Manville Building Products Corp.

3. Tamko Asphalt Products, Inc.

4. Tremco Company

5. W.R. Meadows, Inc.

6. Or equal

PART 3 - EXECUTION

3.1 PREPARATION

A. Proceed with damp-proofing work only when existing and forecasted weather conditions permit work to be performed in accordance with manufacturer’s recommendations.

B. Provide adequate ventilation to prevent accumulation of hazardous fumes during application of solvent-based components in enclosed spaces and maintain ventilation until coatings have thoroughly cured.

C. Clean substrate of projections and substances detrimental to work; comply with recommendations of prime materials manufacturer. Fill voids, seal joints, and apply bond breakers (if any) as recommended by prime materials manufacturer, with particular attention at construction joints.

3.2 APPLICATION

A. Comply with manufacturer's instructions as to application rates and application methods.

B. Apply damp-proofing to all exterior below grade surfaces of exterior underground walls of building structures, tanks, and precast structures in contact with earthwork or other backfill, in any situation where space of any kind is enclosed on opposite side. Extend over top of footing and turn down minimum of 6 inches over outside face of footing

C. Extend vertical damp-proofing down walls from finished grade line to top of footing. Extend 12 inches onto intersecting walls and footings, but do not extend onto surfaces which will be exposed to view when project is completed.

D. Install protection course as indicated by manufacturer's recommendations over completed and cured damp-proofing to protect the damp-proofing from damage during backfilling. Comply with damp-proofing materials manufacturer's instructions for support or attachment of protection materials. Protection course is not required on precast manholes and vaults.

END OF SECTION 07 11 13

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SECTION 07 21 00 – THERMAL PROTECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install building insulation as shown on the drawings and as specified herein. Applications of insulation specified in this section include the following

1. Board insulation at perimeter foundation wall (polystyrene) (supporting backfill).

2. Cavity wall insulation

1.2 REFERENCE STANDARDS

A. HH-I-1972/1 Insulation Board, Thermal, Polyurethane or Polyisocyanurate, Faced With Aluminum Foil on Both Sides of the Foam

B. L-P-375C(3) Plastic Film, Flexible, Vinyl Chloride

C. TT -5-001657 Sealing Compound, Single Component, Butyl Rubber Based, Solvent Release Type (For Buildings and Other Types of Construction)

D. ASTM C578 – Specification for Rigid, Cellular Polystyrene Thermal Insulation

E. ASTM C665 – Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

F. ASTM C1136 – Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation

G. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Material

H. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.

I. ASTM D2626 Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing

J. ANSI/ASTM A653 – General Requirements for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

K. ANSI/ASTM D41 – Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

1.3 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirement of Section 01 33 00 – Submittal Procedures.

B. Product Data: Provide data on product characteristics, performance criteria, product limitations, and formaldehyde content.

1. Provide documentation indicating levels of formaldehyde content and Greenguard certification. Provide independent third-party verification.

C. Manufacturer’s Information: Manufacturer's literature, specifications, installation instructions, technical data, and general recommendations for the vapor retarder materials shall be submitted.

D. Manufacturer's Certification: Certify that products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Thermal Resistivity: Where thermal resistivity properties of insulation materials are designated by R-values, they represent the rate of heat flow through a homogenous material exactly 1-inch thick, measured by test method included in referenced material standard or otherwise indicated. They are expressed by the temperature difference in degrees Fahrenheit between the two exposed faces required to cause one BTU to flow through on square foot per hour at mean temperatures indicated.

B. Fire Performance Characteristic: Provide insulation materials which are identical to those whose fire performance characteristics, as listed for each material or assembly of which insulation is a part, have been determined by testing, per methods indicated below, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction.

1. Surface Burning Characteristics: ASTM E84.

2. Fire Resistance Ratings: ASTM E119.

3. Combustion Characteristics: ASTM E136.

PART 2 - PRODUCTS

2.1 GENERAL

A. The materials and application of building insulation shall conform to the applicable requirement of the Underwriters Laboratories, Fire Resistance Index, Factory Mutual requirements, manufacturer's printed recommendations and specifications, and Federal specifications.

B. Thermal and acoustical insulation shall have a flame-spread rating of 25 or less and a smoke density not exceeding 450 when tested in accordance with ASTM E84.

C. Provide insulating materials which comply with requirements indicated for materials, compliance with referenced standards, and other characteristics.

D. Sizes to fit applications indicated, selected from manufacturer's standard thickness, widths and lengths.

2.2 MATERIALS

A. Batt Insulation: Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used at Contractor's option.

1. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit

a. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any

b. Formaldehyde Content: Zero

c. Thermal Resistance: as indicated on plans, minimum

d. Facing: Aluminum foil, flame spread 25 rated; one side

2. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 when tested in accordance with ASTM E84

a. Smoke Developed Index: 0, when tested in accordance with ASTM E84

b. Thermal Resistance: as indicated on plans, minimum

B. Below-grade Insulation: Below-grade insulation at floor slabs, footings, and foundation walls shall be 2-inch thick rigid expanded polystyrene "Styrofoam- thermal insulation conforming to Federal Specification HH-I-524C, Type II, Class B. Insulation shall have a minimum compressive strength of 25 psi, maximum water vapor transmission rate of 1.5 perm-in, density of 1.5 pounds per cubic foot and an -R- value of 5 per inch of thickness. Acceptable manufacturers include Amoco Foam Products Co., Dow Chemical U.S.A., Minnesota Diversified Products, Inc., and UC Industries.

C. Foam in Place Insulation: Foam in place insulation shall be a tripolymer product using a phenol based synthetic polymer. The system shall consist of two components: an aqueous resin solution and a foaming catalyst. The two components shall be mixed with compressed air to produce a foam in place operation. Provide foam-in-place insulation as manufactured by C.P. Chemical Co., Inc. or Equal

D. Thermal Spacer Blocks: Fabricated from extruded polystyrene, 1-inch

2.3 ACCESSORIES

A. Fasteners: Fasteners shall be per written recommendations of the manufacturer of the insulating materials.

B. Aluminum Foil Tape: Aluminum foil tape shall be 2 inches wide "Aluma-Grip No. AF7-701" manufactured by Hardcast, Inc. (800-527-7092), or equal.

C. Concrete Primer: Concrete primer shall conform to ANSI ASTM D41.

D. Vapor Retarder Membrane System for Walls and Ceilings: See Section 07 25 00 – Weather Barriers for membrane requirements.

E. Foam Sealant: Provide one of the following at perimeter window and door shim spaces and crevices in exterior wall and roof:

1. One-component, minimally expanding, low pressure-build, polyurethane foam sealant.

2. Closed cell, medium density spray applied polyurethane foam insulation and air barrier.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with manufacturer's instruction for particular conditions of installation in each case. If printed instructions are not available or do not apply to protect conditions, consult manufacturer's technical representative for specific recommendations before proceeding with Work.

B. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.

C. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

D. Extend insulation full thickness as shown over entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections which interfere with placement.

E. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

3.2 DELIVERY AND STORAGE

A. Protection insulation (minimum level B or better) during delivery and store against moisture absorption or other damage. Reject material with broken wrappers or cartons.

3.3 INSTALLATION AND PREPARATION

A. Insulation shall be installed in accordance with the manufacturer's printed installation instructions.

B. Require Installer to examine substrates and conditions under which insulation work is to be performed. A satisfactory substrate is one that complies with requirements of the section in which substrate and related work is specified. Obtain Installer's written report listing conditions detrimental to performance of Work in this Section. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

C. Clean substrates of substances harmful to insulation or vapor retarders, including removal of projections which might puncture vapor retarders.

D. Blocking for wall-mounted items and items installed within furring and walls shall be securely installed prior to installation of insulation.

E. Extruded polystyrene foam board insulation shall be secured by construction adhesive.

F. Below-grade insulation shall have insulation protective board installed between below-grade insulation and backfill.

G. Insulation shall be installed to provide maximum sound and thermal benefits for material specified. The insulation shall be installed to completely fill or cover voids between furring studs, providing a continuous blanket of insulation. Insulation shall be cut neatly to snugly fit angles, corners and irregular areas and carefully wrapped around pipes, conduits, outlets, switches, beams, etc., to maintain continuity of insulation. Gaps or bridges shall be avoided. Insulation shall be tight fitting batts and shall be secured as recommended by the Code and the material manufacturers for job conditions.

H. Vapor retarder shall be installed continuously on the warm side of insulation.

3.4 INSTALLATION OF FOAM IN PLACE INSULATION

A. Foam in place insulation shall be installed by an applicator certified by the product manufacturer using special equipment for installation of the foam product.

END OF SECTION 07 21 00

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SECTION 07 22 16 – ROOF BOARD INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Flat Polyisocyanurate Roof Insulation.

B. Tapered Polyisocyanurate Roof Insulation.

1.2 RELATED SECTIONS

A. Section 07 54 23 – Thermoplastic Polyolefin Roofing.

1.3 REFERENCES

A. ASTM C 209 - Methods of Testing Insulating Board, Structural and Decorative.

B. ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

C. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Thermal Insulation Board.

1.4 SYSTEM DESCRIPTION

A. Performance Requirements:

1. UL Assemblies:

a. Component of Class A Roof System - UL 790.

2. Factory Mutual:

a. FM Class 1 approval for steel roof deck constructions, Class 1 Fire and 1-60 and 1-90 windstorm classification (FM 4450).

B. Physical properties (Foam Core Only):

1. Compressive Strength: ASTM D 1621 and ASTM C 1289, Type II, 20 psi minimum for Grade 2.

2. Dimensional Stability: ASTM D 2126, 2 percent linear change (7 days).

3. Moisture Vapor Transmission: ASTM E 96, < 1 perm.

4. Water Absorption: ASTM C 209, < 1 percent by volume.

5. Service Temperature: Minus 100 degrees to 250 degrees F.

6. Foam Core R Values: Based on LTTR (Long-Term Thermal Resistance) in accordance with ASTM C 1289.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.

3. Installation methods.

C. Shop Drawings: Roof plan showing slopes, layout of boards and fastening patterns.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Roof Board Insulation: Provide products that comply with the following:

1. ASTM standards specified.

2. Factory Mutual (FM) approvals specified.

3. Underwriters Laboratories Inc. (UL) classifications specified.

B. Flat Foam Roof Insulation with Fiber-Reinforced Facers: H-Shield; closed-cell polyisocyanurate foam core bonded to fiber-reinforced facers on both sides; conforming to ASTM C 1289, Type II, Class 1 with square edges.

1. Fire Ratings:

a. UL 790 (ASTM E 108), Class A.

2. FM Approval, Wind Uplift Classification: 1-60.

3. Compressive Strength: 20 pounds per square inch (138 kPa) Grade 2.

4. R Value: Provide Insulation with LTTR (Long Term Thermal Resistance) in accordance with ASTM C 1289. Minimum thickness of panels shall be as follows:

a. Min thickness 4.00 inch (76 mm), R Value 17.4, flute spanability 4-3/8 inches (111.13 mm).

C. Tapered Foam Roof Insulation with Coated Glass Facers: H-Shield-CG; sloped closed-cell polyisocyanurate foam core and bonded to high performance coated glass facers on both sides, conforming to ASTM C 1289, Type II, Class 2 with square edges.

1. Fire Ratings:

    a. UL 1256, No. 120 and 123.

    b. UL 790 (ASTM E 108), Class A.

2. FM Approval, Wind Uplift Classification: 1-60.

3. Compressive Strength: 20 pounds per square inch (138 kPa) Grade 2.

4. Slope of tapered board shall be:

    a. 1/2 inch (12.5 mm) per foot.

5. R Value: Provide Insulation with LTTR (Long Term Thermal Resistance) in accordance with ASTM C 1289.

    a. Minimum insulation thickness: 4”

2.2 ACCESSORIES

A. Approved Fasteners: Appropriate for purpose intended and approved by FM Approvals and system manufacturer; length required for thickness of insulation material and penetration of deck substrate, with distribution plates if required.

B. Base Ply: As recommended by membrane manufacturer.

C. Asphalt Bitumen: ASTM D 312, Type III, or Type IV.

1. Use only on approved board insulation types.

2. Provide with labels indicating flash point, softening point, finished blowing temperature and equiviscous temperature.

D. Cant Strip and Tapered Edge Strip: Standard machine cut perlite or wood fiberboard strips in sizes indicated or required.

PART 3 - EXECUTION

3.1 PREPARATION

A. Do not begin installation until substrates have been properly prepared.

B. Examine roof deck for suitability to receive insulation. Verify that substrate is dry, clean, and free of foreign material that will damage insulation installation.

C. Verify that roof drains, scuppers, roof curbs, nailers, equipment supports, vents, and other roof accessories are secured properly and installed in conformance with drawings and submittals.

D. Verify that deck is structurally sound to support installers, materials, and equipment without damaging or deforming work.

E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 INSTALLATION

A. Install specified insulation in accordance with manufacturer's latest printed instructions and as required by governing codes and Owner's insurance carrier.

B. Do not leave installed insulation exposed to weather. Cover and waterproof immediately after installation.

C. Seal exposed insulation joints at the end of each day. Remove seal when work resumes.

D. Remove installed insulation that has become wet or damaged and replace with new solid and dry insulation material.

E. Mechanically Attached Systems:

1. Each H-Shield panel must be secured to the roof deck with Factory Mutual approved fasteners and plates (appropriate to the deck type).

2. Butt edges and stagger joints of adjacent panels.

3. In multi-layer installations, stagger joints in top and bottom layers. Do not align joints in insulation.

4. Install the roof covering according to the roof manufacturer's specifications.

5. Multi-layer systems: Adhere subsequent layers with FM approved cold adhesive.

6. In multi-layer installations, stagger joints in top and bottom layers. Do not align joints in insulation.

7. Install the roof covering according to the roof manufacturer's specifications.

END OF SECTION 07 22 16

SECTION 07 25 00 – WEATHER BARRIERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install water-resistive air barrier: Under wall cladding, over sheathing and other substrate, not airtight or vapor retardant.

B. Furnish and install Vapor Retarders: Materials to make exterior walls, joints, between exterior walls and roof, and joints around frames of openings in exterior walls water vapor resistant and airtight.

1. Installed on interior of wall, under interior gyp board or interior sheathing.

C. Furnish and install vapor barrier under concrete slabs on grade.

1.2 REFERENCE STANDARDS

A. AATCC Test Method 127 - Water Resistance: Hydrostatic Pressure Test; 2018.

B. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications; 2016.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.

D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

E. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.

F. ICC-ES AC148 - Acceptance Criteria for Flexible Flashing Materials; 2017.

G. ASTM E1745-17 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

H. ASTM E1643-18a Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

I. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

J. ACI 302.1R-15 Guide to Concrete Floor and Slab Construction.

1.3 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirement of Section 01 33 00 – Submittal Procedures.

B. Product Data: Provide data on material characteristics.

PART 2 - PRODUCTS

2.1 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

A. Air Barrier Sheet, Mechanically Fastened:

1. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.

2. Water Vapor Permeance: 5 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure A (Desiccant Method) at 73.4 degrees F.

3. Water Penetration Resistance: Withstand a water head of 21 inches, minimum, for minimum of 5 hours, when tested in accordance with AATCC Test Method 127.

4. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 180 days of weather exposure.

5. Surface Burning Characteristics: Flame spread index of 25 or less, and smoke developed index of 50 or less, when tested in accordance with ASTM E84.

6. Seam and Perimeter Tape: Polyethylene self-adhering type, mesh reinforced, 2 inches wide, compatible with sheet material; unless otherwise specified.

7. Manufacturers:

a. DuPont de Nemours, Inc; Tyvek Commercial Wrap with accessories: www.dupont.com/#sle.

b. Fiberweb, Inc; Typar MetroWrap: www.typar.com/#sle.

c. Fortifiber Building Systems Group; WeatherSmart: www.fortifiber.com/#sle.

d. Kingspan Insulation LLC; GreenGuard RainDrop Building Wrap: www.trustgreenguard.com/#sle.

e. VaproShield, LLC; WrapShield IT - Integrated Tape: www.vaproshield.com/#sle.

2.2 VAPOR RETARDER MATERIALS (AIR BARRIER AND WATER-RESISTIVE)

A. Vapor Retarder Sheet: ASTM D4397 polyethylene film reinforced with glass fiber square mesh, clear.

1. Thickness: 10 mil, 0.010 inch.

2. Water Vapor Permeance: 0.076 perms, as required by referenced standard for thickness specified.

3. Seam and Perimeter Tape: Polyethylene self-adhering type, mesh reinforced, 2 inches wide, compatible with sheet material.

2.3 VAPOR RETARDER MATERIALS UNDER SLAB

A. Under Slab Vapor Barrier: Provide 4-ply linear low-density polyethylene and nylon yarn laminate where shown on the Drawings. Yarn shall be suspended in a permanently flexible adhesive media. Vapor barrier shall have the following characteristics:

1. Weight: 80 pounds per 1000 square feet

2. Puncture Propagation Tear: 55 pounds

3. Permeance: 0.038 grains/hr-ft^2-in Hg

4. Drop Dart: 2,900 grams

5. Tensile Strength: 220 pounds per 1,220 pounds per square inch

6. Puncture Strength: 102 pounds

7. Surface Burning Resistance: Class A

8. Smoke Developed Rating: N/A

9. Usable Temperature Range: -25 degrees to 170 degrees Fahrenheit

2.4 ACCESSORIES

A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.

B. Flexible Flashing: Sheathing fabric saturated with air barrier coating and complying with the applicable requirements of ICC-ES AC148.

C. Sill Plate Sealer: Closed-cell foam tape with rubberized adhesive membrane; bridges gap between foundation structure and sill plate or skirt board.

1. Width: 3-1/2 inches.

2. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 30 days of weather exposure.

D. Vapor Retarder Tape: Coated polyester film with acrylic adhesive backing; pressure sensitive.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the work of this section.

3.2 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

3.3 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Air Barriers: Install continuous airtight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

C. Vapor Retarders: Install continuous airtight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

D. Mechanically Fastened Sheets - On Exterior:

1. Install sheets shingle-fashion to shed water, with seams generally horizontal.

2. Overlap seams as recommended by manufacturer but at least 6 inches.

3. Overlap at outside and inside corners as recommended by manufacturer but at least 12 inches.

4. For applications specified to be airtight, seal seams, laps, penetrations, tears, and cuts with self-adhesive tape; use only large-headed, gasketed fasteners recommended by the manufacturer.

5. Install air barrier and vapor retarder underneath the jamb flashings.

6. Install head flashings under weather barrier.

7. At openings to be filled with frames having nailing flanges, wrap excess sheet into opening, at head, seal sheet over flange and flashing.

E. Mechanically Fastened Sheets - Vapor Retarder On Interior:

1. When insulation is to be installed in assembly, install vapor retarder over insulation.

2. Seal seams, laps, perimeter edges, penetrations, tears, and cuts with self-adhesive tape, making airtight seal.

3. Locate laps at a framing member; at laps fasten one sheet to framing member then tape overlapping sheet to first sheet.

4. Seal entire perimeter to structure, window and door frames, and other penetrations.

5. Where conduit, pipes, wires, ducts, outlet boxes, and other items are installed in insulation cavity, pass vapor retarder sheet behind item but over insulation and maintain airtight seal.

F. Openings and Penetrations in Exterior Weather Barriers:

1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.

2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.

3. At openings to be filled with non-flanged frames, seal weather barrier to each side of opening framing, using flashing at least 9 inches wide, covering entire depth of framing.

4. At head of openings, install flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather barrier to flashing.

5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.

6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

G. Vapor Retarder Under Slab:

1. Install vapor barrier in accordance ASTM E1643.

2. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.

3. Extend vapor barrier to the perimeter of the slab.

4. Seal vapor barrier to the entire perimeter wall or footing/grade beam with double sided Tape per manufacturer’s instructions. Ensure the concrete is clean and dry prior to adhering tape.

5. Overlap joints 6 inches and seal with manufacturer’s seam tape.

6. Apply seam tape to a clean and dry vapor barrier.

7. Seal all penetrations (including pipes) per manufacturer’s instructions.

8. For interior forming applications, avoid the use of non-permanent stakes driven through vapor barrier.

9. If non-permanent stakes must be driven through vapor retarder, repair as recommended by vapor retarder manufacturer.

10. Use reinforcing bar supports with base sections that eliminate or minimize the potential for puncture of the vapor barrier.

11. Repair damaged areas with vapor barrier material of similar (or better) permeance, puncture and tensile.

12. For vapor barrier-safe concrete screeding applications, install screed protections system per manufacturer's instructions prior to placing concrete.

3.4 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by Manufacturer.

END OF SECTION 07 25 00

SECTION 07 30 10 - ROOFING UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies underlayment for sloped roofs.

1. Self-adhering sheet membrane

2. Asphalt saturated felt membrane

B. Related Sections: Refer to the following specification sections for coordination:

1. Section 061000 - Rough Carpentry.

2. Section 076100 - Sheet Metal Roofing.

C. Referenced Standards: Comply with the requirements of the following standards published by ASTM International to the extent referenced in this section.

1. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.

2. ASTM D461 - Standard Test Methods for Felt.

3. ASTM D 903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.

4. ASTM D1970 - Standard Specification for Self - Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

5. ASTM D3767 - Standard Practice for Rubber — Measurement of Dimensions.

6. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

7. ASTM G90 – EMMAqua test.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with requirements of authorities having jurisdiction and applicable codes at the location of the project.

B. Manufacturer: Minimum 10 years’ experience producing roofing underlayment.

C. Installer: Minimum 2 years' experience with installation of similar underlayment.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in unopened factory labeled packages. Protect from damage.

B. Cover materials and store in dry condition between temperatures of 40 and 90 degrees F (5 and 32 degrees C). Use within one year of date of manufacture. Do not store at elevated temperatures as that will reduce the shelf life of the product.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Self - Adhering Sheet Membrane Roof Underlayment: Provide Ice and Water Shield with the following characteristics:

1. Material: Cold applied, self-adhering membrane composed of a high strength polyethylene film coated on one side with a layer of rubberized asphalt adhesive and interwound with a disposable release sheet. An embossed, slip resistant surface is provided on the polyethylene.

2. Membrane Thickness: 40 mil (1.02 mm) ASTM D3767 procedure A (Section 9.1).

3. Tensile Strength, Membrane: 250 psi (1720 kN/m2) ASTM D412 (Die C modified).

4. Elongation, Membrane: 250% ASTM D412 (Die C modified).

5. Low Temperature Flexibility: Unaffected @ - 20°F (-29°C) ASTM D1970.

6. Adhesion to Plywood: 3.0 lbs/in. width (525 N/m) ASTM D903.

7. Permeance (Max): 0.05 Perms (2.9 ng/m2s Pa) ASTM E96.

8. Material Weight Installed (Max): 0.3 lb/ft2 (1.3 kg/m2) ASTM D461.

9. Service Temperature: 180 degrees F (82.2 degrees C) per ASTM D1204

10. Code and Standards Compliance: Ice and Water Shield meets the following:

a. Underwriters Laboratories Inc. Class A fire classification under fiber - glass shingles and Class C under organic felt shingles (per ASTM E108/UL 790).

b. International Conference of Building Officials (ICBO-ES) Report No. 3997.

B. Asphalt Saturated Felt Membrane

1. Material: Asphalt saturated felt underlayment

2. Thickness: 30# felt membrane, 0.03” thick

3. Adhesion: Mechanically attached per manufacturer’s recommendations

4. Standards Compliance:

a. ASTM D-4869 Type II

PART 3 - EXECUTION

3.1 EXAMINATION

A. A. Prior to start of installation, inspect existing conditions to ensure surfaces are suitable for

B. installation of roofing underlayment. Verify flashing has been installed. Starting work indicates installers acceptance of existing conditions.

3.2 INSTALLATION

A. A. Installation:

1. Install roofing underlayment on sloped surfaces at locations indicated on the

2. Drawings:

a. Install asphalt saturated felt underlayment as shown on the Drawings.

b. Install self-adhered underlayment membrane as shown, but not at less than at hips, ridges, eaves, valleys, sidewalls and chimneys, and surfaces over interior space within 36 inches (914 mm) from the inside face of the exterior wall. Strictly comply with manufacturer’s installation instructions including but not limited to the following:

1) Schedule installation such that underlayment is covered by roofing within the published exposure limit of the underlayment.

2) Do not install underlayment on wet or frozen substrates.

3) Install when surface temperature of substrate is a minimum of 40 degrees F (5 degrees C) and rising.

4) Remove dust, dirt, loose materials and protrusions from deck surface.

5) Install membrane on clean, dry, continuous structural deck. Fill voids and damaged or unsupported areas prior to installation.

6) Install membrane such that all laps shed water. Work from the low point to the high point of the roof at all times. Apply the membrane in valleys before the membrane is applied to the eaves. Following placement along the eaves, continue application of the membrane up the roof. Membrane may be installed either vertically or horizontally after the first horizontal course.

7) Side laps minimum 3-1/2 inches (89 mm) and end laps minimum 6 inches (152mm) following lap lines marked on underlayment.

8) Patch penetrations and damage using manufacturer's recommended methods.

3.3 CLEANING AND PROTECTION

A. Protection: Protect from damage during construction operations and installation of roofing materials. Promptly repair any damaged or deteriorated surfaces.

B. Repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired in the opinion of the Engineer.

C. Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protective film and reclean as necessary immediately before final acceptance.

END OF SECTION

SECTION 07 40 00 – ROOFING AND SIDING PANELS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install architectural roof, wall and soffit preformed steel panels as shown on the drawings and as specified herein. All metal panel products shall be provided by a single manufacturer.

1.2 REFERENCE STANDARDS

A. The Design shall comply with the 2018 International Building Code (IBC).

B. AISI S100 – Specification for the Design of Cold-Formed Steel Structural Members

C. AISC Steel Construction Manual

D. ASTM A653 – Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

E. ASTM A924 – Specification for General Requirement for Steel Sheet, Metallic-Coated by the Hot-Dip Process

F. ASTM D1790 – Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection

G. ASTM E283 – Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen”

H. ASTM E331 – Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform Static Air Pressure Difference

I. NRCA MS104 – The NRCA Roofing Manual: Steep-slope Roof Systems

J. SMACNA (ASMM) – Architectural Sheet Metal Manual

K. UL 263 – Standard for Fire Tests of Building Construction and Materials

L. Coating Performance Reference Standards

M. Manufacturer’s Standards: In addition to the standards listed above, all roof, wall, soffit panels, and their related accessories shall be in accordance with the manufacturer’s published recommendations and specifications.

1.3 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Summary of test results, indicating compliance with specified requirements.

2. Storage and handling requirements and recommendations.

3. Installation methods.

4. Specimen warranty

C. Shop Drawings: Include layouts of roof, wall, and/or soffit panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.

1. Show work to be field-fabricated or field-assembled.

2. Indicate erection procedures and accessories required.

D. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of colors and patterns.

E. Verification Samples: For each panel system specified, submit samples of minimum size 12-inches square, representing actual metal thickness, profile, color, and texture.

1. Include typical panel joint in sample.

F. Maintenance Data: Include metal panels in maintenance manuals.

G. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 10 years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 10 years of documented experience.

1. The roofing applicator shall be thoroughly experienced and upon request be able to provide evidence of having at least 5 years successful experience installing metal panel roofing systems similar to the specified system and having installed at least four roofing application of similar systems of equal or greater size within the last 12 months.

2. Crew Experience and Supervision: Provide adequate number of experienced workmen regularly engaged in this type of work who are skilled in the application techniques of the materials specified. Provide at least one thoroughly trained and experienced foreman/superintendent on the job at all times roofing work is in progress.

C. Perform Work in accordance with NRCA MS104 – NRCA Roofing Manual and manufacturer's instructions.

1.5 WARRANTY

A. Finish Warranty: Provide manufacturer's special warranty covering failure of factory-applied exterior finish on metal roof panels and agreeing to repair or replace panels that show evidence of finish degradation, including significant fading, chalking, cracking, or peeling within specified warranty period of 20 years from Date of Substantial Completion.

B. Warrant steel panel core substrate against rupture, structural failure, or perforation due to exposure to normal atmospheric corrosion within a 25 year period after Substantial Completion.

C. Waterproofing Warranty: Provide manufacturer's warranty for weathertightness of roofing system, including agreement to repair or replace roofing that fails to keep out water within specified warranty period of 20 years from Date of Substantial Completion.

1. The warranty shall have a maximum 2 year installer's obligation for weathertightness from Substantial Completion and shall not be tied to or reset by the occurrence of leaks within that or any other period.

2. Pro-rated Systems Warranties are not acceptable.

3. The warranty shall be from the manufacturer of the metal panel, not a marketer. No rebranded products shall be accepted.

4. The warranty shall include the full assembly, including, but not limited to: metal panels, associated flashings, insulation, vapor barrier, fasteners, clips, etc.

5. The warranty shall contain no exclusion or limitation for improper installation.

6. Warranty coverage shall not be excluded for roof slopes down to and including 1:12.

7. Manufacturer shall ultimately provide warranty responses in the event installer/contractor fails to.

PART 2 - PRODUCTS

2.1 PANELS

A. Soffit Panels:

1. Soffit panels shall be coated metal panels consisting of a concealed fastener soffit system for long overhang soffits. Installation shall be with framing system, girts or a solid substructure. No fasteners shall be visible after installation. The special locks shall prevent slipping of the panel. Provide smooth solid panels and lanced panels for ventilation where soffit vents are shown on the drawings. Install the strip first, followed by the J channel and soffit panel.

2. Soffit panels shall be fabricated with a concealed fastening system. Panel width shall be 12 inches. Panel lengths shall be cut to proper length to fit the installation requirements. The soffit panels shall be rollformed from minimum 24-gauge steel. Panel depth shall be a minimum of 7/16-inches.

B. Roof Panels: Factory-formed panels with factory applied finish.

1. Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.

2. Profile Configuration: Batten Seam Metal Roof: Vertical 2-inch-high seams with 12-inch panel width and 2-inch-high battens. Minimum 24-gauge panels with striations.

3. Length: Provide panels in the maximum length recommended by the manufacturer to minimize end laps.

4. Panel: The panel shall be a non-structural panel with batten style seams between the panels.

C. Profile Composition:

1. Base Metal:

a. Material: Steel conforming to ASTM A792 Grade 50 (D) with a minimum yield strength of 50,000 psi. and thickness not less than 24-gauge.

b. Protective Coating: Galvanized G-90 coating in accordance with ASTM A653 and coated with a paint system specified below.

2. Coating:

a. Paint system: Signature 300™ 0.8 mil 70% resin finish coat applied over a 0.2 mil baked-on base primer to a total film thickness of 1.0 mil.

b. Color selected by Owner from manufacturer’s standard or premium color chips.

D. Concealed-Clips:

1. Material: 20-gauge galvanized steel.

   Configuration: Clips shall be designed to fix as concealed fasteners, and fully engage the rib of every panel.

E. Fasteners:

1. Clip Fasteners: Follow manufacturer's recommendations for clip attachment to the substrate shown on the drawings. Batten style cover over the seams to conceal the fastening.

2. Other Fasteners: Self-drilling or self-tapping screws or stainless steel pop rivets painted to match the panels where visible, per the panel manufacturer's recommendations.

F. Flashing and Trim:

1. Flashing and/or trim shall be supplied at rakes, high and low eaves, corners, bases, framed openings and as required or specified to provide weathertightness and/or a finished appearance.

2. Standard trim configurations and/or finishes for given conditions shall be determined by the specific roof and wall panel system and finish combinations.

3. Trim finish shall be paint system Signature 300™ 0.8 mil 70% resin finish coat applied over a 0.2 mil baked-on base primer to a total film thickness of 1.0 mil. Color of the exterior finish shall be selected by the Owner/Engineer from the manufacturer's standard or premium colors.

G. Mastics and Sealants:

1. Pre-formed tape mastics, and/or non-skinning tube sealants shall be used for the sidelaps and endlaps of all roof coverings.

2. Tape Mastic shall be pre-formed butyl rubber-based compound conforming to TT-C-1796-A or approved equivalent. The compound shall be non-hardening, non-corrosive to metal and have excellent adhesion properties. Tape mastic shall be white or light gray in color. Tube Sealant shall be a synthetic elastomer-based material in gray or bronze.

3. Gunnable Sealant: Use sealant to meet TT-S-00230C or approved equivalent.

H. Preformed End Closures:

1. Closures, formed to match roof panel profiles shall be used to provide weather tightness. Closures shall be of a closed cell, non-absorbent, laminated, semi-rigid material, EPDM (Ethylene-Propylene-Duene-Monomer) foam in a gray or neutral color shaped to tightly fit the panel configuration.

I. Finish:

1. FLUOROFINISH® (Polyvinylidene Fluoride) or equal, consisting of 0.25 +/- 0.05 mil primer on both sides with 0.75 +/- 0.1 mil 70 percent Signature 300 or Kynar 500 topcoat.

2. The exterior color shall be selected by Owner from manufacturer's standard or premium colors.

J. Trim and Flashing Material:

1. Shall be of the same material, gauge, finish, and color as the panels, unless otherwise indicated.

K. Accessories:

1. Fasteners:

a. Type 304 Stainless Steel with 5/8-inch diameter combination neoprene bonded metal washers, shall be #14 Type A for sheet to sheet and Type B for sheet to structural steel support.

b. Exposed fasteners color coated to match panels.

2. Closures:

a. Provide where called for on the drawings pre-molded flexible, cross-linked, closed-cell gray polyethylene foam to fit the contour of the panel specified.

b. Metal closures shall be manufactured from material that is the same finish and color of the adjacent metal panels and furnished where shown on drawings.

3. Tape Sealant shall be installed in all side and end laps of all metal panels and for all flashings, to assure weather tightness.

4. Sub-girts shall be hat shaped or zee shaped.

a. Sub-girts shall be roll-formed from 16-gauge, G-90 Galvanized Steel.

b. Sub-girts shall be located at each structural building support and not more than 6 feet on center between supports.

L. Approved Manufacturers

1. MBCI Metal Roof and Wall Systems

2. Atas International Inc.

3. Metal Sales Manufacturing Corporation

4. Taylor Metal Products

2.2 FABRICATION

A. Must be in compliance with dimensions, profile limitations, gauges and fabrication details of Manufacturer.

B. Components shall be fabricated to the greatest extent possible in the factory ready for field assembly.

PART 3 - EXECUTION

3.1 DELIVERY AND STORAGE

A. Materials shall be delivered to the site in a dry and undamaged condition and unloaded per the manufacturer's instructions. The installer shall inspect materials for damage and stains upon arrival to the site. Materials shall be stored out of contact with the ground in weathertight coverings to keep them dry per the manufacturer's recommendations. Storage accommodations shall provide good air circulation and protection from surface staining.

3.2 INSPECTION

A. The installer shall examine substrates, areas, and conditions for compliance with requirements for installation tolerances, panel supports, and other conditions affecting performance of the Work.

B. Field-check dimensions and check support alignment with a taut string or wire; support misalignment will cause panel "oil-canning."

C. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.

D. Should any condition be found which, in the opinion of the installer, will prevent proper execution of their work, the installer shall report such condition.

E. Do not proceed until unsatisfactory conditions are corrected.

3.3 INSTALLATION

A. Protect installed panels from abuse by other trades. The Contractor shall be responsible for protecting the panels from wet cement, plaster, painting operations, etc. The installer shall provide walk boards in heavy roofing traffic areas to prevent damage to panels. The metal roof panels shall be mechanically seamed with appropriate equipment as recommended by the manufacture.

B. Install panels in accordance with approved shop drawings and panel manufacturer’s instructions and recommendations, as applicable to specific project conditions. Anchor all components of roofing system securely in place while allowing for thermal and structural movement.

C. Accessories: Install all components required for a complete assembly, including flashings, trim, closure strips, and similar accessory items.

D. Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by panel manufacturer.

E. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA (ASMM).

3.4 DAMAGED MATERIAL AND CLEANING

A. Replace damaged panels and other components of Work which cannot be repaired by finish touch-up or similar minor repair prior to Date of Substantial Completion.

B. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

C. To prevent rust staining, remove immediately from finished surfaces any filings caused by drilling or cutting.

END OF SECTION 07 40 00

SECTION 07 42 43.19 INSULATED METAL WALL PANELS

PART 1 GENERAL

1.1 Work included: Furnish and install insulated metal wall panels.

1.2 REFERENCES

A. ASTM International (ASTM):

1. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

2. ASTM A 792 - Standard Specification for Steel Sheet, Aluminum-Zinc Alloy Coated Steel by the Hot-Dip Process

3. ASTM D 1622 - Apparent Density of Rigid Cellular Plastics

4. ASTM D 6226 - Standard Test Method for Open Cell Content of Rigid Cellular Plastics.

1.3 SUBMITTALS

A. Submit in accordance with Specification Section 01 33 00 – Submittal Procedures.

B. Submit Product Data including Manufacturer's data sheets on each product to be used and the following:

1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.

3. Material type, metal thickness and finish.

4. Installation methods.

C. Submit range of color samples for Owner’s selection.

1.4 WARRANTY

A. Special Manufacturer's Warranty: Submit Manufacturer's two (2) year limited warranty providing panels to be free from defects in materials and workmanship, beginning from the date of substantial completion excluding coil coatings (paint finishes) that are covered under a separate warranty.

PART 2 PRODUCTS

2.1 MATERIALS

A. Galvanized Steel: G-90 galvanized coated steel conforming to ASTM A 653 or AZ-50 aluminum-zinc alloy coated steel, conforming to ASTM A 792, minimum grade 33.

B. Foam Insulating Core: Polyurethane with zero ozone depletion potential blowing agent:

1. Closed Cell Content, ASTM D 6226: Minimum 90 percent.

2. Minimum Density: 2.0 pcf (32 kg/m3) as determined by ASTM D 1622.

2.2 INSULATED METAL WALL PANELS

A. Concealed Fastener, Insulated Metal Wall Panels with Foam Core:

1. Exterior Face Sheet: Galvanized steel.

a. Thickness: 24 gauge.

b. Surface Texture: Stucco embossed.

c. Finish: Fluoropolymer two-coat system.

2. Interior Face Sheet: Galvanized steel.

a. Thickness: 24 gauge.

b. Finish: Polyester two-coat system.

3. Panel Width: Manufacturer’s Standard

4. Panel Thickness: 2 inches.

2.3 ACCESSORIES

A. General: Provide complete metal panel assemblies incorporating trim. Provide required fasteners, closure strips, and sealants as indicated in manufacturer's written instructions.

B. Flashing and Trim: Match material, thickness, and finish of metal panels.

C. Panel Clips: ASTM A 653, G90 hot-dip galvanized zinc coating, one-piece, configured for concealment in panel joints, and identical to clips utilized in tests demonstrating compliance with performance requirements.

D. Sealant: Sealant as recommended by panel manufacturer.

2.4 FABRICATI0N

A. General: Provide factory fabricated and finished metal panels, trim, and accessories meeting performance requirements, indicated profiles, and structural requirements.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install metal panel system in accordance with manufacturer's written instructions, approved shop drawings, and project drawings.

B. Attach panels to metal framing using screws, fasteners, sealants, and adhesives recommended for application by metal panel manufacturer.

1. Fasten metal panels to supports with fasteners at each location indicated on approved shop drawings, at spacing and with fasteners recommended by manufacturer.

2. Cut panels in field where required using manufacturer's recommended methods.

C. Attach panel flashing trim pieces to supports using recommended fasteners and joint sealers.

D. Joint Sealers: Install sealants where required for weatherproof performance of metal panel assemblies.

3.2 CLEANING

A. Remove temporary protective films immediately in accordance with metal panel manufacturer's instructions. Clean finished surfaces as recommended by metal panel manufacturer.

3.3 PROTECTION

A. Protect installed products until completion of project.

B. Replace damaged panels and accessories that cannot be repaired to the satisfaction of the Engineer and Owner.

END OF SECTION 07 42 13.19

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SECTION 07 54 23 – THERMOPLASTIC-POLYOLEFIN ROOFING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Thermoplastic Polyolefin (TPO) sheet roofing fully adhered to roof deck.

1.2 RELATED WORK

A. Roof Insulation: Section 07 22 16 – Roof Board Insulation.

1.3 REFERENCE STANDARDS

A. ASCE 7 – Minimum Design Loads for Buildings and Other Structures

B. ASTM C1177 – Specification for Glass Mat Gypsum Substrate for Use as Sheathing

C. ASTM C1289 – Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

D. ASTM D6878 – Specification for Thermoplastic Polyolefin Based Sheet Roofing

E. ASTM E108 – Standard Test Methods for Fire Tests of Roof Coverings

F. ANSI/SPRI ES-1-03 – Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems

G. NRCA (RM) – National Roofing Contractors Association Roofing Manual

H. NRCA (WM) – National Roofing Contractors Association Waterproofing Manual

I. SPRI ES-1 – Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems

J. UL (DIR) – Online Certifications Directory

1.4 PERFORMANCE REQUIREMENTS

A. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ACSC 7.

B. UL Fire Rating Roof Classification: The completed membrane roofing system shall achieve a minimum UL Class A Fire Rating and shall be listed in the current UL (DIR).

C. IBC Basic Wind Speed Design Criteria: The completed membrane roofing system shall meet or exceed IBC Basic Wind Speed Design Criteria of 115 mph, 3 second gust duration, Exposure C. IBC uplift pressures shall be calculated with ASCE 7-16, but not less than the following:

1. Field: 27 psf

2. Perimeter: 36 psf

3. Corner: 49 psf

D. SPRI ES-1 Roof Edge Standard: The complete membrane roofing system and associated roof edge metal systems shall comply with SPRI ES-1.

E. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

1.5 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, cover board, substrate bond, vapor retarder, and fasteners.

1. Include manufacturer's published specifications for the proposed materials and systems.

C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, setting plan for tapered insulation, mechanical fastener layout, and walkway layout. Include plans, elevations, sections, details and attachments to other Work. Provide complete drawings of non-manufacturer-standard details to be used with details of construction.

1. Indicate insulation fastening patterns for corner, perimeter, and field-of-roof locations.

D. Selection Samples: Manufacturer's full range of available standard colors for prefinished metal fascia, coping, and drip edges.

E. Samples for Verification: Submit two samples 6 by 6 inches in size illustrating metal finish.

F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements, including the following:

1. Submit letter from the membrane manufacturer confirming that the completed membrane roofing system will achieve a minimum UL Class A Fire Rating, and shall be listed in the current UL (DIR).

2. Submit letter from the membrane manufacturer confirming that the completed membrane roofing system shall meet and/or exceed specified wind speed design criteria. IBC uplift pressures shall be calculated in accordance with ASCE 7. Letter shall confirm field, perimeter, and corner values in pounds per square foot.

3. Submit letter from the membrane manufacturer confirming that the completed membrane roofing system and associated roof edge metal systems comply with SPRI ES-1.

4. Submit letter from the membrane manufacturer certifying that roofing system complies with special requirements.

5. Submit certification of the membrane manufacturer's warranty reserve.

6. Submit certification that installer is an approved applicator with the membrane manufacturer.

7. Submit certification from the membrane manufacturer indicating the fasteners are capable of providing a static back-out resistance of 10 inch pounds minimum.

8. Submit Letter of Compliance from the membrane manufacturer that the proposed system complies with the specifications and guidelines stated herein, including the manufacturer's 72 miles per hour warranty criteria for the duration indicated in Warranty Article.

G. Qualification Data: For Installer.

H. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.

J. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.

K. Specimen Warranty: For approval. Sample warranty shall clearly indicate 72 miles per hour wind-speed coverage.

L. Warranty Documentation:

1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

2. Submit installer's certification that installation complies with warranty conditions for waterproof membrane.

M. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1. Manufacturer's warranty is evidence of satisfactory inspection. Report shall be submitted if warranty cannot be issued because of improper workmanship, or if manufacturer's inspection noted any conditions requiring correction.

N. Maintenance Data: For roofing system to include in maintenance manual. Submit in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Company specializing in manufacturing the products specified in this section with minimum 15 years of documented experience.

B. Installer Qualifications: Company authorized and trained by the membrane manufacturer. The roofing applicator shall be thoroughly experienced and upon request be able to provide evidence of having at least 5 years successful experience installing single-ply TPO roofing systems similar to the specified system and having installed at least four roofing applications of similar systems and of equal or greater size within the last 12 months.

1. Crew Experience and Supervision: Provide adequate number of experienced workmen regularly engaged in this type of work who are skilled in the application techniques of the materials specified. Provide at least one thoroughly trained and experienced foreman/superintendent on the job at all times roofing work is in progress.

C. Membrane manufacturer's technical representative shall make site inspections before, during, and after installation of Work and at frequency as required to enable manufacturer to issue specified warranty.

1. Perform and document inspections by designated and properly qualified technical representative of membrane manufacturer.

2. Verify that materials and Work meet specified requirements.

3. Should Work and/or materials not meet specified requirements, promptly advice Engineer with recommended course of action.

D. Product/Material Requirements

1. Obtain products from single manufacturer or from sources recommended by manufacturer for use with roofing system and incorporated in manufacturer's warranty.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact. Deliver in sufficient quantity to permit work to continue without interruption.

B. Store products in weather protected environment, clear of ground and moisture. Comply with the manufacturer's written instructions for proper material storage.

C. Ensure storage and staging of materials does not exceed static and dynamic load bearing capacities of roof decking.

D. Protect foam insulation from direct exposure to sunlight. Store on pallets, off the ground or roof deck and tightly covered with waterproof materials.

E. Do not overload roof structure by concentrating stored materials in certain locations.

F. Store adhesives at temperatures about 40 degrees Fahrenheit.

G. Comply with the recommendations of the NRCA "Roofing and Waterproofing Manual" applicable to single ply membrane roofing for storage, handling and installation.

1.8 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather.

B. Do not apply roofing membrane when ambient temperature is below 40 degrees Fahrenheit.

C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.9 WARRANTY

A. System Warranty: Provide manufacturer's standard or customized form of system warranty without monetary limitation, agreeing to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.

1. The warranty shall contain no exclusion or limitation for damage caused by wind or gale. Minimum wind speed limitation under warranty shall be 72 miles per hour measured at 10 meters above ground level.

2. The warranty shall include all components of membrane roofing system such as membrane, insulation, cover board, substrate board, vapor barrier, fasteners and plates, accessories, adhesives, sealants, term bars, pre-fabricated roof edge and coping systems, walkways, and other components of membrane roofing system.

3. The warranty shall contain no exclusion or limitation for improper installation, or damage from environmental contaminants, or damage from water that ponds, or does not drain from environmental contaminants, or damage from water that ponds, or does not drain freely.

4. For repair and replacement, include costs of both material and labor in warranty.

5. Pro-Rated System Warranties shall not be accepted.

6. Warranty Term: 20 years, "No Dollar Limit".

PART 2 - PRODUCTS

2.1 MANUFACTURERS, OR EQUAL

A. Thermoplastic Polyolefin (TPO) Membrane Roofing Materials:

1. Carlisle Roofing Systems, Inc

2. Firestone Building Products, LLC

3. Johns Mansville

B. Insulation:

1. As approved by membrane manufacturer.

2.2 ROOFING

A. Thermoplastic Membrane Roofing: Provide the following assemblies:

1. One ply membrane mechanically attached over mechanically attached cover board over mechanically fastened insulation over mechanically fastened base layer insulation over metal/wood/concrete roof deck. (or no backing)

B. Roofing Assembly Requirements:

1. Roof Covering External Fire Resistance Classification: UL (FRD) Class A, where indicated to receive insulation.

2. Insulation Thermal Value (R), minimum: R-49 for complete assembly, except at roof drains; provide insulation of thickness required.

C. Acceptable Insulation Types – Constant Thickness Application: Any of the types specified.

1. Minimum 2 layers of polyisocyanurate board.

2. Provide tapered insulation where indicated or required to slope to drain.

2.3 MEMBRANE ROOFIING AND ASSOCIATED MATERIALS

A. Membrane Roofing Materials:

1. TPO: Thermoplastic Polyolefin (TPO) complying with ASTM D6878, sheet contains reinforcing fabrics or scrims.

a. Thickness: 80 mils

2. Sheet Widths: Factory fabricated into largest sheets possible.

3. Color: To be selected by Owner from manufacturer’s full color range.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Membrane Fasteners: As recommended by manufacturer to meet performance and warranty requirements.

D. Flexible Flashing Material: Same material as membrane.

1. Available products, or equal:

a. GCP, Grave Vicor Pro

2.4 COVER BOARD

A. Cover Board: Glass mat faced gypsum panels, ASTM C1177, fire resistant type, 1/2-inch thick.

1. Basis-of-Design Product, or equal:

a. Carlisle Secure Shield HD

b. Georgia-Pacific DensDeck Prime

c. USG Securock Roof Board

2.5 SUBSTRATE BOARD

A. Substrate Board: Glass mat faced gypsum panels, ASTM C1177, fire resistant type, 1/2-inch thick

1. Available Products, or equal:

a. Georgia-Pacific Corporation: Dens Deck

b. USG Securock Roof Board

2.6 INSULATION

A. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C1289, Type II, Class 1, cellulose felt or glass fiber mat both faces; Grade 2 and with the following characteristics:

1. Board Size: 48 inch by 96 inch.

a. Provide 48 by 48 inch sheets for adhered applications unless otherwise approved by membrane manufacturer.

2. Thermal Resistance: Min R-value of 49 for complete roof assembly.

3. Provide a minimum of two layers.

a. Minimum thickness of board stock not less than 1-1/2 inches.

b. Maximum thickness of board stock not to exceed 2-1/2 inches.

4. Provide tapered cricket materials where indicated.

B. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope as indicated on the drawings.

1. Verify existing roof slope prior to fabrication of insulation boards. Tapered insulation to be fabricated to provide final roof slope as shown on the drawings.

C. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricated slopes indicated.

2.7 METAL EDGING AND MEMBRANE TERMINATIONS

A. Pre-Fabricated Pre-Finished Metal Drip Edge System (Drip Edge): “L” shaped continuous 22-gauge cleat with pre-slotted fastening holes. Provide prefinished 24-gauge galvanized steel cover.

1. Wind Performance: As required to meet SPRI ES-1 Test Method RE-1 and RE-2.

2. Basis-of-Design Product, or Equal: Carlisle SecurWeld Heat-Weldable Drip Edge.

B. Roof Edge Pre-Fabricated Metal Fascia System: Provide roof edge fascia system consisting of heavy 0.100-inch thick extruded aluminum anchor bar, stainless steel fasteners, and snap-on fascia cover. Snap-on fascia shall be 0.040-inch aluminum with Kynar finish.

1. Wind Performance: As required to meet SPRI ES-1 Test Method RE-1 and RE-2.

2. Fascia height dimension shall be as indicated on Drawings.

3. Basis-of-Design Product, or equal: Carlisle SecurEdge 2000 Fascia System.

C. Parapet Pre-Fabricated Metal Coping System: Provide coping system with full snap-on design with 20-gauge galvanized steel anchor clips and factory applied stainless steel springs. Provide prefinished snap-on 0.04-inch aluminum cover.

1. Wind Performance: As required to meet SPRI ES-1Test Method RE-3.

2. Shaped Components: Provide factory-fabricated pieces necessary for a complete installation, including miters, corners, intersections, and end caps. Provide minimum 14-inch long legs on corner, intersection, and end pieces.

3. Basis-of-Design Product, or equal: Carlisle SecurEdge 200 Coping System – Tapered and Flat Version.

D. Coated Metal: 24-gauge, galvanized steel sheet coated with a layer of non-reinforced roofing membrane flashing. Cut sheets to the appropriate width and use to fabricate metal drip edges or other roof perimeter edging profiles and scuppers. Roofing membrane may be heat welded directly to the coated metal.

1. Color: to match membrane color.

E. Sheet Metal Counterflashings: 24-gauge minimum pre-painted sheet metal materials with hemmed drip edges.

1. Locations of Use: At all wall and curb locations where sheet metal counterflashing materials are required or detailed.

F. Termination Bar: 1-inch wide and 0.098-inch-thick extruded aluminum bar pre-punched, which incorporates a sealant ledge to support sealant. Provide termination bar at all membrane termination points, including membrane terminations where sheet metal counterflashings are used and as required for manufacturer's warranty.

G. Color of prefinished components furnished by this Section: Custom to match color of sheet metal as indicated in Section 07 60 00 – Flashing and Sheet Metal.

2.8 ACCESSORIES

A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.

B. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.

1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.

C. Sealants and Primers:

1. Single Ply Roof Membrane Adhesives: 250 g/L.

2. PVC Welding: 510 g/L.

3. Architectural Sealants: 250 g/L.

4. Sealant Single Ply Roof Membrane: 450 g/L.

5. Sealant Primers for Nonporous Substrates: 250 g/L.

6. Sealant Primers for Porous Substrates: 775 g/L.

D. Membrane Adhesive: As recommended by membrane manufacturer.

E. Cover Board Adhesive: One- or two-part bead-applied, low-rise, multicomponent urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer, as recommended by membrane manufacturer.

1. Approved Products, or equal:

a. OMG Roofing Products, OlyBond 500

b. Sika Sarnafil Sarnacol 2163

F. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.

G. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.

H. Insulation Adhesive: One- or two-part bead-applied, low-rise, multicomponent urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer, as recommended by insulation manufacturer.

1. Approved Products, or equal:

a. OMG Roofing Products, OlyBond 500

b. Sika Sarnafil Sarnacol 2163

I. Sealants: As recommended by membrane manufacturer.

J. Walkway Pads: Type recommended by membrane manufacturer, suitable for maintenance traffic, contrasting in color or otherwise visually distinctive from roof membrane. Provide non-skid surface pattern.

1. Composition: Reinforced PVC membrane with textured surface.

2. Size: As indicated.

3. Surface Color: Gray.

K. Drains: Install drains and overflows per drain and roofing manufacturer's recommendations, design drawings, and NRCA standards.

L. Membrane Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with FM Approvals 4470, designed for fastening membrane to substrate.

M. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, prepunched.

N. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories as recommended by membrane manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions with roofing Installer and roofing inspector to verify compliance with project requirements and suitability to accept subsequent roofing work. Correct unsatisfactory conditions before proceeding with roofing work.

B. Do not apply roofing if roof surface will be used for subsequent work platform, storage of materials, or staging or scaffolding will be erected thereon unless system is protected.

3.2 PREPARATION

A. Complete roof deck construction prior to commencing roofing work:

1. Install curbs, blocking, edge strips, nailers, cants, and other components where insulation, roofing, and base flashing is attached to, in place ready to receive insulation and roofing.

2. Complete deck and insulation to provide designed drainage to working roof drains.

3. Document installation of related materials to be concealed prior to installing roofing work.

B. Dry out surfaces, including the flutes of metal deck that become wet from any cause during progress of the Work before roofing work is resumed. Apply materials to dry substrates.

C. Sweep decks to broom clean condition. Remove all dust, dirt or debris.

D. Remove projections that might damage materials.

3.3 TEMPORARY PROTECTION

A. Install temporary protection at the end of day's work and when work is halted for an indefinite period or work is stopped when precipitation is imminent.

3.4 INSTALLATION, GENERAL

A. Perform work in accordance with manufacturer’s instructions, NRCA (RM), and NRCA (WM) applicable requirements.

B. Do not apply roofing membrane during unsuitable weather.

1. Except for temporary protection, do not apply materials during damp or rainy weather, during excessive wind conditions, nor while moisture (dew, snow, ice, fog or frost) is present in any amount in or on the materials to be covered or installed:

a. Do not apply materials when the temperature is below 40 degrees Fahrenheit or temperature range recommended by manufacturer, whichever is more stringent.

b. Do not apply materials to substrate having temperature of 40 degrees Fahrenheit or less.

C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

D. Do not expose materials vulnerable to water or sun damaged in quantities greater than can be weatherproofed in the same day.

E. Coordinate this work with installation of associated counterflashings installed by other sections as the work of this section proceeds.

F. Schedule and execute work to prevent leaks and excessive traffic on completed roof sections. Exercise care to provide protection for the interior of the building and to ensure water does not flow beneath any completed sections of the membrane system.

G. When positioning membrane sheets, exercise care to locate all field splices away from low spots and out of drain sumps. Shingle all field splices.

H. Proceed with work so new roofing materials are not subject to construction traffic. When necessary, inspect and protect new roof sections upon completion for possible damage.

I. New roofing shall be complete and weather-tight at the end of the workday.

J. Contaminants such as grease, fats, and oils shall not be allowed to come in direct contact with the roofing membrane.

K. During and after membrane construction, general contractor shall provide wood sheathing for other trades that need to work from the roof membrane to perform their tasks.

L. FM Approvals Installation Standard: Install roofing membrane, base flashings, wood cants, blocking, curbs, and nailers, and component materials. Comply with recommendations in FM Approvals' Loss Prevention Data Sheet 1-49, including requirements for wood nailers and cants.

3.5 SUBSTRATE BOARD INSTALLATION

A. At areas not indicated to receive insulation, install substrate board as defined for first layer of insulation.

B. Install 1/2-inch-thick board directly over roof deck and fasten in accordance with manufacturer’s instructions.

C. Mechanically attach substrate board to the substrate per manufacturer’s requirements for mechanically attached application.

1. Where underside of roof deck is visible from below, fasteners shall penetrate the top flute only. Size fasteners so that the shortest fastener length is utilized. No bottom flute fastening is allowed. From below the roof deck, fasteners shall remain mostly hidden within the flute pocket.

3.6 INSULATION AND COVERBOARD – UNDER MEMBRANE

A. Install insulation under area of roofing to achieve required R-value. Install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

B. Attachment of Insulation:

1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer’s instructions, as required to meet specified warranty requirements, and as required to resist specified uplift pressures at corners, perimeter, and field-of-roof.

2. Adhesively attach subsequent layers of insulation and cover board as required to meet specified warranty requirements and to resist specified uplift pressure at corners, perimeter, and field-of-roof.

3. Install insulation and cover board materials over the substrate with boards butted tightly together with no joints or gaps greater than 1/4-inch. Stagger joints a minimum of 6 inches both horizontally and vertically.

   a. Cut and fit insulation within 1/4-inch of projections and penetrations.

4. Install cover board vertically at inside face of parapet walls where indicated.

5. Where underside of roof deck is visible from below, fasteners shall penetrate the top flute only. Size fasteners so that the shortest fastener length is utilized. No bottom flute fastening is allowed. From below the roof deck, fasteners shall remain mostly hidden within the flute pocket.

6. All fasteners shall penetrate wood deck a minimum of 1-inch and a maximum of 1-1/2-inch.

3.7 INSTALLATION OF TPO ROOFING

A. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.

B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.

C. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching and allow sheet to relax a minimum of 20 minutes prior to applying adhesive. Inspect for defects as being rolled out and remove defective areas.

   1. Finish edges of laps with a continuous beveled bead of sealant to sheet edges to provide smooth transition.

   2. Finish seams as the membrane is being installed (same day).

D. Shingle joints on sloped substrate in direction of drainage.

E. Mechanical Attachment: Apply membrane and mechanical attachment devices in accordance with manufacturer's instructions.

   1. Overlap adjacent membrane sheets approximately 5-1/2-inches at those locations where fastening plates are located (along length of the membrane) and a minimum of 2-inches at end roll sections (width of membrane).

   2. Hot air weld the membrane sheets a minimum of 1-1/2-inches with an automatic hot air welding machine.

3. Where underside of roof deck is visible from below, membrane screw fasteners shall penetrate the top flute only. Size fasteners so that the shortest fastener length is utilized. No bottom flute fastening is allowed. From below the roof deck, fastener shall remain mostly hidden within the flute pocket.

F. At intersections with vertical surfaces:

1. Extend membrane up a minimum of 8-inches onto vertical surfaces and, where applicable, over the top of the parapet under copings. Terminate in accordance with membrane manufacturer's requirements.

2. Fully adhere flexible flashing over membrane and up to termination bars or nailing strips.

3. At inside and outside corners of parapets cut membrane as required to fit contours and weld in a patch to close gaps for continuous roof membrane.

G. Around roof penetrations, seal with premolded or prefabricated accessories where practical welding to base membrane.

H. Coordinate installation of roof drains and related flashings.

I. Install perimeter copings and edge metal to comply with SPRI ES-1 and requirements specified.

J. Install the membrane so the sheets run perpendicular to the long dimension of the insulation boards.

K. Commence installation at the low point of the roof and work towards the high point. Lap the sheets so the flow of water is not against the edges of the sheet.

L. Repair areas of welded seams where samples have been taken or marginal welds, bond voids, or skips occurs.

M. Repair fishmouths and wrinkles by cutting to lay flat and installing patch over cut area extending 4 inches beyond cut.

N. Membrane Perimeter Anchorage:

1. Install metal fastening strip at the perimeter of each roof level, curb flashing, expansion joints and similar penetrations as indicated and in accordance with membrane manufacturer's instructions on top of roof membrane to deck or wall.

2. Mechanically Fastened Metal Fastening Strip:

a. Set top of mechanical fastener set flush with top surface of the metal fastening strip. Space mechanical fasteners a maximum 12 inches on center starting one inch from the end of the nailing strip.

b. When strips are cut round corners and eliminate sharp corners.

c. After mechanically fastening strip cover and seal strip with a six-inch wide roof membrane strip; heat weld to roof membrane and seal edges.

d. At roof edge metal, turn the membrane down over the front edge of the blocking or the nailer to below blocking. Secure the membrane to the vertical portion of the nailer; or, if required by the membrane manufacturer with fasteners spaced not over 12 inches on centers.

e. At parapet walls, intersecting building walls and curbs, secure the membrane to the structural deck with fasteners 12 inches on centers or as shown on NRCA manual.

O. Adhered System:

1. Apply adhesive in quantities required by roof membrane manufacturer.

2. Fold sheet back on itself after rolling out and coat the bottom side of the membrane and the top of the deck with adhesive. Do not coat the lap joint area.

3. After adhesive has set according to adhesive manufacturers application instruction, roll the membrane into the adhesive in a manner that minimizes voids and wrinkles.

4. Repeat for other half of sheet. Cut voids and wrinkles to lay flat and clean for repair patch over cut area.

3.8 INSTALLATION OF FLASHING

A. Follow manufacturer's typical flashing procedures for all wall, curb, and penetration flashings including metal edging/coping and roof drain applications.

B. Install flashings as the membrane is being installed. If the flashing cannot be completely installed in one day, complete the installation until the flashing is in a watertight condition and provide temporary covers or seals.

C. At parapet wall locations, extend wall flashing materials up and over the top, and down the outside edge where possible. Terminate the membrane in accordance with manufacturer's requirements.

D. Provide bug screen and shim out counterflashing as required at vent ways for roof venting with free venting area to equal that required for roof venting.

E. Flashing Roof Drains:

1. Install roof drain flashing as recommended by the membrane manufacturer, generally as follows:

a. Coordinate to set the metal drain flashing in asphalt roof cement, holding cement back from the edge of the metal flange.

b. Do not allow the roof cement to come in contact with the TPO roof membrane.

c. Adhere the TPO roof membrane to the metal flashing with the membrane manufacturer's recommended adhesive.

2. Turn down the metal drain flashing and TPO roof membrane into the drain body and install clamping ring and strainer.

F. Installing TPO Base Flashing and Pipe Flashing:

1. Install TPO flashing membranes to pipes, wall or curbs to a height not less than eight-inches above roof surfaces and four inches on roof membrane.

a. Adhere flashing to pipe, wall or curb with adhesive.

b. Heat weld flashing membranes together and flashing membranes to roof membranes. Finish exposed edges with sealant as specified.

c. Install flashing membranes in accordance with NRCA manual.

3.9 WALKWAYS

A. Install walkways at all traffic concentration points (such as roof hatches, mechanical units, access doors, rooftop ladders, etc.) and all locations as indicated on the Drawings.

1. Install walkways at bottom of all downspouts, extending a minimum of 3 feet beyond the downspout discharge.

B. Heat weld or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer’s written instructions.

C. Do not install in continuous lengths greater than 10 feet.

D. Install walkways leaving minimum 3-inch/ maximum 4-inch gap between edges of individual walkways for proper drainage.

E. Cut walkways that occur in drainage ways to allow for unobstructed water flow.

3.10 DAILY SEAL

A. On phased roofing, when the completion of flashings and terminations is not achieved by the end of the workday, a daily seal must be performed to temporarily close the membrane, cover board, and insulation to prevent water infiltration.

B. Use pourable sealer or other acceptable membrane seal in accordance with the manufacturer’s requirements.

C. Seal all tie-offs to prevent moisture from flowing under new work.

3.11 FIELD QUALITY CONTROL

A. Contractor will engage a qualified roofing inspector to perform roof tests and inspections and to prepare test reports.

B. Roofing Inspector: Contractor shall engage a qualified roofing inspector for a minimum of one day on site to perform roof tests and inspections and to prepare start up, interim, and final reports.

1. Examine and probe seams in the membrane and flashing in the presence of Resident Engineer and Membrane Manufacturer's Inspector.

C. Prior to the inspection, perform a pre-inspection to review all work and to verify all flashing has been completed as well as the application of sealants.

D. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

1. Notify Engineer and Owner 48 hours in advance of date and time of inspection.

2. Arrange for a non-sales, technical representative of the membrane manufacturer to determine whether or not corrective work will be required before the warranty will be issued.

E. Repair or remove and replace components of roofing work where test results or inspections indicate that they do not comply with specified requirements.

3.12 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials acceptable to roofing manufacturer.

C. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of acceptance by Owner.

D. Remove bituminous markings from finished surfaces. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

E. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.

F. Completely remove stains and construction debris from the roof membrane. Areas of stained membrane which are unable to be cleaned to like-new appearance will be rejected.

END OF SECTION 07 54 23

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SECTION 07 60 00 - FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide sheet metal and appurtenant work, complete, in accordance with the Contract Documents.

B. The principal items of sheet metal work shall include, but not be limited to the following: sheet metal flashings, collars, pitch pockets (pans), equipment platforms, and equipment (sleeper) supports at all roof penetrations which are not provided as part of the roofing system.

1.2 REFERENCE STANDARDS

A. TT -P-641 G(1) Primer Coating, Zinc Dust-Zinc Oxide (For Galvanized Surfaces)

B. UU-B-790A INT AMD 1 Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellent and Fire Resistant)

C. ASTM A240 Stainless and Heat-Resisting Chromium Steel Plate. Sheet. and Strip

D. ASTM A653 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process

E. ASTM A666 Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

F. ASTM B32 Solder Metal

G. ASTM B209 Aluminum and Aluminum-Alloy Sheet and Plate

H. ASTM C920 Specification for Elastomeric Joint Sealants

I. ASTM D226 Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

J. ASTM D1187 Asphalt-Base Emulsions for Use as Protective Coatings for Metal

K. SMACNA (ASMM) Architectural Sheet Metal Manual

L. AWS The Aluminum Association Specifications for Aluminum Sheet Metal Work in Building Construction, American Welding Society

M. Manufacturer's Standards: In addition to the standards listed above, the flashing products and their installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.3 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirement of Section 01 33 00 – Submittal Procedures.

B. Samples: Color samples and samples shall be submitted where required for color selections and/or review by the Engineer.

C. Shop Drawings: Shop drawings showing materials, gauges, finishes, layout, jointing, profiles, fasteners, fabrication of special shapes, and method of attachment to adjacent construction shall be submitted.

D. Submit manufacturers literature indicating materials, finish, construction, and method of installation of prefabricated items and sealants.

E. Warranties: Special warranties as specified in this Section.

1.4 QUALITY ASSURANCE

A. General: sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Design, fabricate, and install flashings at roof edges in accordance with SPRI ES-1, except with basic wind speed as indicated on the Structural Drawings.

C. Water Infiltration: Provide sheet metal flashing and trim that does not allow water infiltration to building interior.

D. Perform work in accordance with SMACNA (ASMM) requirements and standard details, except as otherwise indicated.

E. Fabricator and Installer Qualifications: Company specializing in sheet metal work with ten years of documented experience.

F. Warranty:

1. Special Project Warranty: Submit Installer’s warranty, or installer’s standard or customized form, signed by Installer, covering the Work of this Section, including all components of flashing and sheet metal against defects in materials and workmanship, for two years from date of substantial completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. Sheet metal shall be aluminum and/or galvanized steel unless otherwise specified or shown. Sheet metal work in connection with roofing shall be in accordance with roofing manufacturer's published specifications.

B. All sheet metal flashings necessary to make building weathertight shall be provided, whether or not specified or shown.

2.2 ALUMINUM PRODUCTS

A. Aluminum shall be 0.032-inch minimum thickness and shall conform to ASTM B209, alloy 3003-H 14, with anodized finish AA-C12-A42 and color selected by Owner unless specified or shown otherwise. Thickness of aluminum to be welded shall be as necessary for welding method being used.

B. Reglets shall be extruded aluminum with protective coating such as manufactured by Superior Concrete Accessories; Morrison and Company "Cushion-Lock"; Fry Reglet; or equal.

2.3 FERROUS METALS

A. Unless otherwise specified, galvanized steel shall be 24-gauge minimum thickness conforming to ASTM A653.

B. Stainless steel shall be 24-gauge minimum thickness conforming to ASTM A176, Type 3.04, dull No. 20 finish.

2.4 LEAD AND SOLDERING MATERIALS

A. Lead shall be 4 to 6 percent antimony and remainder shall be lead. Lead sheet shall be soft temper I except hard temper for flanges. Weight shall be not less than 4 pounds per square feet unless otherwise shown.

B. Solder shall conform to ASTM B32, Alloy 5b, 50 percent tin, 50 percent lead.

C. Soldering flux shall be of a type not injurious to metal surface being treated.

2.5 FASTENERS

A. Fastening devices shall be of the same material as the sheet metal being used or corrosion-resistant metal compatible with sheet metal being used. Fasteners exposed to the weather shall have neoprene washers. Washers shall be 0.04-inch minimum thickness. A rubber-type washer shall be used beneath the aluminum washer or fastener head where weathertightness is required.

2.6 SEALING MATERIALS

A. Sealants shall be as specified under Section 07 92 00 – Joint Sealants or shall be of the silicone type. Colors shall be selected by the Engineer from manufacturer's standard colors.

B. Sealer tape shall be polyisobutylene sealer tape specifically formulated for setting flanges on bituminous roofing, as manufactured by Morrison and Company CL-50; plasticity 579.6; or equal.

2.7 COATING MATERIALS

A. Primer coat for galvanized steel shall conform to Federal Specification TT-P-641 G(1) Type II.

B. Asphaltic coating compound shall conform to ASTM D1187.

2.8 BUILDING PAPER OR FELT

A. Unless other specified, provide asphalt saturated roofing felt underlayment (Number 30) conforming to ASTM D226

2.9 SHOP FABRICATION REQUIREMENTS

A. General: Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA (ASMM) that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to the greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

2. Obtain field measurements for accurate fit before shop fabrication.

3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

5. Snip flashing material with shears in lieu of abrasive cutting to close off bare metal with finish during fabrication in shop and on site.

B. Gutters and downspouts shall be of sizes as shown with wire basket type strainers of 14-gauge stainless steel wire or cast bronze.

C. All aluminum shall be welded where specified or shown. Welding shall conform to Reference Standards.

D. Galvanized steel corner joints shall be soldered. Other joints shall be as specified, or as required by the Reference Standards.

E. All Work and finishes shall be protected from scratches and abrasions.

F. All flashings, reglets, counter-flashing and other associated flashings shall be fabricated by the same manufacturer and be installed as a complete flashing system. All flashings shall be creased longitudinally or otherwise formed with sufficient spring action to hold bottom edges firmly against base flashing or similar material.

G. Intersecting corners of copings shall be accurately fitted and welded. Corners may be shop-assembled, manufactured, or extruded units. Coping shall be per ASMM Plate 68 except modified as shown, with Alternate 5 seams that allow for 1/4-inch expansion per each 10 feet of length.

H. All required access doors, unless specified elsewhere, shall be provided. Size and location shall be as required by governing authorities, codes, and as shown. Key-locked access doors shall be provided where shown.

I. Flashing required through concrete or clay tile shall be flexible flashing in order to assure against undue separation between tiles on account of rigidity of the flashing material. Flashing around pipes, vents, flues, chimneys, etc., shall be of lead, copper, or other approved flexible flashing material.

2.10 FABRICATED SHEET METALWORK

A. Scuppers in walls shall be constructed of 0.040-inch aluminum and/or 16-gauge material similar to design shown on ASMM Plate 26 with all joints welded. Scuppers through top course without head shall be similar to ASMM Plate 28.

B. Stamped sheet metal vents or louver-type vents (where shown) shall be designed to provide watertight flush corners and shall be of size shown. Each vent shall be equipped with 1/4-inch square galvanized or aluminum mesh hardware cloth insect screen. Stamped metal items shall be made of coated aluminum or galvanized sheet metal.

C. Downspouts with conductor head 1/2 inch below gutter or scupper and hangers shall be designed similar to design shown on ASMM Plates 32, 25, and 34, Figure B or D. Downspout and conductor head shall be constructed of 1/16-inch aluminum or 16-gauge metal and shall have all joints welded except joint between head outlet pipe and downspout.

D. Surface mounted, downspout and hangers shall be designed similar to design shown on ASMM Plates. Downspout shall be constructed of 16-gauge metal and shall have all joints soldered except joint between gutter outlet pipe and downspout.

E. Metal vent screeds shall be plaster channel screeds PCS-V-300 as manufactured by Fry Reglet Corp.; H.K. Porter Co., Inc.; or equal. Screeds shall be extruded aluminum with either clear plastic coating, clear anodized coating, or clear acrylic baked-on coating. All corners shall be mitered.

F. Wall louvers shall be extruded aluminum louvers conforming to ASMM Plate 14, unless otherwise specified or shown. Louvers and screens shall have clear anodized finish. All exterior louvers shall be provided with 1/2-inch by 1/2-inch mesh bird screen and frame. Screen units shall be removable.

G. Scuppers in walls and parapets shall be constructed of 0.040-inch aluminum similar to ASMM Plate 30. All joints shall be welded.

H. Access doors shall be as manufactured by Milcor Division of Enryco, Inc.; Karp Associates, Inc.; Inland Ryerson Steel Corporation; or equal and shall be of the types necessary to suit job conditions.

I. Equipment supports conforming to Reference Standards shall be provided where required or necessary and may be of galvanized steel construction unless otherwise shown.

J. The roof penetrations sheet metal work items shall be provided and shall be coordinated with the roofing system. The design and details shall conform to the Reference Standards unless otherwise shown.

K. The roof penetrations shall be provided with the following flashing:

1. Vent pipes: Lead collars vent pipe flashing with top of lead sleeve flashing bent into vent pipe. Ref. ASMM. Plate 66, F18.B and 71 Figure A.

2. Single pipes: Sheet metal or lead collars with sheet metal or lead draw band with sealant or cap top. Ref. ASMM. Plate 65 & 66, F18.C.

3. Multi-pipes: Lead collar with cap. Ref. Stoneman Engineering and Mfg. Co.

4. Multi-pipes w/curb: Sheet metal with sealant and draw bands. Ref. ASMM. Plate 65, Figure B.

5. Equipment support and/or Platform (See Note 1): Sheet metal. Ref. ASMM. Plate 68.

6. Pitch pockets for supports: Sheet metal with all joints welded or soldered. Ref. ASMM. Plate 61, figure E.

7. Ducts with curb (See Note 1): Sheet metal. Ref. ASMM Plate 148, Figure B 150, 151.

8. Prefabricated products, curbs, supports, and platforms which are part of mechanical equipment and are specified in other Sections of these Specifications, shall be provided with equipment as specified.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall coordinate the flashings necessary with the different trades to make sure all items which penetrate the roof are provided with all necessary sheet metal items and work, such as (but not limited to) the following: pipes, ducts, support racks, equipment platforms or sleepers, and supports. Sheet metal shop manufactured curbs, equipment supports, and equipment platforms shall be provided where prefabricated curbs, support or platform are not specified in other Sections of these Specifications.

B. All Work shall conform to Reference Standards. Flashing work shall be coordinated with roofing work. Sheet metal and roofing shall provide a weather-tight and watertight assembly without oil canning, buckles, tool marks, fastening stresses, distortion or defects which impair strength or mar appearance.

C. Sheet metal work shall be accurately formed to dimensions and shapes shown. Work shall be fitted snugly, with straight, true lines with exposed faces aligned in proper plane, free from waves and buckles. Arises and angles shall have true and sharp lines, and surfaces shall be free from waves and buckles. All exposed edges shall be hemmed. Holes for fasteners within sheet metal work exposed to temperature changes shall be elongated holes for material expansion and movement.

D. All sheet metal work shall be furnished complete with supports, hangers, bracing, anchors, and other devices as required for reinforcement and proper attachment to adjacent construction. Fastenings shall be concealed wherever possible. Joints, fastenings, reinforcements, and supports shall be sized and located as required to preclude distortion or displacement due to thermal expansion and contraction.

E. All surfaces upon which sheet metal is to be placed shall be dry, smooth, even, and free of any projections and hollows. Sheet metal shall be laid with all joints true and even and firmly attached with all fastener heads flush with the top surface.

F. The underlayment shall be overlapped at least 2 inches so as to shed water and shall be secured along the lapped edges. Aluminum fasteners shall be used with aluminum sheet metal.

G. Dissimilar materials shall be isolated with 2 coats of asphaltic paint, asphaltic coating compound, or sealer tape. Only stainless-steel fasteners shall be used to connect isolated dissimilar metals.

H. Joints shall be sized and spaced to permit sheet movement for thermal expansion and contraction of 1/4 inch per 10 feet length, on 140 degree Fahrenheit temperature difference. Holes for fasteners or anchors shall be elongated to provide for movement.

I. Roofing sheet metal items shall be built into the roofing in strict accordance with directions of roofing manufacturer.

3.2 INSTALLATION

A. Flashing at vertical surfaces shall be installed at intersections of roof with vertical surfaces and at projections through roof. Corner units shall be factory-fabricated and shall have mitered soldered or welded corner joints and shall be installed with 3-inch (min) lap joint over flashings on each side.

B. Copings shall have joints at 10 feet (max) spacing and at 2-1/2 feet from corners. Joints shall be butted with 3/16-inch space centered over matching 8-inch-long backing plate with sealer tape in laps. Corner units shall be welded or soldered units. All joints shall be provided with cover plates.

C. Flanges of sheet metal items shall be set on continuous sealer tape on top edge envelope ply of roofing. Flanges shall be nailed through sealer tape at 3 inches (max) spacing or securely fastened per Reference Standards.

D. Metal protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

END OF SECTION 07 60 00

SECTION 07 71 00 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section includes the following:

1. Copings.
2. Roof edge flashings.
3. Counterflashings and reglets.

1.2 PERFORMANCE REQUIREMENTS

A. Manufacture and install copings and roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressures:

B. Design pressure is determined by formulas in SPRI ES-1 that account for basic wind speed, exposure factor, building height, building importance factor, and pressure coefficient that combines a gust factor.

1.3 SUBMITTALS

A. Submit product data for each type of product indicated in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Show layouts of manufactured roof specialties, including plans and elevations. Identify factory- vs. field-assembled work.

C. Samples: For each type of manufactured roof specialty indicated with factory-applied color finishes.

D. Product Test Reports: Verifying compliance for each type of product indicated with performance requirements.

PART 2 - PRODUCTS

2.1 EXPOSED METALS

A. Prefinished, Zinc-Coated Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation, structural quality, and prefinished by the coil-coating process to comply with ASTM A 755/A 755M.

1. Surface: Per manufacturers recommendation.
2. High-Performance Organic Finish: Three-coat, thermocured system with color coats containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2604, except as modified for below:

2.2 CONCEALED METALS

A. Aluminum Sheet: ASTM B209, alloy and temper recommended by manufacturer for use and structural performance indicated, mill finished.

B. Aluminum Extrusions: ASTM B221, alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.

C. Stainless-Steel Sheet: ASTM A240, Type 304.

D. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653, G90 (Z275) coating designation; structural quality.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, separators, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.

C. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

D. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.

E. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.4 COPINGS

A. Copings: Manufactured coping system consisting of formed-metal coping cap in section lengths not exceeding 12 feet, concealed anchorage, concealed splice plates with same finish as coping caps, mitered corner units, and end cap units.

1. Available Manufacturers:

a. Architectural Products Co.

b. ATAS International, Inc.

c. Castle Metal Products.

d. Cheney Flashing Company.

e. Hickman, W. P. Company.

f. Merchant & Evans, Inc.

g. Metal-Era, Inc.

h. Metal-Fab Manufacturing LLC.

i. MM Systems Corporation.

j. Perimeter Systems, a division of Southern Aluminum Finishing Co.

k. Petersen Aluminum Corp.

l. Or equal

2. Coping Caps: Snap-on or Face leg hooked to continuous cleat with back leg fastener exposed, fabricated from the following exposed metal:

a. Prefinished, Zinc-Coated Steel: thickness as indicated on drawings.

3. Coping Cap Color: As indicated on drawings.

4. Corners: Mechanically clinched and sealed watertight.

5. Snap-on Coping Anchor Plates: Concealed, galvanized steel sheet, 12 inches wide, 0.028 inch thick, with integral cleats.

6. Face Leg Cleats: Concealed, continuous galvanized steel sheet.

2.5 ROOF EDGE FLASHINGS

A. Roof Edge Fascia: Manufactured, two-piece, roof edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet and a continuous formed- or extruded-aluminum anchor bar with integral drip edge cleat to engage fascia cover. Provide matching mitered and welded corner units.

1. Available Manufacturers:

a. Hickman, W. P. Company.

b. Metal-Era, Inc.

c. MM Systems Corporation.

d. Or equal

2. Fascia Cover: Fabricated from the following exposed metal:

a. Prefinished, Zinc-Coated Steel: thickness as indicated on drawings.

3. Fascia Cover Color: As indicated on drawings.

4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.

2.6 ROOF EDGE DRAINAGE SYSTEMS

A. Available Manufacturers:

1. Architectural Products Co.
2. ATAS International, Inc.
3. Berger Bros. Co.
4. Castle Metal Products.
5. Cheney Flashing Company.
6. Hickman, W. P. Company.
7. Merchant & Evans, Inc.
8. Metal-Era, Inc.
9. Metal-Fab Manufacturing LLC.
10. MM Systems Corporation.
11. Obdyke, Benjamin Incorporated.
12. Perimeter Systems, a division of Southern Aluminum Finishing Co.
13. Petersen Aluminum Corp.
14. Or equal

B. Prefinished, Zinc-Coated Steel: thickness as indicated on drawings.

2.7 COUNTERFLASHINGS AND REGLETS

A. Available Manufacturers:

1. Castle Metal Products.
2. Cheney Flashing Company.
3. Fry Reglet Corporation.
4. Hickman, W. P. Company.
5. Keystone Flashing Company.
6. Merchant & Evans, Inc.
7. Metal-Era, Inc.
8. MM Systems Corporation.

9. Or equal

B. Counterflashings: Manufactured units in lengths not exceeding 12 feet designed to snap into reglets and compress against base flashings with joints lapped, from the following exposed metal in thickness indicated:

C. Prepainted, Zinc-Coated Steel: thickness as indicated on drawings.

D. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashings indicated with factory-mitered and welded corners and junctions, from the following exposed metal in thickness indicated:

1. Zinc-Coated Steel: thickness as indicated on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install manufactured roof specialties according to manufacturer's written instructions. Anchor manufactured roof specialties securely in place and capable of resisting forces specified in performance requirements. Use fasteners, separators, sealants, and other miscellaneous items as required to complete manufactured roof specialty systems.

1. Install manufactured roof specialties with provisions for thermal and structural movement.

2. Torch cutting of manufactured roof specialties is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

C. Install manufactured roof specialties level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil-canning, buckling, or tool marks.

D. Install manufactured roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.

E. Expansion Provisions: Provide for thermal expansion of exposed manufactured roof specialties. Space movement joints at a maximum of 12 feet with no unplanned joints within 18 inches of corners or intersections.

F. Fasteners: Use fasteners of type and size recommended by manufacturer but of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

G. Seal joints with elastomeric or butyl sealant as required by manufacturer of roofing specialties.

3.2 COPING INSTALLATION

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings to resist uplift and outward forces according to performance requirements.

1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's recommended spacing.

2. Interlock face leg drip edge into continuous cleat anchored to substrate at manufacturer's recommended spacing. Anchor back leg of coping with screw fasteners and elastomeric washers at manufacturers recommended spacing.

3.3 ROOF EDGE FLASHING INSTALLATION

A. Install cleats, cant dams, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings to resist uplift and outward forces according to performance requirements.

3.4 COUNTERFLASHING AND REGLET INSTALLATION

A. Counterflashings: Coordinate installation of counterflashings with installation of base flashings. Insert counterflashings in reglets or receivers and fit tightly to base flashings. Extend counterflashings 4 inches over base flashings. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric or butyl sealant.

END OF SECTION 07 71 00

SECTION 07 71 23 – MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 - GENERAL

1.1 PERFORMANCE REQUIREMENTS

A. General: Gutters and downspouts shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

1.2 SUBMITTALS

A. Submit product data for each type of product indicated in accordance with Section 01 33 00 – Contractor Submittals.

B. Shop Drawings: show joints, types and location of fasteners, and special shapes.

C. Catalog data for stock manufactured items.

D. Samples: Color Samples for items to be factory finished.

1.3 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA 1793. Conform to dimensions and profiles shown, unless more stringent requirements are indicated.

1.4 DELIVERY, HANDLING, AND STORAGE

A. Inspect for damage, dampness, and wet storage stains upon delivery to Site.

B. Remove and replace damaged or permanently stained materials that cannot be restored to like-new location.

C. Carefully handle to avoid damage to surfaces, edges, and ends.

D. Do not open packages until ready for use.

E. Store materials in dry, weathertight, ventilated areas until immediately before installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Architectural Products Co.

2. ATAS International, Inc.

3. Berger Bros. Co.

4. Castle Metal Products.

5. OMG Roofing Products.

6. Metal-Era, Inc.

7. Metal-Fab Manufacturing LLC.

8. Petersen Aluminum Corp.

9. Or approved equal.

2.2 EXPOSED METALS

A. Prefinished, Zinc-Coated Steel Sheet: ASTM A924, Grade A or ASTM A653, G90 zinc coating, commercial quality copper bearing steel, and prefinished by the coil-coating process to comply with ASTM A755, thickness 0.0239-inch (24 gauge), unless otherwise shown.

B. Prefinished Aluminum Sheet: ASTM B209, alloy and temper as required for application and finish. Minimum 0.032-inch thick; finish; shop precoated with fluoropolymer coating (Kynar polyvinylidene fluoride resin) coating; color by Owner.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, separators, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.

C. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

D. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.

E. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.4 ROOF EDGE DRAINAGE SYSTEMS

A. Gutters and Downspouts: Manufactured formed gutter in uniform section lengths not exceeding 12 feet, with mitered and welded or soldered corner units, end caps, outlet tubes, and other accessories. Elevate back edge at least 1 inch (25 mm) above front gutter rim. Furnish with flat-stock gutter straps and gutter support brackets and expansion joints and expansion-joint covers fabricated from same metal as gutters.

1. Fabricate gutter from the following exposed metal:

a. Prefinished, Zinc-Coated Steel: thickness as indicated on drawings.

2. Gutter Style: As indicated on drawings according to SMACNA's "Architectural Sheet Metal Manual."

3. Gutter Accessories: Continuous removable leaf screen with sheet metal frame.

4. Downspouts: Rectangular closed-face with mitered elbows, manufactured from the following exposed metal. Furnish wall brackets, from same material and finish as downspouts, with anchors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install manufactured roof specialties according to manufacturer's written instructions. Anchor manufactured roof specialties securely in place and capable of resisting forces specified in performance requirements. Use fasteners, separators, sealants, and other miscellaneous items as required to complete manufactured roof specialty systems.

1. Install manufactured roof specialties with provisions for thermal and structural movement.

2. Torch cutting of manufactured roof specialties is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

C. Install manufactured roof specialties level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil-canning, buckling, or tool marks.

D. Install manufactured roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.

E. Expansion Provisions: Provide for thermal expansion of exposed manufactured roof specialties. Space movement joints at a maximum of 12 feet with no unplanned joints within 18 inches of corners or intersections.

F. Fasteners: Use fasteners of type and size recommended by manufacturer but of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

G. Seal joints with elastomeric or butyl sealant as required by manufacturer of roofing specialties.

3.2 ROOF EDGE DRAINAGE SYSTEM INSTALLATION

A. General: Install gutters and downspouts to produce a complete roof drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Gutters: Join and seal gutter lengths. Attach gutters to firmly anchored gutter brackets spaced not more than 36 inches apart. Slope gutters to downspouts.

1. Install gutter with expansion joints at locations indicated but not exceeding 25 feet apart. Install expansion joint caps.

2. Install continuous gutter screens on gutters with noncorrosive fasteners, removable for cleaning gutters.

C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide fasteners designed to hold downspouts securely; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.

END OF SECTION 07 71 23

SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Roof curbs.

1.2 SUBMITTALS

A. Product Data: For each type of roof accessory indicated.

1.3 QUALITY ASSURANCE

A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers listed in other Part 2 articles.

2.2 METAL MATERIALS

A. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coated and mill phosphatized for field painting.

2.3 ROOF CURBS

A. Roof Curbs: Provide metal roof curbs, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Fabricate with welded or sealed mechanical corner joints, with integral formed mounting flange at perimeter bottom. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1. Available Manufacturers:

a. Colony Custom Curbs.

b. Commodity Products Company, Inc.

c. Conn-Fab Sales, Inc.

d. Curbs Plus Inc.

e. Custom Curb, Inc.

f. LM Curbs.

g. Loren Cook Company.

h. Metallic Products Corporation.

i. Pate Company (The).

j. Roof Products & Systems Corporation.

k. Roof Products, Inc.

l. Thaler Metal Industries Ltd.

m. ThyCurb; Div. of Thybar Corporation.

n. Uni-Curb, Inc.

o. Vent Products Company, Inc.

2. Load Requirements: Coordinate with mechanical equipment.

3. Material: Galvanized or Aluminum-zinc alloy-coated steel sheet, 0.079 inch (2.0 mm) thick.

4. Liner: Same material as curb, of manufacturer's standard thickness and finish.

5. Factory install wood nailers at tops of curbs.

6. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.

7. Factory insulate curbs with 1-1/2-inch- (38-mm-) thick, polyisocyanurate board insulation.

8. Curb height may be determined by adding thickness of roof insulation and minimum base flashing height recommended by roofing membrane manufacturer. Fabricate units to minimum height of 12 inches (300 mm), unless otherwise indicated.

9. Sloping Roofs: Where slope of roof deck exceeds 1:48, fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Install roof accessories to fit substrates and to result in watertight performance.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum or stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.

2. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.

3. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.

D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

E. Seal joints with elastomeric or butyl sealant as required by manufacturer of roof accessories.

END OF SECTION 07 72 00

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SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install joint sealers shown on the drawings and as specified herein.

1.2 REFERANCE STANDARDS

A. ASTM C834 – Specification for Latex Sealants

B. ASTM C920 – Specification for Elastomeric Joint Sealants

C. ASTM C1193 – Guide for Use of Joint Sealants

D. ASTM C1248 – Test Method for Staining of Porous Substrate by Join Sealants

E. ASTM C1521 – Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints

F. ASTM D2240 – Test Method for Rubber Property – Durometer Hardness

1.3 CONDITIONS

A. Install elastomeric sealants when temperature is in lower third of temperature range recommended by manufacturer for installation.

B. Except as otherwise indicated, joint sealers are required to establish and maintain waterproof continuous seals on a permanent basis, which recognized limitations of wear and aging as indicated for each application. Failures of installed sealers to comply with this requirement will be recognized as failures of materials and workmanship.

1.4 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Product Data for Sealants: Submit manufacturer’s technical data sheets for each product to be used, that includes the following:

1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.

2. List of backing materials approved for use with the specified product.

3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.

4. Substrates the product should not be used on.

5. Substrates for which use of primer is required.

6. Installation instructions, including precautions, limitations, and recommended backing material and tools.

7. Warranties: See warranties as specified in this Section

1.5 QUALITIY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with minimum five years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section and with at least five years of documented experience.

C. Warranty:

1. Special Manufacturer's Warranty: Manufacturer's standard form in which joint sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this section within specified warranty period.

a. Warranty Period for Silicone Sealants: 20 years from Date of Substantial Completion.

b. Warranty Period for Polyurea Sealants: 1 year for Date of Substantial Completion.

c. Warranty Period for All other Types of Sealants: 5 years from Date of Substantial Completion.

2. Include Coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Elastomeric Sealants

1. Joints in Concrete Floors and Sidewalks: One component self-leveling polyurethane sealant conforming to ASTM C920, Type S, Grade P.

2. Joints in Water Containing Structures and Intermittently Submerged Joints: Two component, non-sag, water immersion, polysulfide polymer based elastomeric sealant conforming to ASTM C920, Type M, Grade NS.

3. Exterior Joints in Building Construction: One component, non-sag, SBR polymer based elastomeric sealant conforming to ASTM C920, Type S, Grade NS. Sealant color match substrate.

a. Seal open joints, whether or not the joint is indicated on Drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.

1) Wall expansion and control joints.

2) Joints between door, window, storefront, and other frames and adjacent construction.

3) Joints between different exposed materials.

4) Openings below ledge angles in masonry.

5) Masonry control and expansion joints.

4. Interior Joints in Building Construction: One component multipurpose silicone sealant conforming to ASTM C920, Type S, Grade NS. Color of sealant to match substrate. Translucent where color match is not available.

a. Seal interior joints unless specifically indicated not to be sealed. Interior joints to be sealed include, but are not limited to, the following items.

1) Joints between door, window, storefront, and other frames and adjacent construction.

2) All joints between dissimilar materials.

3) In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.

a) Exception: Through-penetrations in sound-rated assemblies that are also fire-rated assemblies.

5. Do not seal the following type of joints:

a. Intentional weepholes in masonry.

b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.

c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.

d. Joints where installation of sealant is specified in another section.

B. Fire Stopping: Where piping, conduit, wire, or other materials pass through fire rated walls, floors, ceilings or roofs, provide a 1-hour fire rated sealant in accordance with ASTM E814 and UL 1479. Fire-resistant penetration sealant shall be a medium-density, fire-resistant foam that retains form and stability at high temperature.

C. Joint Primer/Sealer: Provide type of joint primer/sealer recommended by sealant manufacturer for joint surfaces to be primed or sealed; non-staining.

D. Sealant Backer Rod: Provide compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable non-absorbent materials as recommended by sealant manufacturer for back-up of and compatibility with sealant. Oversize 30 to 50 percent larger than joint width.

PART 3 - EXECUTION

3.1 JOINT PREPARATION

A. Clean joint surfaces immediately before installation of gaskets, sealants, or caulking compounds. Remove loose materials and foreign matter that could impair adhesion of sealant. Remove dirt, insecure coatings, moisture and other substrates which could interfere with seal. Prepare all joint surfaces as recommended by sealant manufacturer.

B. Use primer on all surfaces as recommended by the product manufacturer. Use backer rod on all joints to control the depth of sealant application to manufacturer's recommended sealant depth.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

3.2 INSTALLATION

A. Comply with manufacturer's printed instructions except where more stringent requirements are shown or specified, and except where manufacturer's technical representative directs otherwise.

B. Employ only proven installation techniques, which will ensure that sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides. Except as otherwise indicated, surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. When horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove so that joint will not trap moisture and dirt.

C. Perform installation in accordance with ASTM C1193.

D. Seal all exposed joints of dissimilar materials and elsewhere as indicated.

E. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability

1. Do not leave gaps between ends of sealant backings.

2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

F. Install sealant free of air pockets, foreign embedded material, ridges, sags, and without getting sealant on adjacent surfaces.

G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

H. Seal bottoms of hollow metal frames to floor at resilient flooring.

I. Seal thresholds in a full continuous bed of sealant.

J. Spillage: Do not allow sealants or compounds to overflow from confines of joints, or spill onto adjoining work, or to migrate into voids of exposed finishes. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage.

K. Recess exposed edges of gaskets and exposed joint fillers slightly behind adjoining surfaces, unless otherwise shown, so that compressed units will not protrude from joints.

3.3 CURE AND PROTECTION

A. Cure sealants in compliance with manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength, and surface durability. Advise Contractor of procedures required for cure and protection of joint sealers during construction period so that they will be without deterioration or damage (other than normal wear and weathering) at time of substantial completion. Cure and protect sealants in a manner which will minimize effects. Replace or restore sealants which are damaged during construction period.

3.4 POST OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that the joints have opened to their greatest width; i.e. at low temperature in thermal cycle. Report failures immediately and repair.

END OF SECTION 07 92 00

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SECTION 08 11 13 – HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install non-fire-rated hollow metal doors and frames.

B. Furnish and install fire-rated hollow metal doors and frames where indicated on the Drawings.

C. Furnish and install thermally insulated hollow metal doors and frames.

1.2 REFERENCE STANDARDS

A. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.

B. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2017.

C. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

E. ASTM A653/A653M- Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process, 2022a.

F. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2015a.

G. ASTM C476 - Standard Specification for Grout for Masonry; 2020.

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.

I. ITS (DIR) - Directory of Listed Products; current edition.

J. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2007.

K. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.

L. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2019.

M. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2017.

N. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.

O. UL (DIR) - Online Certifications Directory; Current Edition.

P. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirement of Section 01 33 00 – Submittal Procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide hollow metal doors and frames from SDI Certified manufacturer: www.steeldoor.org/sdicertified.php/#sle.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

C. Maintain at project site copies of reference standards relating to installation of products specified.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Hollow Metal Doors and Frames:

1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.

2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.

3. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.

4. Steelcraft, an Allegion brand: www.allegion.com/#sle.

5. Or approved equal.

2.2 PERFORMANCE REQUIREMENTS

A. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.3 HOLLOW METAL DOORS

A. Exterior Doors: Thermally insulated.

1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).

a. Level 3 - Extra Heavy-duty.

b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.

c. Model 1 - Full Flush.

d. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum, hot dipped zinc, G90 coated that complies with ASTM A924 & ASTM A653 on both sides.

2. Door Core Material: Polyurethane, 2.0 lbs/cu ft minimum density.

a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.

b. Minimum R-value 2.5

3. Door Thickness: 1-3/4 inches, nominal.

4. Door Finish: Factory primed per SDI/DOOR A250.8 and field finished.

B. Interior Doors, Non-Fire-Rated:

1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).

a. Level 3 - Extra Heavy-duty.

b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.

c. Model 1 - Full Flush.

d. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum, hot dipped zinc, G90 coated that complies with ASTM A924 & ASTM A653 on both sides.

2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.

3. Door Thickness: 1-3/4 inches, nominal.

C. Fire-Rated Doors:

1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).

a. Level 3 - Extra Heavy-duty.

b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.

c. Model 1 - Full Flush.

d. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum, hot dipped zinc, G 90 coated that complies with ASTM A924 & ASTM A653 on both sides..

2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").

3. Provide units listed and labeled by UL (DIR) or ITS (DIR).

a. Attach fire rating label to each fire rated unit.

4. Door Thickness: 1-3/4 inches, nominal.

2.4 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Exterior Door Frames: Face welded type.

1. Frame Metal Thickness: 14 gauge, 0.067 inch, minimum, hot dipped zinc, G 90 coated, that complies with ASTM A924 & ASTM A653.

2. Frame Finish: Factory primed and field finished.

3. Weatherstripping: Separate, see Section 08 71 00 – Door Hardware.

C. Interior Door Frames, Non-Fire Rated: Face welded type.

1. Frame Metal Thickness: 14 gauge, 0.067 inch, minimum.

2. Frame Finish: Factory primed and field finished.

D. Door Frames, Fire-Rated: Face welded type.

1. Fire Rating: Same as door, labeled.

2. Frame Metal Thickness: 14 gauge, 0.067 inch, minimum.

3. Frame Finish: Factory primed per SDI/DOOR A250.8 and field finished.

2.5 FINISHES

A. Primer: Factory primed per SDI/DOOR A250.8, door manufacturer's standard.

B. Field finish: Finish coat per Section 09 90 00 – Painting and Coatings.

2.6 ACCESSORIES

A. Louvers: Roll formed steel with overlapping frame; finish same as door components; factory-installed.

1. Style: Standard straight slat blade.

2. Fasteners: Exposed or concealed fasteners.

B. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.

C. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

D. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.2 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

E. Install door hardware as specified in Section 08 71 00 – Door Hardware.

3.3 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.4 ADJUSTING

A. Adjust for smooth and balanced door movement.

END OF SECTION 08 11 13

SECTION 08 31 00 – ACCESS DOORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide and install access doors in locations as shown on the drawings and as specified herein. Access doors for valve vaults shall be standard doors as specified herein. Access doors for pump hatch at wet wells shall be safety barrier doors, designed with safety grate to provide fall protection.

B. Provide ladder safety post as per schedule.

C. Refer to the Access Door Schedule at the end of this section for specific locations and design requirements.

1.2 STANDARDS

A. “Architectural Sheet Metal Manual” by Sheet Metal and Air Conditioning Contractor’s National Association, Inc. (SMACCNA).

B. ASTM A36: Standard Specification for Structural Steel

1.3 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirement of Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: For each type of door, showing all data required for installation and anchoring. Drawings to include profiles, accessories, location, adjacent construction interface, dimensions, and installation and anchoring instructions

C. Manufacturer’s Data: Submit manufacturer’s product data and installation requirements.

D. Provide manufacturer’s warranty. Material shall be free of defects and workmanship for a period of 5 years form the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years documented experience.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum: ASTM B209 plate alloy 3003-H 14 or 5005-H 14, 1/4-inch minimum thickness and 6063 T5 extruded frame.

B. Steel ASTM A36 grade, 1/4-inch minimum thickness.

C. Stainless Steel: Type 316.

D. Neoprene: Closed cell foam, ASTM C509, 10 pounds per cubic foot density.

E. Odor Control and Debris Gaskets: EPDM rubber, ASTM D2000 M2MAA607

2.2 FABRICATION

A. Standard Doors: Fabricate a frame of extruded aluminum and doors of diamond plate aluminum. All doors shall be reinforced to support 300 pounds per square foot and a maximum deflection of 1/150 the span or AASHTO HS-20 loading as indicated in schedule. Provide with neoprene seal. Equip door with lock key. Provide lower side with handle, hold open arm, and torsion spring or other opening assisting device. Provide Bilco Model J or JD, Babcock-Davis, Milcor or equal. Provide frame anchors, 8 min.

1. Frame: Channel frame shall be 1/4-inch aluminum with full anchor flange around the perimeter.

2. Cover: Shall be 1/4-inch aluminum diamond pattern.

3. Hinges: Shall be designed for horizontal installation and shall be thru-bolted to the cover with tamper-proof type 316 stainless steel lock bolts and shall be thru-bolted to the frame with type 316 stainless steel bolts and locknuts.

4. Drain Coupling: Provide a 1-1/2-inch drain coupling located in the right front corner of the channel frame. Drain coupling can be placed at a different location if specified.

5. Lifting Mechanisms: Manufacturer shall provide the required number and size of compression spring operators enclosed in telescopic tubes to provide smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe fastened to a formed 1/4-inch gusset support plate.

6. Exterior Handle: A removable exterior turn/lift handle with a spring-loaded ball detent shall be provided to open the cover and the latch release shall be protected by a flush, gasketed, removable screw plug.

7. Hardware:

   a. Hinges: Heavy forged brass hinges, each having a minimum 3/8-inch diameter type 316 stainless steel pin, shall be provided and shall pivot so the cover does not protrude into the channel frame.

   b. Cover: Shall be equipped with a hold open arm which automatically locks the cover in the open position. Cover shall be fitted with the required number and size of compression spring operators. A type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the cover.

   c. Hardware: Compression spring tubes shall be anti-corrosive composite. All fasteners and hardware shall be Type 316 stainless steel material.

B. Safety Barrier Doors: Safety barrier doors shall be designed to combine covering of the opening, fall through protection and controlled confined space entry. The safety barrier doors shall be installed inside the pump hatch opening for the lift station.

1. Material shall be 6061-T6 aluminum for bars, angles, and extrusions; 1/4-inch diamond plate shall be 5086 aluminum. Safety grate shall be rated at 300 pounds per square foot and designed to meet OSHA 29 CFR 1910.23 requirements. Cover without safety grate shall be rated at 150 pounds per square foot. Hatch frame shall be of extruded aluminum, with a continuous anchor flange.

2. Cover hinges shall be grade 316 stainless-steel. Hinge shall be fastened to the frame extrusion and diamond plate with grade 316 stainless steel bolts and ny-lock nuts. All hardware shall be stainless steel except for the rail nuts, which shall be aluminum.

3. Each hatch shall be supplied with a recessed padlock clip. Padlock to be provided by Owner. Each door shall be equipped with a cover stay. Door shall lock open in the 90-degree position.

4. Grate openings shall allow for visual inspection, limited maintenance, and float adjustments while the safety grate fall through protection is left in place. Design shall assure that the fall through protection is in place before the doors can be closed, thereby protecting the next operator. Each grate shall be provided with a permanent hinging system, which shall lock the grate in the 90-degree position once opened. Each grate shall have a pull open arm, designed so the grate can be pulled open, with the grate acting as a barrier between the operator and the pit. The opening arm shall also be equipped with a controlled confined space entry lock to said in controlling unauthorized entry to the confined space. The grating system shall allow anyone to make visual inspection and float adjustments without entering the confined space.

5. Each aluminum safety grate shall be coated with a safety orange color, promoting visual awareness of the hazard. The coating shall be provided by manufacturer and shall be a thermosetting, powder coat finish with a minimum thickness of 2-4 mils and shall be baked at 350-375 degrees Fahrenheit until cured.

6. Safety barrier shall be as manufactured by ITT Flygt (Safe Hatch) or approved equal.

2.3 ACCESSORIES

A. Provide ladder safety extension constructed of aluminum and/or stainless steel for each ladder specified in the Schedule. The safety extension shall mount to the precast manhole steps or ladder with stainless steel clamps secured to the ladder rungs. The telescoping post shall extend approximately 3 feet above the top of the hatch and shall lock into position. Provide Series L1E by Halliday, Bilco LadderUP safety post Model LU-3 or LU-4, or equal.

2.4 FINISH

A. Mill finish aluminum with lacquer on exposed sides and bituminous coatings on concealed surfaces that come in contact with concrete.

2.5 ACCESS DOOR SCHEDULE

A. Provide access doors as follows:

DOOR LOCATION	SIZE	SINGLE DOOR	DOUBLE DOOR	LOAD RATING	CHANNEL FRAME	LADDER SAFETY POST	SAFETY GRATING
Chemical Leak Detection Vault	36” x 48”		X	H20	X	X	X
Digester Outlet Vault	4’ x 6’		X	H20	X	X	X
D1 – Wetwell (2 Each)	3’ x 2’-6”	X		H20	X		X
D1- Wetwell	2’-6” x 4’		X	H20	X		X
D1 – Valve Vault	5’ x 5’		X	H20	X	X	
D1 -Valve Vault	4’ x 6’		X	H20	X	X	

PART 3 - EXECUTION

3.1 INSTALLATION

A. Deliver products in manufacturer’s original packaging. Store materials in a dry, well-vented area.

B. Verify rough openings are correctly sized and located.

C. Coordinate with trades installing adjacent materials. Anchor firmly to lid by casting into concrete or equivalent fasteners as approved.

D. Install in accordance with Manufacturer’s instructions and approved shop drawings.

E. Test units for proper function and adjust until proper operation is achieved.

3.2 CHANNEL DOOR DRAINS

A. Channel drains in normally dry vaults and manholes shall be piped to the floor drain or shall be piped through the wall to drain outside in the adjacent soil if there is not a floor drain in the vault.

B. Drainpipe shall be Schedule 40, Type 316 stainless steel and shall be a minimum of 1 1/2" diameter. Support piping in accordance with specifications using only Type 316 stainless steel supports, hardware, and anchors.

C. Wall pipe penetrations shall be as per the Mechanical standard details and shall be water-tight.

D. Wrap a minimum of 2' x 2' x 2' of gravel in filter fabric adjacent to the manhole or vault for channel drain discharge.

3.3 ADJUSTING AND CLEANING

A. Adjust doors and hardware after installation for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 31 00

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SECTION 08 33 23 – OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install overhead coiling doors, operating hardware, non-fire-rated and exterior, manual operated with dimensions as indicated on the Drawings.

1.2 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.

B. ITS (DIR) - Directory of Listed Products; current edition.

C. UL (DIR) - Online Certifications Directory; Current Edition.

D. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. General: All submittals shall be in accordance with the requirements of Section 01 33 00-Submittal Procedures.

B. Product Data: Provide general construction and component connections and details.

C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

1. Provide summary of forces and loads on walls and jambs.

D. Provide color samples for Owner’s selection.

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.5 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to ASCE 7.

1. The term “withstand” means “the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified”.

2. Seismic Component Importance Factor: As indicated on the Structural Drawings.

B. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than the number of cycles indicated for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position. The minimum requirements for all rolling service doors is a standard maximum of 25 cycles per day and an overall maximum of 50,000 operating cycles for the life of the door.

1.6 WARRANTY

A. Provide two-year manufacturer limited warranty for three-ply multifilament polyester fabric curtain.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Overhead Coiling Doors:

1. Alpine Overhead Doors, Inc; www.alpinedoors.com/#sle.

2. C.H.I. Overhead Doors: www.chiohd.com/#sle.

3. Clopay Building Products: www.clopaydoor.com/#sle.

4. Cornell Iron Works, Inc; www.cornelliron.com/#sle.

5. Raynor Garage Doors: www.raynor.com/#sle.

6. The Cookson Company: www.cooksondoor.com/#sle.

7. Wayne-Dalton, a Division of Overhead Door Corporation: www.wayne-dalton.com/#sle.

2.2 COILING DOORS

A. Exterior Coiling Doors: Steel slat curtain.

1. Capable of withstanding positive and negative wind loads of 20 psf, without undue deflection or damage to components.

2. Single thickness slats.

3. Nominal Slat Size: 2 inches wide by required length.

4. Finish: Galvanized with factory applied Powder-Coat finish with color selected by owner.

5. Guides, Formed Sheet Metal: Galvanized steel.

6. Hood Enclosure: Manufacturer's standard; primed steel.

7. Manual operation.

8. Mounting: Within framed opening.

9. Standard slat construction with insulated core of foamed-in-place polyurethane insulation, minimum R-value of 8.1

2.3 MATERIALS AND COMPONENTS

A. Metal Curtain Construction: Hinged slats.

1. Curtain Bottom for Panel-Slat Curtains: Extruded aluminum.

2. Weatherstripping for Exterior Doors: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.

3. Steel Slats: Minimum thickness, 18 gauge, 0.478 inch; ASTM A653/A653M galvanized steel sheet.

a. Galvanizing: Minimum G90 coating.

B. Guide Construction: Continuous, of profile to retain door in place, mounting brackets of same metal.

C. Guides - Sheet Metal: Formed from 16 gauge sheet metal by 2 inches wide minimum.

1. Hot-Dip Galvanizing: Minimum G90 coating, in compliance with ASTM A653/A653M.

D. Hood Enclosure and Trim: Internally reinforced to maintain rigidity and shape.

E. Lock Hardware:

1. Lock or latching mechanisms per manufacturer

F. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb. nominal force to operate.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that opening sizes, tolerances, and conditions are acceptable.

3.2 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Install enclosure and perimeter trim.

3.3 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation From Plumb: 1/16 inch.

C. Maximum Variation From Level: 1/16 inch.

D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 feet straight edge.

3.4 ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.

3.5 CLEANING

A. Clean installed components

B. Remove labels and visible markings.

END OF SECTION 08 33 23

SECTION 08 51 13 – ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install window units complete with glazing and necessary anchors and accessories, including glazing beads.

B. The Drawings indicate sizes, profiles, dimensional requirements, and aesthetic effects of windows and are based on the specific window types and models indicated. Other window manufacturers whose products have equal performance characteristics may be considered provided deviations in size, profile, and dimensions are minor and do not alter the aesthetic effect.

1.2 REFERENCE STANDARDS

A. ANSI/AAMA 108-88, AAMA 1502 & 1503

B.	ASTM B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars
C.	ASTM C509	Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material
D.	ASTM D2000	Standard Classification System for Rubber Products in Automotive Applications
E.	ASTM D2287	Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
F.	ASTM E283	Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
G.	ASTM E331	Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

H. Aluminum Association

1.3 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 – Submittal Procedures. Submit drawings showing window type, fabrication, and installation of each type of window required including information not fully detailed in manufacturers standard Product Data.

B. Product Data: The manufacturer's specifications, literature, and published installation instructions for all components of the window units shall be submitted by the Contractor.

C. Samples for Verification: The Engineer reserves the right to require additional samples that show fabrication techniques, workmanship, and accessories.

D. Test Reports: The Contractor shall submit certified independent laboratory test reports verifying compliance with all test requirements and structural calculations prepared by registered structural engineer licensed in the State where Work is being performed, and indicating adequacy of all installed materials to meet the uniform and structural load requirements as specified

1.4 QUALITY CONTROL

A. Single-Source Responsibility: Aluminum windows, frames, and all accessories shall be obtained from one source and by a single manufacturer.

B. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

C. Special Warranty: A written warranty signed by aluminum window manufacturer agreeing to repair or replace window components that fail in materials or workmanship within the specified warranty period shall be submitted. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.

2. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

D. The warranty period shall last for three (3) years after date of Substantial Completion. The warranty period for metal finishes and glass shall be for five (5) years after Substantial Completion.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Comply with minimum test requirements of AAMA for classification of specified window in following: (1) Air infiltration; (2) Water Resistance; and (3) Uniform Structural Load

B. Each window shall be designed to conform with AAMA performance class of CW and Performance Grade at least as high as specified design pressure.

C. Condensation Resistance Factor (CFR) of 48 minimum when tested in accordance with AAMA 1502 Standards.

D. Thermal Transmittance of 0.65 maximum when tested in accordance with AAMA 1503 Standards.

2.2 FIXED WINDOWS

A. Unless otherwise specified, all exterior windows shall be fixed aluminum units. Provide pre-glazed dual units having both a primary and secondary glazing combined into one unit for energy conservation.

B. Thermally broken system with poured-in-place and de-bridged structural thermal break.

C. Aluminum Extrusions: Provide aluminum alloy 6063-T5 tempered extrusions that satisfy all ASTM B221 requirements. Aluminum alloy shall have ultimate tensile strength of not less than 22,000-psi and not less than 0.062-inch thick at any location for main frame and sash members.

D. Weatherstrip: Unless otherwise indicated, and at manufacturer's option, provide compressible stripping for glazing and weatherstripping such as molded EPDM or neoprene gaskets complying with ASTM D2000 Designation 2BC415 to 3BC620, or molded PVC gaskets complying with ASTM D2287, or molded expanded EPDM or neoprene gaskets complying with ASTM C509, Grade 4.

E. Glazing Characteristics: Provide bronze or gray on exterior side/clear on interior side and supply manufacturer’s standard glazing beads.

F. Approved Manufacturers, or Equal

1. Aluma - Glass Inc.

2. U.S. Metal Manufacturing Corp.

2.3 FABRICATION

A. Aluminum window units shall be fabricated to comply with indicated standards. A complete system for assembly of components and anchorage of window units shall be included.

B. Units that are reglazable without dismantling sash framing shall be provided. Frame shall be 2-7/16 inch by 4 inches wide, with minimum 0.125-inch wall thickness.

C. Windows shall be preglazed at the factory.

D. Subframes: Provide subframes with anchors for window units of not less than 0.062-inch thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units.

E. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated.

F. Glazing Stops: Provide screw-applied or snap-on glazing stops, coordinated with glass selection and glazing system indicated. Finish to match window units.

2.4 FINISHES

A. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

B. Architectural Class II minimum anodizing.

C. Color to be selected by the Owner.

2.5 ACCESSORIES

A. Fasteners: Provide aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components of window units.

B. Reinforcement: Where fasteners screw anchor into aluminum less than 1/8-inch thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads or provide standard, noncorrosive, pressed-in, splined grommet nuts.

C. Exposed Fasteners: Except where unavoidable for application of hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

D. Anchors and Clips: Fabricate anchors, clips, and window accessories of aluminum or nonmagnetic stainless steel. Other corrosion-resistant or insulated anchors as specifically approved in writing prior to use. Sufficient strength to withstand design pressure indicated shall be provided.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation of window units, and other components of the Work shall comply with the manufacturer's specifications and recommendations.

3.2 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Manufactured products shall be delivered in original unbroken packages, containers, or crating, bearing the manufacturer's label with manufacturer's name, product description, and rating.

B. Storage: All products shall be carefully stored in an area that is protected from the elements, in a manner recommended by the products manufacturer. Storage shall be in a manner that will prevent damage to the product and its finish.

3.3 INSPECTION

A. Inspect openings before installation. Verify that rough or masonry opening is correct, and that sill is level. Masonry surfaces shall be visibly dry and free of excess mortar, sand, and other construction debris.

3.4 INSTALLATION

A. Experienced mechanics shall install windows. Do not force windows into openings.

B. Set receptors or sub-frames plumb, level, and in alignment. Secure window proper to receptor or sub-frame with anchors and fastening devices supplied by Manufacturer.

C. Bed joints at mullions and contacts of windows with sills in specified sealant. Trim off excess sealant.

D. Avoid direct contact between aluminum and adjacent steel work by insulating with materials equal to 3M's EC 1202 tape if materials are in pressure contact, or with bituminous paint if pressure between surfaces cannot be maintained.

E. Protect window surfaces from adjacent work as necessary.

F. Sill members shall be set in sill pan (seal edges) and other members in a bed of sealant with joint fillers to provide weathertight construction. The Contractor shall coordinate installation of the window units with wall flashings and other components of the Work.

1. Sealants, joint fillers, and gaskets to be installed after installation of window units as specified in Section 07 92 00 – Joint Sealants.

3.5 CLEANING

A. Clean aluminum and glass surfaces promptly after installing windows. Exercise care to avoid damage to protective coatings and finishes. Remove excess glazing and sealant compounds, dirt, and other substances.

END OF SECTION 08 51 13

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SECTION 08 71 00 – DOOR HARDWARE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install all hardware for wood and hollow metal doors, fire-rated doors, thresholds, weatherstripping and gasketing.

1.2 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. BHMA A156.1 - American National Standard for Butts and Hinges; 2016.

C. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches; 2017.

D. BHMA A156.4 - American National Standard for Door Controls - Closers; 2013.

E. BHMA A156.6 - American National Standard for Architectural Door Trim; 2015.

F. BHMA A156.16 - American National Standard for Auxiliary Hardware; 2018.

G. BHMA A156.18 - American National Standard for Materials and Finishes; 2016.

H. BHMA A156.21 - American National Standard for Thresholds; 2014.

I. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems Sponsor; 2017.

J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

K. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2019.

L. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2017.

M. UL (DIR) - Online Certifications Directory; Current Edition.

N. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

B. Keying Requirements Meeting:

1. Schedule a keying meeting prior to securing and installing the door hardware.

2. Attendance Required:

   a. Contractor.

   b. Owner.

3. Agenda:

   a. Establish keying requirements.

   b. Verify locksets and locking hardware are functionally correct for project requirements.

4. Deliver established keying requirements to manufacturers.

5. Furnish keys in the following quantities:

Number of Keys	Type of Key
4 each	Master keys per set
2 each	Change keys each keyed core
6 each	Construction master keys
2 each	Control keys

1.4 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirement of Section 01 33 00 – Submittal Procedures.

B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.

   1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).

   2. Provide complete description for each door listed.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years of documented experience.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. All door hardware to be made of stainless steel or aluminum unless noted otherwise.

C. Provide individual items of single type, of same model, and by same manufacturer.

D. Provide door hardware products that comply with the following requirements:

1. Applicable provisions of federal, state, and local codes.

2. Accessibility: ADA Standards and ICC A117.1.

3. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

4. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR) or testing firm acceptable to authorities having jurisdiction as suitable for application indicated.

2.2 HINGES

A. Hinges: Comply with BHMA A156.1, Grade 1.

1. Provide hinges on every swinging door.

2. All hinges and pivots shall be of stainless steel unless otherwise specified.

3. Provide ball-bearing hinges at each door with closer.

4. Provide non-removable pins on exterior outswinging doors.

5. Provide following quantity of butt hinges for each door:

a. Doors up to 60 inches High: Two hinges.

b. Doors From 60 inches High up to 90 inches High: Three hinges.

c. Doors 90 inches High up to 120 inches High: Four hinges.

2.3 FLUSH BOLTS

A. Flush Bolts: Comply with BHMA A156.16, Grade 1.

1. Flush Bolt Throw: 3/4 inch, minimum.

2. All flush bolts shall be of stainless steel unless otherwise specified.

3. Provides extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.

    a. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.

4. Manual Flush Bolts: Provide lever extensions for top bolt at over-sized doors.

2.4 LOCK CYLINDERS

A. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.

1. Provide cylinders from same manufacturer as locking device.

2. Provide cams and/or tailpieces as required for locking devices.

2.5 CYLINDRICAL LOCKS

A. Cylindrical Locks (Bored): Comply with BHMA A156.2, Grade 2, 4000 Series.

1. Bored Hole: 2-1/8 inch diameter.

2. Latchbolt Throw: 1/2 inch, minimum.

3. Material: Stainless steel unless otherwise indicated.

4. Backset: 2-3/4 inch unless otherwise indicated.

5. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.

    a. Finish: To match lock or latch.

6. Provide a lock for each door, unless otherwise indicated that lock is not required.

7. Trim: Provide lever handle or pull trim on outside of each lock, unless otherwise indicated.

2.6 CLOSERS

A. Closers: Comply with BHMA A156.4, Grade 1.

1. Type: Surface mounted to door.

2. Provide door closer on each fire-rated and smoke-rated door.

    a. Spring hinges are not an acceptable self-closing device, unless otherwise indicated.

3. At out swinging exterior doors, mount closer on interior side of door.

2.7 PROTECTION PLATES

A. Protection Plates: Comply with BHMA A156.6.

B. Metal Properties: Stainless Steel.

1. Metal, Standard Duty: Thickness 0.05 inch, minimum.

C. Edges: Beveled, on four sides unless otherwise indicated.

D. Fasteners: Countersunk screw fasteners.

2.8 ARMOR PLATES

A. Armor Plates: Provide on bottom half of push side of doors that require protection from objects moving through openings that may damage door surface.

1. Size: 16 inch high by 1-1/2 inch less door width (LDW) on pull side and 2 inch LDW on push side of door.

2. Armor Plates shall be stainless steel unless otherwise noted.

2.9 KICK PLATES

A. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.

1. Size: 8 inch high by 2 inch less door width (LDW) on push side of door.

2. All kick plates shall be of stainless steel unless otherwise specified.

2.10 FLOOR STOPS

A. Floor Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.

1. Type: Manual hold-open, with pencil floor stop.

2. Material: Aluminum housing with rubber insert.

2.11 WALL STOPS

A. Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.

1. Type: Bumper, concave, wall stop.

2. Material: Aluminum housing with rubber insert.

2.12 THRESHOLDS

A. Thresholds: Comply with BHMA A156.21.

1. Provide threshold at each exterior door, unless otherwise indicated.

2. Type: Flat surface.

3. Material: Aluminum.

4. Threshold Surface: Fluted horizontal grooves across full width.

5. Field cut threshold to profile of frame and width of door sill for tight fit.

6. Provide non-corroding fasteners at exterior locations.

2.13 WEATHERSTRIPPING AND GASKETING

A. Weatherstripping and Gasketing: Comply with BHMA A156.22.

1. Head and Jamb Type: Adjustable.

2. Door Sweep Type: Encased in retainer.

3. Material: Aluminum, with neoprene weatherstripping.

4. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated; .

5. Provide door bottom sweep on each exterior door, unless otherwise indicated.

2.14 SILENCERS

A. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.

1. Single Door: Provide three on strike jamb of frame.

2. Pair of Doors: Provide two on head of frame, one for each door at latch side.

3. Material: Rubber, gray color.

4. Silencers are NOT required on doors with weather seals.

2.15 FINISHES

A. Finishes: Provide door hardware of same finish, unless otherwise indicated.

1. Primary Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.

2. Secondary Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.

a. Use secondary finish in kitchens, bathrooms, and other spaces containing chrome or stainless steel finished appliances, fittings, and equipment; provide primary finish on one side of door and secondary finish on other side if necessary.

PART 3 - EXECUTION

3.1 HARDWARE SCHEDULED

A. The hardware schedule is arranged for convenience of locating hardware and does not preclude in any way the requirements that all necessary hardware shall be furnished and properly installed. Hardware not specifically called out shall be similar to that required for similar uses.

1. Hardware Set 1: Each single, exterior roll-up or sectional door shall be by door manufacturer. All related and necessary finish hardware items shall be provided by overhead door manufacturer as required for a complete, fully functional and waterproof door assembly installation.

2. Hardware Set 2: Each single, exterior door shall have:

Quantity	Description
Per spec	Hinges
1	Lockset, entrance
1	Interior panic bar
1 set	Surface closer
1	Seals & Wall Stop (provide both),
1	Door Threshold
1 pair	Kick plates
1	Door bottom
1	Drip, head

3. Hardware Set 4: Each single, interior door shall have:

Quantity	Description
Per spec	Hinges
1	Surface closer seals
1	Wall Stop
1	Lever lock set

1. Hardware Set 5: Each double, interior door shall have:

Quantity	Description
Per spec	Hinges
2	Surface closer seals
1	Wall Stop
1	Lever lock set

Quantity	Description
1	Bottom and top flush bolts on inactive door only

3.2 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.

C. Use templates provided by hardware item manufacturer.

D. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.

E. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.3 ADJUSTING

A. Adjust work under provisions of Section 01 70 00 - Execution and Closeout Requirements.

B. Adjust hardware for smooth operation.

C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.4 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

B. Clean adjacent surfaces soiled by hardware installation.

3.5 PROTECTION

A. Protect finished Work under provisions of Section 01 70 00 - Execution and Closeout Requirements.

B. Do not permit adjacent work to damage hardware or finish.

END OF SECTION 08 71 00

SECTION 08 80 00 – GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Doors

1.2 REFERENCE STANDARDS

A. 16 CFR 1201 – Safety Standard for Architectural Glazing Materials

B. ANSI Z97.1 – American National Standard for Safety Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test

C. ASTM C920 – Specification for Elastomeric Joint Sealants

D. ASTM C1036 – Specification for Flat Glass

E. ASTM C1048 – Specification for Heat-Strengthened and Fully Tempered Flat Glass

F. ASTM C1172 – Specification for Laminated Architectural Flat Glass

G. ASTM C1193 – Guide for Use of Joint Sealants

H. ASTM C1376 – Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass

I. ASTM E2190 – Specification for Insulating Glass Unit Performance and Evaluation

J. GANA (GM) – GANA Glazing Manual

K. GANA (SM) – GANA Sealing Manual

L. GANA (LGRM) – Laminated Glazing Reference Manual

M. IGMA TM-3000 – North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use

1.3 DEFINITIONS

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C1036.

C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.4 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirement of Section 01 33 00 – Submittal Procedures.

B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical, and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

D. Selection Samples: Provide manufacturer’s full range of colors for glazing sealants and opacifier coating.

E. Certificate: Certify that products of this section meet or exceed specified requirements.

F. Warranty: See warranties as specified in this Section. Submit manufacturer warranty and ensure that forms have been completed in Owner’s name and registered with manufacturer.

1.5 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.

2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.

3. Center-of-Glass Values: Based on using LBL-44189 WINDOW 5.0 computer program for the following methodologies:

a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F.

b. Solar Heat Gain Coefficient: NFRC 200.

c. Solar Optical Properties: NFRC 300.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LRGM), IGMA TM-3000, and IGMA TB-3001 for glazing installation methods.

B. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance", and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).

C. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass, coated float glass and insulating glass.

D. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

E. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and, for wired glass, ANSI Z97.1.

1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of manufacturer acceptable to authorities having jurisdiction.

2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in area, provide glazing products that comply with Category II materials, and for lites 9 sq. ft. or less in area, provide glazing products that comply with Category I or II materials.

F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Glazing Manual."

2. IGMA Publication for Insulating Glass: IGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."

G. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:

1. Insulating Glass Certification Council.

2. Associated Laboratories, Inc.

1.7 WARRANTY

A. Insulating Glass Units: Provide a five-year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

B. Laminated Glass: Provide a five-year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.

C. Coated Glass: Provide a ten-year manufacturer warranty to include deterioration of coated glass including peeling, cracking, and other indications of deterioration of coating.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS

A. Heat-Treated Float Glass: ASTM C1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.

2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.

3. For uncoated glass, comply with requirements for Condition A.

4. For coated vision glass, comply with requirements for Condition C (other uncoated glass).

5. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.

B. Pyrolytic-Coated Float Glass: ASTM C1376, float glass with metallic-oxide coating applied by pyrolytic deposition process during initial manufacture and complying with other requirements specified.

C. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace.

1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.

2. Provide Kind FT (fully tempered) glass lites where safety glass is indicated.

3. Overall Unit Thickness and Thickness of Bach Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.

4. Sealing System: Dual Seal, with primary and secondary sealants as follows:

a. Manufacturer's standard sealants.

5. Spacer Specifications: Manufacturer's standard spacer material and construction.

2.2 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and 'shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type 0 (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

2.3 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

2.4 MONOLITHIC FLOAT-GLASS UNITS

A. Uncoated Clear Float-Glass Units: Class 1 (clear) Kind HS (heat-strengthened) float glass.

1. Thickness: 6.0 mm.

B. Coated Clear Float-Glass Units: Class 1 (clear) Kind HS (heat-strengthened) float glass.

1. Thickness: 6.0 mm.

2. Reflective Coating: Pyrolytic.

a. Color: Silver.

b. Location: Second surface.

2.5 INSULATING-GLASS UNITS

A. Passive Solar Low-E Insulating-Glass Units:

1. Available Products:

a. AFG Industries, Inc.

b. Ford Glass Division

c. Guardian Industries, Inc.

d. Hordis Brothers, Inc.

e. PPG Industries, Inc.

2. Overall Unit Thickness and Thickness of Bach Lite: 16 and 5.0 mm.

3. Interspace Content: Air.

4. Outdoor Lite: Class 1 (clear) float glass.

PART 3 - EXCECUTION

3.1 PREPARATION

A. Verify openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that the minimum required face and edge clearances are being provided.

C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

D. Verify that sealing between joints of glass framing members has been completed effectively.

E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

F. Clean contact surfaces with appropriate solvent and wipe dry within maximum 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

G. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

3.2 INSTALLATION

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM) and manufacturer’s instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior, or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, but not limited to the following: weld splatter, fire-safing, plastering, mortar droppings, etc.

3.3 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to the glass surface. Remove non-permanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass Manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08 80 00

SECTION 08 91 00 - LOUVERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work includes furnishing and installing fixed and operable louvers at the location and size shown on the drawings.

1.2 REQUIREMENTS

A. Structural Performance: Provide exterior metal louvers capable of withstanding the effects of loads and stresses from wind and normal thermal movement without evidencing permanent deformation of louver components including blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter; or permanent damage to fasteners and anchors.

1. Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft. acting inward or outward.

B. Air-Performance, Water-Penetration, and Air-Leakage Ratings: Provide louvers complying with performance requirements indicated, as demonstrated by testing manufacturer's stock units 48 inches wide by 48 inches high. Test units according to AMCA 500.

1. Perform testing on unpainted, cleaned, degreased units.

2. Perform water-penetration testing on louvers without screens.

C. Weather Louver Effectiveness: Provide louvers complying with performance requirements indicated, as demonstrated by testing manufacturer’s stock units for a 60 minute test in accordance with AMCA Standard 500-L-99, Wind Driven Rain Water Penetration Test.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: For each type of product specified.

C. Shop Drawings: For louver units and accessories. Include plans; elevations; sections; and details showing profiles, angles, and spacing of louver blades. Show unit dimensions related to wall openings and construction; free area for each size indicated; profiles of frames at jambs, heads, and sills; and anchorage details and locations.

D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221, alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209 alloy 3003 or 5005 with temper as required for forming.

C. Aluminum Castings: ASTM B 26/B alloy 319.

D. Fasteners: Of same basic metal and alloy as fastened metal or 300 series stainless steel, unless otherwise indicated.

E. Anchors and Inserts: Stainless steel.

F. Provide stainless steel where shown.

2.2 FIXED LOUVERS

A. Louver Construction: Provide fixed-blade louvers with extruded-aluminum frames and blades.

B. Horizontal Louvers: Drainable blade type complying with the following:

1. Retain one subparagraph from each set below or revise to suit Project.

2. Louver Depth: 4 inches

3. Frame Thickness: 0.125 inch

4. Blade Thickness: 0.081 inch, Blade angle 45 degrees

5. Performance Requirements: Maximum standard airflow point for water penetration 1,192 fpm

6. Performance Requirements: Maximum standard airflow not less than 7500 cfm with not more than 0.18 inch wg static pressure loss.

7. Minimum percent of free area of louver: 40

8. Verify availability of seal below for louver sizes indicated. Delete if not required. See Editing Instruction No. 2 in the Evaluations.

9. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.3 MOTOR OPERATED LOUVERS

A. Louver Construction and Operation: Provide combination dual blade adjustable louvers with extruded-aluminum frames and blades, and with operating mechanisms to suit louver sizes.

B. Motor operation, with two-position, spring-return application (with power on, motor opens louver; with power off, spring closes louver); 110-V, 60-Hz motor; and limit switch wired for grounding; equipped as follows:

1. Toggle switch mounted on louver frame, ready for wiring

2. Loose toggle switch and indicator light, ready for installation

3. Terminals for controlling devices

C. Dual-Blade, Drainable, and Adjustable Louvers: Fixed drainable blades and adjustable blades combined in single frame.

1. Louver Depth: 4 inches

2. Frame Thickness: 0.125 inch

3. Fixed-Blade Thickness: 0.081 inch

4. Adjustable-Blade Thickness: 0.081 inch.

5. Blade Angle: 45 degrees.

6. Performance Requirements: As follows:

a. Maximum Standard Airflow: Not less than 6850 cfm with not more than 0.15 inch wg static pressure loss.

b. Air Leakage: Not more than 1.5 cfm per sq. ft. of louver gross area at a differential static pressure of 0.15 inch wg with adjustable louver blades closed.

c. Minimum percent free area of louver: 35

2.4 SCREENS

A. General: Provide each exterior louver with louver screens complying with the following requirements:

1. Screen Location for Fixed Louvers: Interior face

2. Screen Location for Adjustable Louvers: Exterior face

B. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate screen frames with mitered corners to louver sizes and to comply with the following requirements:

1. Metal: Same kind and form of metal as indicated for louver to which screens are attached.

a. Reinforce extruded-aluminum screen frames at corners with clips.

2. Finish: Same finish as louver frames to which louver screens are attached.

3. Type: Non-rewirable, U-shaped frames for permanently securing screen mesh.

4. Louver Screening for Aluminum Louvers: Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

2.5 INSULATED BLANK OFF PANELS

A. General: Provide an insulated blank off panel for each louver on the project. Fabricate blank-off panels from materials and to sizes indicated and comply with the following requirements:

1. Finish: Mill finish aluminum.

2. Attach blank-off panels to back of louver frames with clips.

B. Insulated, Blank-off Panels: Laminated metal-faced panels consisting of insulating core surfaced on back and front with metal sheets, complying with the following requirements:

1. Thickness: 1 inch

2. Metal Facing Sheets: Aluminum sheet, 0.032 inch thick.

3. Insulating Core: Extruded-polystyrene insulation board complying with ASTM C 578, Type VII.

4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames 0.081 inch thick, with corners mitered and with same finish as panels.

5. Seal perimeter joints between panel faces and louver frames with 1/8-by-l-inch PVC compression gaskets.

2.6 FINISH

A. All louvers shall be finished with a full strength Kynar 500 fluoro-coating. Color to be selected by the Owner from Manufacturer's color chart. All steel shall be thoroughly cleaned, etched and given a chromate conversion pretreatment before the application of an epoxy baked-on prime coat. The subsequent top finish color coating shall have a minimum baking cycle of 450º F for 20 minutes and shall be no less than 0.8 mils thick. All finishing procedures shall be one continuous operation and take place in the plant of the manufacturer. There shall be no checking, peeling, or caulking.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate and place louver units level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather-tight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Install concealed gaskets, flashings, joint fillers, and insulation, as louver installation progresses, to provide weather-tight louver joints. Use proper sealants during louver installation.

END OF SECTION 08 91 00

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SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Install all non-load-bearing steel framing members for the following applications:

1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).

1.2 REFERENCE STANDARDS

A. ASTM E 119

B. ASTM E 90

C. ASTM E 413

D. ASTM C 754

E. ASTM C 645

1.3 SUBMITTALS

A. Submit manufacturer information in accordance with Section 01 33 00 – Submittal Procedures.

1.4 QUALITY ASSURANCE

A. Fire- Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non- load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. Sound Transmission Characteristics: For STC-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

PART 2 - PRODUCTS

2.1 GENERAL

A. General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.

2. Protective Coating: manufacturer's standard corrosion-resistant zinc coating, unless

2.2 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Studs and Runners: ASTM C 645.

1. Minimum Base-Metal Thickness: As indicated on Drawings.

B. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: As indicated on Drawings.

C. Cold-Rolled Channel Bridging: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.

1. Depth: As indicated on Drawings.

2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38.1 by 38.1 mill), 0.068-inch- (1.73- mm-) thick, galvanized steel.

D. Z-Shaped Furring: With slotted or non-slotted web, face flange of 1-1/4 inches (31.8 mill), wall attachment flange of 7/8 inch (22.2 mill), minimum bare-metal thickness of 0.0179 inch (0.45 mill), and depth required to fit insulation thickness indicated.

2.3 AUXILIARY MATERIALS

A. Isolation Strip at Exterior Walls: Provide one of the following:

1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mill) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

3.2 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

a. Install two studs at each jamb, unless otherwise indicated.

2. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

3. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

END OF SECTION 09 22 16

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SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install gypsum drywall ceilings and walls over metal framing as shown on the Drawings and as specified herein.

B. Furnish and install gypsum panels over metal roof decking as shown on the Drawings and as specified herein.

1.2 REFERENCE STANDARDS

A. QQ-W-461H – Wire, Steel, Carbon {Round, Bare, and Coated}

B. ANSI A108.11 – Specifications for Interior Installation of Cementitious Backer Units

C. ASTM A118.9 – Specifications for Test Methods and Specifications for Cementitious Backer Units

D. ASTM B211 – Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire

E. ASTM C475 – Specification for Joint Compound and Joint Tape for Finishing Gypsum Board

F. ASTM C514 – Specification for Nails for the Application of Gypsum Board

G. ASTM C645 – Specification for Nonstructural Steel Framing Members

H. ASTM C754 – Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

I. ASTM C840 – Specification for Application and Finishing of Gypsum Board

J. ASTM C1002 – Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

K. ASTM C1047 – Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base

L. ASTM C1177 – Specification for Glass Mat Gypsum Substrate for Use as Sheathing

M. ASTM C1178 – Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel

N. ASTM C1280 – Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing

O. ASTM C1325 – Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units

P. ASTM C1396 X – Specification for Gypsum Board

Q. ASTM C1629 – Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels

R. ASTM D226 – Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

S. ASTM D3273 – Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in and Environmental Chamber

T. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials

U. GA-214 – Recommended Levels of Gypsum Board Finish

V. GA-216 – Application and Finishing of Gypsum Board

W. GA-253 – Application of Gypsum Sheathing

X. GA-600 – Fire Resistance and Sound Control Design Manual

1.3 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirement of Section 01 33 00 – Submittal Procedures.

B. Product Data: Provide data on gypsum board indicating material composition, thickness, sizes, and fire resistance. Provide data on glass mat faced gypsum board, accessories, joint finishing system.

1. Indicate profiles and products for wall and ceiling trim accessories.

C. Shop Drawings: Indicate fastener and adhesive patterns for FM wind uplift resistance.

D. Certification: Submit manufacturer’s written certification that produce meets specified fire resistance requirements.

E. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM 754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum five-years of experience.

PART 2 - PRODUCTS

2.1 GENERAL

A. Labeling: All materials shall be delivered to the project site with manufacturer's labels intact and legible. Fire-rated materials shall bear testing agency labels and required fire classification numbers.

B. Assemblies:

1. Provide completed assemblies complying with ASTM C840 and GA-216.

2. Interior Partitions: Provide completed assemblies with the following characteristics:

a. Acoustic Attenuation: 44 minimum calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90, unless otherwise specified.

2.2 GYPSUM CEILING PANELS

A. Composition: Provide non-structural, glass mat faced, silicone-treated gypsum core panel. Each panel shall have nominal size of 4 feet by 8 feet dimensions and shall have a minimum 5/8-inch thickness and Type X.

1. Lightweight gypsum wallboard is not allowed.

B. Fire Resistance: Provide gypsum roof panels with Flamespread “0”, smoke developed “0”, when tested in accordance with ASTM E84. Panels shall be non-combustible when tested in accordance with ASTM E136.

1. Firestop Type X: Provide UL Classified Type X when tested in accordance with ASTM E119 where specified.

C. Contact adhesives with hydrocarbon-based solvents require extended open time for solvent vapor evaporation when used with expanded and extruded polystyrene and when adhered to gypsum panels.

D. Mold resistance: score of 10, when tested in accordance with ASTM D3273.

1. Moisture-resistant board is required whenever board is being installed before the building is enclosed and conditioned.

2.3 GYPSUM BOARDS

A. Gypsum Board: Gypsum board shall conform to ASTM C 1396. Unless otherwise specified or shown on Drawings, gypsum board shall be 5/8" type "X" or fireguard board with tapered edges.

B. Where shown on Drawings, water-resistant gypsum board shall conform to ASTM C1396, regular, type “X”.

C. Manufacturers or Equal

1. Flintkote Co.

2. Laticrete International

3. National Gypsum Co.

4. United States Gypsum Corporation

5. G-P Gypsum

6. American Gypsum Co.

2.4 TILE BACKING BOARD

A. Where shown on Drawings, tile backing board shall be a Portland cement slurry, reinforced with fiber glass mesh and coated vinyl board. The board shall be not less than 1/2-inch thick and shall be designed for use behind tile. Tile backing board shall be United States Gypsum's "Durock Board"; Laticrete International's "Latipanel"; or Equal.

2.5 ACCESSORIES

A. Metal trim, corner beads, edge, casing beads, and accessories shall be manufactured from galvanized sheet steel unless otherwise specified or shown and shall be manufacturer's standard products. Special shapes shall be provided where specified or shown.

B. Tape and Compound: Provide materials complying with ASTM C475, ASTM C840, and recommendations of manufacturer of both gypsum board and joint treatment materials for the application indicated.

1. Joint Tape: Paper reinforcing tape, unless otherwise indicated. Use pressure sensitive or staple-attached open-weave glass fiber reinforcing tape with compatible joint compound where recommended by manufacturer of gypsum board and joint treatment materials for application indicated

2. Drying-Tape Joint Compounds: Factory-prepackaged vinyl-based products complying with the following requirements for formulation and intended use. Use all-purposed compound formulated for use as both taping and topping compound.

C. Fasteners: Nails shall conform to ASTM C514, and shall be of the length recommended by the Gypsum Association referenced standards and the Building Code for various gypsum board thickness. Nails for nailing tile backing board to wood studs shall be 1-1/4-inch galvanized roofing nails unless otherwise required by code, and board manufacturer. Screws shall be self-drilling, self-tapping, bugle head for use with power tools, Length as recommended by Gypsum Association referenced standards and the building code.

1. Type "5" for wallboard to sheet metal application

2. Type "W" for wallboard to wood application

3. Type “8” for wallboard to wallboard application

D. Adhesives: Adhesives for fastening gypsum board to gypsum board shall be in accordance with the printed recommendations of the gypsum board manufacturer.

E. Waterproof Membrane: Waterproof membrane shall be asphaltic saturated 43-pound (vapor-retarder) membrane conforming to ASTM D2626 Type 1, 25 pounds per 100 square foot minimum or 10-mil polyethylene film membrane.

F. Corner Bead and Edge Trim: Metal trim, comer beads, edge, casing beads, and accessories shall be manufactured from galvanized sheet steel unless otherwise specified or shown and shall be manufacturer's standard products. Special shapes shall be provided where specified or shown.

G. Metal Support Materials: Furring channels shall be ASTM C645, 25-gauge Hat shaped channels.

PART 3 - EXECUTION

3.1 GENERAL

A. Verify that project conditions are appropriate for work of this section to commence. Start of wall and ceiling system Work will indicate acceptance of surfaces and conditions within each area.

B. Comply with ASTM C840, GA-216, and manufacturer’s instructions. Install to minimize butt end joints, especially in highly visible locations.

C. Provide gypsum panels on drawings using fastening system specified.

D. Use maximum lengths possible to minimize number and joints. Locate edge joints parallel to and located on deck ribs. Stagger end joints of adjacent lengths panel.

E. Gypsum wallboard shall be applied first to ceiling and then to walls. Wall application shall be horizontal (right angles to framing), or vertical (parallel to framing), conforming to reference standards.

F. All gypsum board shall be nail or screw fastened to metal framing and furring. Fastener spacing shall be per reference standards.

G. Gypsum wallboard surface finish shall be three-coat work. Reference standards and manufacturer's recommendations for multi-layer applications.

H. Installation of steel framing shall be in accordance with ASTM C754 and code.

3.2 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver materials to the job site in manufacturer’s original packaging, containers and bundles with manufacturer’s brand name and identification intact and legible.

B. Storage and handling: Storage and handle materials to protect against contact with damp and wet surfaces, exposure to weather, breakage and damage to edges. Provide air circulation under covering and around stacks of materials.

3.3 INSPECTION

A. Check framing for accurate spacing and alignment. Verify that spacing of installed framing does not exceed maximum allowable for thickness of wallboard to be used. Do not proceed with installation until deficiencies have been corrected.

3.4 COORDINATION

A. Coordinate with mechanical and electrical sections for the installation of their work in drywall construction.

3.5 CEILING INSTALLATION

A. Place boards with long dimension at right angles to supports and end joints occurring over supports. Perimeters of ceilings and edges of openings shall be placed over solid members.

3.6 FASTENERS

A. Place fasteners not less than 3/8-inch from edges of boards except when using washers or clips with fasteners in joint. Install when using washers or clips with fasteners in joint. Install fasteners with heads dimpled slightly below surface but not so deep as to cut through paper. Use approved type power tools for self-drilling screws. Obtain final set by turning screw down, not by driving. Space fasteners along all abutting edges and ends occurring over supports and in field at 12 inches on center. Stagger fasteners along common joints.

3.7 TRIM

A. Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges to comply with manufacturer's recommendations.

B. Install corner beads at external corners.

C. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed, and except where plastic trim is indicated. Provide type with face flange to receive joint compound except where "U" bead (semi-finishing type) is indicated.

1. Install "LC" bead where drywall construction is tightly abutted to other construction and back flange can be attached to framing or supporting substrate.

2. Install "LK" bead where substrate is kerfed to receive long flange of trim.

3. Install "L" bead where edge where edge trim can only be installed after gypsum board is installed

4. Install U-type trim where edge is exposed, revealed, gasketed, or sealant-filled (including expansion joints).

3.8 FINISHING OF DRYWALL

A. Apply joint treatment at gypsum board joints (both directions); flanges of corner bead, edge trim, and control joints; penetrations; fastener heads, surface defects and elsewhere as required to prepare work for decoration.

B. Prefill open joints and rounded or beveled edges, if any, using setting-type joint compound.

C. Apply joint tape at joints between gypsum boards, except where trim accessories are indicated.

D. Finish interior gypsum wallboard by applying the following joint compounds in 3 coats (not including prefill of openings in base), and sand between coats and after last coat.

E. Unless otherwise specified, all gypsum board shall be sanded smooth, dusted, and provided with an orange peel finish coat. Gypsum board at non-visible locations, such as within attics, shall be finished as required for fire protection.

3.9 RECESSED LIGHT FIXTURES

A. Light fixtures, speakers, and other recessed items in rated ceilings shall be provided with gypsum board enclosure as required for rated ceiling system.

END OF SECTION 09 29 00

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SECTION 09 30 00 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ceramic tile.
2. Setting Materials
3. Grout Materials
4. Elastomeric Sealants
5. Metal edge strips.

1.2 SUBMITTALS

A. Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: For each type of product indicated.

C. Samples:

1. Each type and composition of tile for color and pattern selection by Owner
2. Samples, for each type and composition of tile and for each color and finish required.
3. Stone thresholds in 6-inch lengths.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 TILE PRODUCTS

A. ANSI Ceramic Tile Standard: Provide Standard grade tile that complies with ANSI Al37.1 for types, compositions, and other characteristics indicated.

B. FloorScore Compliance: Tile for floors shall comply with requirements of FloorScore Standard.

C. Ceramic Tile Type: unglazed porcelain floor tile.

1. Certification: Tile certified by the Porcelain Tile Certification Agency.

2. Face Size: 11-13/16 by 11-13/16 inches

3. Face Size Variation: Rectified

4. Thickness: 3/8 inch

5. Face: Plain with square or cushion edges

6. Dynamic Coefficient of Friction: Not less than 0.42.

7. Tile Color, Glaze, and Pattern:

   a. Color and Glaze: As selected by Owner from manufacturer's full range.

   b. Pattern: Grid Pattern

8. Grout Color: As selected by Owner from manufacturer's full range.

9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

   a. Base Cap: Surface bullnose, module size same as adjoining flat tile.

   b. Wainscot Cap: Surface bullnose, module size same as adjoining flat tile.

   c. External Corners: Surface bullnose, module size same as adjoining flat.

D. Ceramic Tile Type: Glazed wall tile.

1. Module Size: 6 by 6 inches.

2. Face Size Variation: Rectified.

3. Thickness: 5/16 inch.

4. Face: Plain with modified square edges or cushion edges

5. Finish: Mat, clear.

6. Tile Color and Pattern:

   a. Color as selected by Owner from manufacturer's full range.

   b. Pattern: Straight Pattern.

7. Grout Color: As selected by Owner from manufacturer's full range.

8. Mounting: Factory, back mounted.

9. Mounting: Pregrouted sheets of tiles are factory assembled and grouted with manufacturer's standard white silicone rubber.

10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

2.2 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

2.3 TILE BACKING PANELS

A. As indicated in drawings and specification Section 09 29 00.

2.4 SETTING MATERIALS

A. Dry-Set Portland Cement Mortar (Thin Set): ANSI A118.1.

1. For all applications, provide nonsagging mortar

B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.

1. Prepackaged, dry-mortar mix to which only water must be added.

2. Prepackaged, dry-mortar mix combined with liquid-latex additive.

3. For wall applications, provide nonsagging mortar.

2.5 GROUT MATERIALS

A. Polymer-Modified Tile Grout: ANSI Al 18.7.

1. Polymer Type: Dry, redispersible form, prepackaged with other dry ingredients.

2. Polymer Type: Liquid-latex form for addition to prepackaged dry-grout mix.

2.6 ELASTOMERIC SEALANTS

A. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

2.7 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, Portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shape, half-hard brass exposed-edge material.

C. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.lA and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, use factory blended tile or blend tiles at Project site before installing.

D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Ceramic Mosaic Tile: 1/16 inch.

G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mo1tar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thin set).

J. Metal Edge Strips: Install at locations indicated.

K. Grout Sealer: Apply grout sealer to grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

L. Install cementitious backer units and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

M. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.

N. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

END OF SECTION 09 30 00

SECTION 09 65 00 – RESILIENT RUBBER WALL BASE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide Resilient wall base and other accessories installed with resilient wall base.

1.2 REFERENCE STANDARDS

A. ASTM F1861 – Standard Specification for Resilient Wall base

1.3 SUBMITTALS

A. General: All submittals shall be submitted in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Product Data: Provide Data on specified products, describing physical and performance characteristics; including sizes, patterns, and colors available; and installation instructions.

1. Provide product data for adhesives, including printed statement of VOC content and chemical compounds.

C. Shop Drawings: Indicate layout, size, product literature product accessories and attachment.

D. Selection Samples: Submit manufacturer's complete set of color samples for Owner's initial selection for resilient base.

E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:

1. Extra Wall Base: 10 linear feet of each type and color.

2. Maintenance Products: One year's annual required maintenance products of type recommended by flooring manufacturer.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store all materials off of the floor in an acclimatized, weather-tight space.

B. Maintain temperature in storage area between 55 degrees Fahrenheit and 90 degrees Fahrenheit.

C. Protect roll materials from damage by storing on end.

D. Do not double stack pallets.

1.6 PROJECT CONDITIONS

A. Store materials for not less than 72 hours prior to installation in an area of installation at a temperature of 70 degrees Fahrenheit to establish stability. Thereafter, maintain conditions above 68 degrees Fahrenheit.

B. Moisture Testing: Maintain temperatures and humidity expected during normal use for testing. If this is not possible, then the test conditions should be 75+/- 10 degrees Fahrenheit and 50+/- 10 percent relative humidity. Maintain these conditions 48 hours prior to and during testing.

C. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive floor tile.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset, top set Style B, Cove

1. Approved Manufacturers or Equal:

a. Burke Flooring

b. Flexco, Inc

c. Johnsonite, a Tarkett Company

d. Roppe Corp

2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.

3. Height: 4 inches

4. Thickness: 0.125 inch

5. Finish: Satin

6. Length: Roll

7. Color: To be selected by Owner from manufacturer’s full range.

2.2 ACCESSORIES

A. Moldings, Transition, and Edge Strips: Rubber.

1. Integral-Flash-Cove-Base Accessories:

a. Cove Strip: 1-inch radius provided or approved by manufacturer.

b. Cap Strip: Square metal cap provided or approved by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.

1. Test in accordance with ASTM F710.

2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

D. Verify that required floor-mounted utilities are in correct location.

E. Install resilient flooring material and accessories after other finishing operations, including painting, have been completed.

3.2 PREPARATION

A. Prepare substrates according to manufacturer’s written instructions to ensure adhesion of resilient base.

3.3 INSTALLATION - GENERAL

A. Install in accordance with manufacturer’s written instructions.

3.4 INSTALLATION – RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Miter internal corners. At external corners, ‘V’ cut back of base strip to 2/3 of its thickness and fold.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

3.5 INSTALLATION – ACCESSSORIES

A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece.

1. Install reducer strips at edges of resilient flooring, carpet, and entry mat that would otherwise be exposed.

2. Install transition strips at joints between one material to another.

3.6 CLEANING AND PROTECTION

A. Remove excess adhesive from base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

C. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Perform initial maintenance on installed products in accordance with manufacturer's instructions, prior to Owner's acceptance. Remove construction site debris from project site and legally dispose of debris.

1. Remove visible adhesive and other surface blemishes using cleaning methods recommended by manufacturer.

2. Do not perform initial maintenance for a minimum of 5 days after installation has been completed to allow the adhesive the proper time to set.

D. Protect base from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION 09 65 00

SECTION 09 90 00 – PAINTING AND COATING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials and equipment as required for all painting and coatings as specified herein. All materials, equipment, piping and miscellaneous surfaces shall be coated except for those indicated under Part 1.7. Work includes but is not to be limited to cleaning and preparation of surfaces, paint materials, and the application of all paint and other materials. Provide third party inspection of surface preparation, application and testing of coating and painting during application.

B. Provide coatings for pipe identification as specified in Section 40 05 97 – Piping Identification.

C. Any painting or coating in contact with potable drinking water, or water that will become potable drinking water, shall be NSF61 Certified.

1.2 DEFINITIONS

A. The term paint, coatings, or finishes as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.

B. Dry Film Thickness (DFT): The minimum dry film thickness, without any negative tolerance.

C. Submerged Metal: Steel or iron surfaces below tops of channel or structure walls which will contain water even when above expected water level.

D. Submerged Concrete and Masonry Surfaces: Surfaces which are or will be:

1. Underwater.

2. Inside structures which normally contain water.

3. Below tops of walls of water containing structures.

E. Exposed Surface: Any metal or concrete surface, indoors or outdoors that is exposed to view or exposed to corrosive gases in wastewater structures and process buildings.

F. Volatile Organic Compound (VOC): Content of air polluting hydrocarbons in uncured coating product measured in units of grams per liter or pounds per gallon, as determined by EPA Method 24.

G. Ferrous: Cast iron, ductile iron, wrought iron, and all steel alloys except stainless steel.

H. Where SSPC surface preparation standards are specified or implied for ductile iron pipe or fittings, the equivalent NAPF surface preparation standard shall be substituted for the SSPC standard.

1.3 REFERENCE STANDARDS

A. Codes and Standards: In addition to the requirements of these Specifications, the work to be performed under this Section is to comply with the following codes and regulations:

1. The Society of Protective Coatings Specifications (SSPC):

a.	SSPC SP-1	Solvent Cleaning.
b.	SSPC SP-2	Hand Tool Cleaning.
c.	SSPC SP-3	Power Tool Cleaning.
d.	SSPC SP-5	White Metal Blast Cleaning.
e.	SSPC SP-6	Commercial Blast Cleaning.
f.	SSPC SP-7	Brush-Off Blast Cleaning.
g.	SSPC SP-10	Near-White Blast Cleaning.
h.	SSPC SP-11	Power Tool Cleaning to Bare Metal.
i.	SSPC-SP-12	High- and Ultrahigh-pressure Water Jetting.
j.	SSPC-SP-13	Surface Preparation of Concrete
k.	SSPC-SP-16	Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals

2. Underwriters' Laboratory (UL):

a.	UL 3P83	Drinking Water System Components - Health Effects.

3. National Association of Corrosion Engineers Standards (NACE):

a.	RP0188-06	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.

4. Applicable Standards of American National Standards Institute, Inc. (ANSI)

5. National Association of Pipe Fabricators (NAPF):

a.	NAPF 500-03	Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.

6. American Society for Testing and Materials (ASTM):

a.	ASTM D4262	Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
b.	ASTM D4263	Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
c.	ASTM D4285	Test Method for Indicating Oil or Water in Compressed Air.
d.	ASTM D4541	Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testers.

1.4 QUALITY ASSURANCE

A. Pre-Application Conference: Prior to commencement of any paint application, the Engineer will hold an on-site pre-application meeting. The purpose of the meeting is to establish a working understanding between all parties and to discuss items that pertain directly to the paint application.

B. Painter's Qualifications: The work specified under this Section shall be performed by or under the supervision of a qualified painter. The Contractor shall be required to document the painter's experience, competence, and ability to comply with the requirements of these Specifications and to complete the work in a timely manner. The Painter or Applicator shall have the following qualifications:

1. Minimum of 5 years of experience applying specified type or types of coatings under conditions similar to those of the Work. Provide qualifications of applicator and references listing five similar projects completed in the past two years.

2. Manufacturer approved applicator when manufacturer has approved applicator program.

C. Coatings Inspection: Surface preparation, mixing, thinning, coating application, and measurement of dry film thicknesses shall be performed by a NACE Certified Coatings Inspector. Each requirement of this specification shall be met and approved by the Inspector prior to moving on to the next step in the progression of the coating’s specification.

D. Standard Products: All paints in a paint system are to be the standard products. All products applied in any paint and coating system shall be from a single manufacturer.

E. The NACE Inspector must approve all surface preparation prior to the application of coatings. This will include surface cleanliness, the degree of sandblast and surface profiles.

F. At a minimum of every four hours or more often when conditions change during surface preparation and coatings application, environmental conditions IE: Relative Humidity, dew-point, surface temperature and the dew-point/surface temperature depression must be measured and recorded. The use of a sling psychrometer and US weather bureau barometric chart or approved equal such as Defelsko or Elcometer test instruments shall be used to measure the environmental conditions.

G. Warranty Inspection: A warranty inspection will be conducted at the end of the one-year warranty period from the substantial completion date. The Contractor and a representative of the coating material manufacturer may attend this inspection. All defective work shall be repaired in accordance with these specifications and to the satisfaction of the Owner. The Owner may, by written notice to the Contractor, reschedule the warranty inspection to another date within the warranty period.

H. Quality Assurance Responsibility: The Contractor is responsible to obtain and pay for the services of the NACE inspector referred to above.

1.5 SUBMITTALS

A. Before any paint materials are delivered to the job site, submit a complete list of all materials proposed to be furnished and applied under this Section. Include schedule of where and for what use coating materials are proposed in accordance with requirements for Product Data. Any coating or paint materials ordered by Contractor prior to receiving submittal response from Engineer indicating that the submitted material is accepted shall be at the risk of the Contractor.

B. For each paint, furnish the paint manufacturer's specific application instructions and the following information:

1. Paint manufacturer’s data sheet for each product proposed, including statements on the suitability of the materials for the intended use.

2. Surface preparation recommendations.

3. Type of primer, if required.

4. Maximum dry and wet mil thickness per coat.

5. Minimum and maximum curing time between coats, including atmospheric conditions for each.

6. Curing time before submergence in water.

7. Thinner to be used with each paint.

8. General ventilation requirements.

9. Atmospheric conditions during which the paint is <u>not</u> to be applied.

10. Allowable methods of application.

11. Maximum allowable moisture content and minimum age of plaster, concrete and wood surfaces at time of paint application.

12. Compatibility of shop and field applied coatings (where applicable).

13. For coating in contact with potable water, provide NSF61 Certification.

C. Reports: Submit the following to the Engineer:

1. Reports on visits to project site to view and approve surface preparation of structures to be coated.

2. Reports on visits to project site to observe and approve coating application procedures.

3. Reports on visits to coating plants to observe and approve surface preparation and coating application on items that are “shop coated.”

1.6 DELIVERY AND STORAGE

A. Deliver, store, and handle products in accordance with manufacturer’s requirements. All materials are to be delivered to the job site in their original, unopened containers bearing the manufacturer's name, brand, batch number, date of manufacture, and any special directions.

B. Only the approved material shall be stored at the job site and stored only in designated areas restricted to the storage of paint materials and related equipment. All paint is to be stored in enclosed structures and protected from weather and excessive heat or cold. Store coatings in well-ventilated facility that provides protection from the sun, weather, and fire hazards. Maintain ambient storage temperature between 45- and 90-degrees Fahrenheit, unless otherwise recommended by the manufacturer.

C. Store flammable materials to conform with State and local safety codes. Protect emulsion type paints from freezing. Take precautions to prevent fire and spontaneous combustion.

D. Materials exceeding storage life recommended by the manufacturer will be subject to rejection.

E. Remove unspecified and unapproved paints from Project site immediately.

1.7 SURFACES NOT REQUIRING PAINTING

A. Nonferrous and corrosion-resistant ferrous alloys such as copper, bronze, aluminum, chromium plate, and weathering steel, except where (1) required for electrical insulation between dissimilar metals, (2) aluminum is in contact with concrete or masonry, and (3) color coding of equipment and piping is required.

B. Copper, bronze, aluminum, weathering steel, and stainless steel,

C. Glass, porcelain, and plastics do not require painting.

D. Prefinished architectural finishes such as acoustical tile, cabinets, and wall panels do not require painting.

E. Prefinished electrical items such as motor control centers, switchboards, switchgear, panelboards, transformers, and disconnect switches do not require painting.

F. Exposed electrical conduits shall be painted to match the color of the adjacent wall or equipment to which they are attached, except that non-submerged conduits attached to unpainted masonry and concrete surfaces need not be painted.

G. Exterior concrete slabs, exterior sidewalks, exterior concrete stairs and exterior concrete curbs.

H. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.

1.8 MAINTENANCE

A. Extra Materials: Include minimum 1 gallon of each type and color of coating applied. When manufacturer packages material in gallon cans, deliver unopened labeled cans as comes from factory. When manufacturer does not package material in gallon cans, deliver material in new gallon containers, properly sealed and identified with typed labels indicating brand, type and color.

PART 2 - PRODUCTS

2.1 PAINT AND COATING SYSTEM APPLICATIONS

A. Prepare surfaces and apply paint and coating systems in accordance with the following schedules for all surfaces.

Surface Preparation	Description
SSPC SP-1	Solvent Cleaning
SSPC SP-2	Hand Tool Cleaning
SSPC SP-3	Power Tool Cleaning
SSPC SP-5	White Metal Blast Cleaning
SSPC SP-6	Commercial Blast Cleaning
SSPC SP-7	Brush off Blast Cleaning
SSPC SP-10	Near White Blast Cleaning
SSPC SP-11	Power Tool Cleaning to Bare Metal
SSPC SP-12	High- and Ultrahigh-Pressure Water Jetting
SSPC SP-13	Surface Preparation of Concrete
SSPC SP-16	Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals
C-1	Abrasive blast clean in accordance with ASTM D4259 and fill all holes and imperfections with Sika Mono Top 615.

Paint and Coating Application Schedule		
Surface to be Painted or Coated	Surface Preparation	Paint System
Ferrous Metal (ungalvanized), Exposed	SSPC – SP-6	System 1
Ferrous Metal (galvanized)	SSPC – SP-1	System 2
Ferrous Metal, Submerged or Buried	SSPC – SP-10	System 3
Ferrous Metal, Exposed Inside Tankage	SSPC – SP-10	System 3
Ferrous Metal, Buried (galvanized)	SSPC – SP-6	System 5
Ferrous Metal, Buried (black)	NAPF 500-03-04	System 5
Concrete Block (CMU), Exterior Surfaces, all buildings	Manufacturer's Inst.	System 4

2.2 PAINT AND COATING SYSTEMS

A. Furnish primers and finish coatings as shown on the following coating table schedule. If manufacturers have changed their coating products and the products shown below are no longer available, provide the product that the manufacturer recommends as the improved version of the product shown.

B. Where dry film thicknesses are not shown, the DFT shall be as recommended by the manufacturer for the product and service shown in the Application Schedules above.

C. Paint and Coating Systems:

System	Sherwin Williams	ICI Devoe Coatings	Tnemec Company
1	Kem Kromik primer 3-4 mils Industrial Enamel HS 2-3 mils B54 Series, Industrial Enamel 2-3 mils	Devguard 4160 primer Devguard 4308 finish (4550) finish 2 coats, 3.0 mils each	Tnemec 66 primer Tnemec 2H finish 2 coats, 3.0 mils each
2	SHER-CRYL HPA 2 coats, 3-4 mils each	Same as System 1 but for Devoe Coatings but use Devguard 4120 primer	Same as System 1 but pretreat galvanizing
3	SHER-GLASS FF 2 coats, 8-10 mils each	Catha-Coat 302H primer Devtar 5A finish 8.0 mils	Tnemec N69 8 mils primer Tnemec HS Epoxy 104 10 mils finish
5	Macropoxy 646FC 2 coats, 8-10 mils each	Bar Rust 235, 2 coats & 20 mils PVC Wrap	Tnemec HS Epoxy 104, 2 coats 10 mils & 20 mils PVC Wrap

	BASF	RainguardPro	Prosoco
4	Sherwin Williams Invisi-Shield Anti-Graffiti	VandlGuard Non-Sacrificial Anti-Graffiti Coating	Weather Seal Block Guard and Graffiti Control WB 15

2.3 OTHER COATINGS

A. Factory Applied Coatings and Touchup: Field touchup shall consist of touching up the shop prime coat to achieve the film thickness, continuity and coating specified in accordance with the paint system data sheets. Badly damaged shop coatings shall be removed and the surfaces recoated in accordance with the specified system requirements.

B. Aluminum Metal Insulation: Where aluminum surfaces come in contact with concrete or with metals not compatible with aluminum, paint the dissimilar materials with a prime coat of zinc-chromate primer or a coating of heavy-bodied bituminous paint.

C. Painting and Identification of Piping: All exposed new piping is to be painted and identified in accordance with Section 40 05 97 – Piping Identification.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Prepare all surfaces prior to application of paint or coatings. Comply with surface preparation requirements of the Society for Protective Coatings (SSPC). If the paint or coating manufacturer recommends a surface preparation different than that shown, follow the more stringent surface preparation requirement.

B. ASTM D4259 – Wet Abrasive Blasting, Vacuum Assisted Dry Abrasive Blasting or Centrifugal Shot Abrasive Blasting

1. Shot Blasting – Before blasting fill defects and holes with filler recommended by the coating manufacturer. Blast with dustless steel shot to remove laitance, residue, and loose material to roughen the surface to a texture of No. 40 to 60 grit sandpaper.

C. Surface preparation requirements of the Society for Protective Coatings (SSPC) are as follows:

1. SSPC – SP-1 – Solvent Cleaning

2. SSPC – SP-2 – Hand Tool Cleaning

3. SSPC – SP-3 – Power Tool Cleaning

4. SSPC – SP-5 – White Metal Blast Cleaning

5. SSPC – SP-6 – Commercial Blast Cleaning

6. SSPC – SP-13 – Mechanical or Chemical Cleaning

D. Preparation of Concrete and Masonry Surfaces: Unless otherwise specified, concrete surfaces which are to receive any paint coating shall be allowed to age for a minimum of 28 days. Moisture content shall be tested with a Delmhorst Instrument Company moisture detector prior to application of paint or coating. The moisture content of the concrete shall be within the limits recommended by the manufacturer of the paint or coating before any paint or coating is applied.

3.2 APPLICATION

A. Workmanship: All work shall be done in a workmanlike manner so that the finished surface will be free from runs, drips, ridges, waves, laps and unnecessary brush marks. All coats shall be applied in such a manner as to produce an even film of uniform thickness, completely coating all corners and crevices.

B. The Contractor's coating and painting equipment shall be designed for application of materials specified and shall be maintained in a first-class working condition. Compressors shall have suitable traps and filters to remove water and oils from the air. Spray equipment shall be equipped with mechanical agitators, pressure gauges, and pressure regulators. Spray nozzles shall be of the proper sizes.

C. Each coat of paint shall be applied evenly and sharply cut to line. Care shall be exercised to avoid over spraying or spattering paint on surfaces not to be coated. Glass, hardware, floors, roofs and other adjacent areas and installation shall be protected by taping, drop cloths or other suitable measures.

D. Paint Properties, Mixing and Thinning. All paint, when applied, shall provide a satisfactory film and smooth, even surface. Glossy undercoats shall be lightly sanded to provide a surface suitable for the proper application, adhesion and subsequent coats. Paints shall be thoroughly stirred, strained and kept at a uniform consistency during application. Coatings consisting of two (2) or more components shall be mixed in accordance with manufacturer's instructions. Where necessary to suit conditions of the surface, temperature, weather and method of application, and with the Engineer's approval, the paint may be thinned immediately prior to use by the addition of not more than one pint per gallon of the proper thinner; provided that in no case shall the paint be reduced more than necessary to obtain the proper application characteristics. Where specifically permitted by the Specifications, certain paints may be thinned more than the maximum indicated above. Paint thinner shall be as recommended by the paint manufacturer.

E. Atmospheric Conditions: Except as specified or required for certain water-thinned paints, paints shall be applied only to surfaces that are thoroughly dry and only under such combination of humidity and temperatures of the atmosphere and surfaces to be painted as will cause evaporation rather than condensation.

1. In no case shall any paint be applied during rainy, misty weather, or to surfaces upon which there is frost or moisture condensation without suitable protection, as accepted by the Engineer. Where painting is permitted during damp weather or when the temperature is at or below 40 degrees F, the surfaces shall be heated to prevent moisture condensation thereof.

2. Bar metal surfaces, except those which may be warped by heat, may be dehydrated by flame-heating devices immediately prior to paint application.

3. While any painting is being done and for a period of at least eight (8) hours after the paint has been applied, the temperature of the surfaces to be painted, the painted surfaces and the atmosphere in contact therewith shall be maintained at or above 40 degrees F and 5 degrees above the dew point.

4. All paint, when applied, shall be approximately the same temperature as that of the surface on which it is applied. The use of fans or heaters shall be required in enclosed areas where conditions causing condensation are severe.

F. Method of Paint Application: Where two (2) or more coats are required, alternate coats shall contain sufficient compatible color additive to act as indicator of coverage, or the alternate coats shall be of contrasting colors. Color additives shall not contain lead or any lead compound which may be destroyed or affected by hydrogen sulfide or any gas likely to be found in wastewater treatment plants.

G. Electrical and mechanical equipment, on which the manufacturer's coating is found, shall be touch-up primed and painted with two (2) coats of the specified paint system to match the color scheduled. This does not apply to electrical and instrumental equipment otherwise specified in Division 26.

H. No paint shall be applied to any surface until it has been prepared as specified and approved by the Engineer. Unless otherwise specified, the primer or first coat of paint shall be applied by brush to ferrous surfaces. All subsequent coats for all ferrous surfaces may be either brush or spray applied. Unless stated otherwise, prime and finish coats shall be applied at the rate recommended by the manufacturer for the services involved. After prime coat is dry, all suction spots shall be touched up before succeeding coats are sprayed. All coats for concrete and masonry shall be brushed or rolled unless otherwise specified. Before painting or repainting existing surfaces, the Contractor shall test-paint a small area on the actual surface to show that the color matches the existing surfaces.

I. Unless otherwise specified, do not apply finish coats until all other work in the area is done and until the prime and intermediate coats have been inspected by the Engineer.

J. Film Thickness and Continuity: The actual surface area covered per gallon of oil and varnish vehicle paint for various types of surfaces shall not exceed those recommended by the manufacturer. All paint and coating thickness stated in this specification are dry film thickness. The first coat on metal surfaces refers to the first full paint coat and not to conditioning or other pretreatment applications. All coatings shall be applied to the thickness in accordance with these Specifications. The minimum thickness at any point shall not deviate more than 25 percent from the required average. Except as specified, no less than two (2) coats shall be applied.

K. Special Requirements: Hangers shall be painted, except for the final coat, prior to installation. Paint underside of all ungalvanized equipment bases and supports with at least two (2) coats of rust inhibiting primer prior to setting the equipment in place. Paint bolt and bolt holes in flanges, such as those used with couplings or wager type valves, where hold and bolt as finally installed will be exposed to weather or moisture, prior to assembly to prevent rusting of the unprotected metal.

3.3 FIELD INSPECTION AND TESTING

A. Where two (2) or more coats are required, alternate coats shall contain sufficient compatible color additive to act as indicator of coverage, or the alternate coats shall be of contrasting colors.

B. Unless otherwise specified, do not apply finish coats until all other work in the area is done and until the underlying coats have been inspected and accepted by the NACE Inspector.

C. Film Thickness: All paint and coating thickness stated in this specification are dry film thickness. The first coat on metal surfaces refers to the first full paint coat and not to conditioning or other pretreatment applications. All coatings shall be applied to the thickness in accordance with these Specifications and the Manufacturer’s recommendations as stated in the product data sheets. The dry film thickness of each coating application will be measured using the SSPA-2 standard. The minimum/maximum thickness requirements shall meet the perimeters outlined in this standard. Where the minimums and maximums do not meet the requirements of this standard, corrections must be made.

D. Continuity: Holiday testing will be performed in accordance with NACE RP0188. All surfaces below the waterline shall be tested.

In testing for continuity, all pinholes and holidays located shall be repainted to the required dry film thickness. All ferrous metal surfaces shall meet minimum continuity requirements outlined the NACE RP0188 standard. All holiday repairs will be re-tested following the repairs.

E. It is intended that the dry film thickness and the continuity of painted ferrous metal surfaces be subject to continual field check by the Contractor's quality control subcontractor. Dry-film thickness will be measured by an Elcometer or Mikrotest magnetic type dry-film thickness gauge. Continuity will be tested by a low voltage wet sponge transistorized device, as manufactured by Tinker-Rasor (Model M-1), or equal. The Contractor's quality control subcontractor shall use inspection devices that are in good working condition for detection of holidays and measurement of dry-film thickness. The Contractor's subcontractor shall also furnish U.S. Department of Commerce, National Bureau of Standards certified thickness calibration plates to test accuracy of dry-film thickness gauge and certified instrumentation to test accuracy of holiday detectors. Provide safe and suitable ladders or temporary scaffolding and adequate illumination to facilitate inspection.

3.4 PROTECTION OF PAINT SURFACES

A. Where protection is provided for painted surfaces, such protection shall be preserved in place until the paint film has properly dried and the removal is authorized. Items which have been painted shall not be handled, worked on, or otherwise disturbed until the paint coat is completely dry and hard.

B. After delivery at the site of materials for permanent erection or installation, all shop-coated metalwork shall be repainted or retouched from time to time, which specified paint, whenever, in the opinion of the Engineer, it becomes necessary to maintain the integrity of the film.

3.5 CLEANUP

A. Upon completion of all painting, remove all surplus materials, protective coverings and accumulated rubbish and thoroughly clean all surfaces and repair any overspray or other paint-related damage.

END OF SECTION 09 90 00

SECTION 09 91 23 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Surface preparation and coating of all gypsum board in office areas, laboratory area, and restroom.

B. Surface preparation and coating of masonry block in hallway of Control Building.

C. Application of paint systems on other gypsum board, concrete and CMU walls as indicated in the finish schedule. Refer to Section 09 90 00 – Painting and Coating for coatings in process areas.

1.2 SUBMITTALS

A. Submit product data for each type of product indicated in accordance with Section 01 33 00 – Submittal Procedures.

B. Samples: For each finish and for each color and texture required.

1.3 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent of those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Source limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coat.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material

2. Product description (generic classification or binder type)

3. Manufacturer's stock number and date of manufacturer

4. Contents by volume, for pigment and vehicle constituents

5. Thinning instructions

6. Application instructions

7. Color name and number

8. VOC content

B. Store materials not used in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep the storage area neat and orderly. Remove oily rags and waste daily.

1.5 PROJECT CONDITIONS

A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.

B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.

C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.6 EXTRA MATERIALS

A. Extra materials may not be allowed for publicly funded projects.

B. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied. To efficiently edit Part 2, first edit the Interior Painting Schedule in Part 3; then retain, delete, and insert appropriate products in Part 2 to correspond with paint systems specified in the Interior Painting Schedule.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer's Name

1. Benjamin Moore

2. Sherwin Williams

2.2 PAINT, GENERAL

A. Material Compatibility

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: Provide color chart for selection by Owner.

2.3 BLOCK FILLER

A. Prior to painting any interior masonry wall, a latex block filler shall be applied meeting PCA Level 3 (Premium Fill) Standard.

2.4 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

2.5 LATEX PAINTS

A. Interior Latex (Flat): MPI #53 (Gloss Level 1).

B. Interior Latex (Satin): MPI #43 (Gloss Level 4).

C. Interior Low Luster Epoxy Enamel: Factory Formulated low luster epoxy enamel.

1. As recommended for wet and kitchen prep areas by Benjamin Moore, Sherwin Williams, or Equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION AND APPLICATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

D. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.3 INTERIOR PAINTING SCHEDULE

A. Gypsum Board Substrates:

1. Latex System: MPI INT 9.2A.
   a. Prime Coat: Interior latex primer matching topcoat.
   b. Intermediate Coat: Interior latex matching topcoat.
   c. Topcoat: Interior latex satin.
2. Low Luster Epoxy Finish: Two finish coats over a primer.
   a. Primer: Interior gypsum board primer.
   b. Finish Coats: Interior low luster epoxy enamel.
3. High-Performance Architectural Latex System: MPI INT 9.2B.
   a. Prime Coat: Interior latex primer/sealer.
   b. Intermediate Coat: High-performance architectural latex matching topcoat.
   c. Topcoat: High-performance architectural latex semigloss.

B. Spray Ceiling Substrates:

1. Latex (Flat) System: MPI INT 9.1A, spray applied.
   a. Prime Coat: Interior latex primer (flat).

b. Topcoat: Interior latex (flat).

2. In high humidity areas such as bathrooms, showers and dewatering areas use High-Performance Architectural Latex System: MPI INT 9.2B.

a. Prime Coat: Interior latex primer/sealer.

b. Intermediate Coat: High-performance architectural latex matching top-coat.

c. Topcoat: High-performance architectural latex semigloss.

C. Interior Masonry Wall Substate at Control Building Hallway

1. Latex System: MPI INT 4.2A.

a. Prime Coat: Interior latex primer matching topcoat.

b. Intermediate Coat: Interior latex matching topcoat.

c. Topcoat: Interior latex satin.

END OF SECTION 09 91 23

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SECTION 10 14 00 - SIGNAGE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall furnish and install identification, warning and safety signs as shown on the drawings and as specified herein.

B. The Contractor shall furnish and install nameplates for buildings and rooms as specified herein.

C. The Contractor shall install a bronze plaque as specified herein.

1.2 REFERENCE STANDARDS

A. Provide 1910-OSHA code standard signs where applicable.

B. Regulatory Requirements: Provide signage in accordance with Americans with Disabilities Act as published in the Federal Register, Volume 56, No. 144, Friday, July 26, 1991.

1.3 SUBMITTALS

A. Shop Drawings: The Contractor shall provide shop drawings of all signs in accordance with the requirements of Section 01 33 00 – Submittal procedures.

B. Submit catalog cuts and schedule of proposed fastening system for each sign.

C. Shop Drawing shall consist of full-size layouts of all signs and plaques. Repetitive sign layouts of typical and most restrictive conditions shall be submitted. Details of installation shall be submitted showing fasteners and mountings. Style and color of lettering shall be as selected by the Owner from the manufacturer’s standards.

PART 2 - PRODUCTS

2.1 GENERAL

A. Identification devices shall be installed where indicated by the Engineer. All wording shall be as indicated and shall be verified and approved before fabrication.

2.2 EQUIPMENT SIGNAGE

A. Lift Stations:

1. Every lift point attached to a joist shall be provided with a sign indicating the lifting capacity in pounds with the words “Lifting Capacity”.

2. Every hoist shall have a lifting capacity painted on the hoist in three-inch high letters.

B. Equipment Nametags

1. A stainless steel plate shall be attached to all equipment with lettering embossed into the plate. Lettering shall be the equipment number in the contract documents. Method of attachment shall be as recommended by the signage supplier.

2. Large equipment may have lettering stenciled directly onto the equipment, in letter size and color determined by the Engineer. Furnish the proposed wording to the Engineer for approval.

2.3 WARNING SIGNS

A. Warning Signs shall be enamel painted on semi-rigid butyrates. Signs shall conform to OSHA standards and directions. Lettering sizes shall be 3-inch in height unless indicated otherwise. Provide the following warning signs:

1. No Smoking Sign: 8" x 10" white background with red letters "NO SMOKING" on 20-gauge steel. Signs shall be located in areas which contain flammable or combustible materials.

2. Equipment Warning Sign: Signs shall be 10" x 12" yellow reflectorized sheeting background with non-reflectorized black screened legend. Sign shall read "CAUTION - THIS MACHINE STARTS AUTOMATICALLY". Mount sign on each side of the machine in a conspicuous place at approximately 64 inches above the floor. Provide one sign for each machine which can be started either automatically or remotely.

3. Exit Sign: Install an "EXIT" sign on the interior side of all exterior doors and interior doors that are means of egress in accordance with the building code.

4. High Voltage Warning: Install warning signs that read "DANGER HIGH VOLTAGE KEEP OUT" on front and back of equipment, adjacent to doors to rooms containing devices, and devices that operate at 600 volts or greater.

5. Utility Water: Provide warning signs at each hose bid that uses utility water (W2) as per the detail on the drawings. Sign shall read "DANGER – NON-POTABLE WATER- DO NOT DRINK."

B. Provide Chemical Building signage as specified below and per applicable 2006 IBC requirements. All signs to be plastic with clear protective polyester coating and shall be included with hardware as necessary for mounting in specified locations. Signs to be as manufactured by Emedco or equal.

1. The following signs shall be provided on all access doors to the Tertiary Filter Building.

a. DANGER HAZARDOUS CHEMICALS

b. NFPA Hazardous material sign.

2. Provide NFPA chemical hazard label and product identification signage on each chemical tank.

3. Provide chemical identification signs at the entrance to each chemical secondary containment area. The signs shall be chemical information signs containing the information for the chemical stored and associated hazards of each area.

4. Provide a single right-to-know information station sign for location of the Material Safety Data Sheets. Locate the sign per the Engineer's direction in the MSDS area for the chemical containment area in the Tertiary Filter Building.

5. Provide one sign above each chemical fill connection outside the Tertiary Filter Building. The chemical of each fill line shall be clearly marked and easily visible. Each sign shall be a chemical information sign containing the information of the chemical transported and associated hazards.

2.4 NAMEPLATES

A. Each room shall have a nameplate attached to each door entrance. Nameplates shall be Vomar Products, Inc., ES 100 Series; or equal, with colored 1/8-inch acrylic plastic (matte finish) raised 1/32-inch. Lettering shall be white, ½-inch high, or 48 points, and fused by heat and pressure to a depth of approximately 0.005-inch. Provide Grade 2 Braille underneath lettering. Plates to be installed in an extruded aluminum frame, medium bronze or dark anodized finish, and furnished with 2-way adhesive mounting tape. Plastic color and lettering style shall be as selected by the Owner.

B. Room nameplates shall be located 60" above floor on wall outside room adjacent to latch side of doors or when not enough space on latch side, on nearest adjacent wall.

C. Room nameplates shall include room number and room name as indicated in drawings.

PART 3 - EXECUTION

3.1 GENERAL

A. All installation of identifying devices shall be vandal-resistant. Fasteners shall be concealed, non-corrosive fasteners appropriate for materials being fastened and as required.

3.2 PREPARATION

A. Protect adjacent surfaces which may be damaged by installation of signs.

B. Prepare substrates in accordance with signs manufacturer's instructions.

C. Remove scale, dirt, grease, and other contaminates from substrates.

3.3 INSTALLATION

A. Install signs in accordance with sign manufacturer's instructions.

B. Fasten signs securely in level, plumb, and true to plane positions.

END OF SECTION 10 14 00

SECTION 10 28 00 - TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install toilet accessories as shown on the drawings and specified herein.

1.2 REFERENCE STANDARDS

A. Manufacturer's Standards: The toilet and bath accessories and their installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.3 SUBMITTALS

A. Product Data: Submit Manufacturer’s literature and cut sheet in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Submit schedule showing items used, location where installed and proper attaching devices for substrate.

PART 2 - PRODUCTS

2.1 GENERAL

A. For the purpose of establishing quality and type, all catalog numbers have been taken from the manufacturer catalogs, unless otherwise specified. All items furnished shall be products of the same manufacturer, wherever possible.

B. Mounting locations shall be where shown, or at manufacturers recommended heights where not shown, and where determined by the Owner.

C. All exposed exterior finish shall be satin finish stainless steel, except where otherwise specified.

2.2 SCHEDULE

A. Toilet Tissue Dispensers

1.	A & J	Model U806B
2.	ASI	Model 0264-1A
3.	Bobrick	Model B2740
4.	Bradley	Model 5241-50
5.	Gamco	Equal
6.	McKinney	Model 1031DLCD

B. Toilet Paper Towel Dispenser

1.	A & J	Model U180TK
2.	ASI	Model 0210
3.	Bobrick	Model T9FB489420
4.	Bradley	Model 250-150000
5.	Gamco	TD-2

C. Single Robe Hook with Exposed Fasteners:

1.	A & J	Model UX110B
2.	ASI	Model 7340B
3.	Bobrick	Model B-671
4.	Bradley	Model 9114
5.	Gamco	Model 5153B
6.	McKinney	Model 1444

D. Mirrors: Provide glass with stainless steel channel frame in size shown on drawings.

1.	A & J	Model U711
2.	ASI	Model 0620
3.	Bobrick	Model B-165
4.	Bradley	Model 710 Series
5.	Gamco	Model C Series
6.	McKinney	Model 190 Series

E. Grab Bars: Concealed mount, 18-gauge, type 304 stainless steel, 1-1/2-inch diameter, and non-slip finish in configuration shown on drawings.

F. Liquid Soap Dispensers: Bobrick B-116 (wall mounted) or equal.

2.3 APPROVED MANUFACTURERS

A. A & J Washroom Accessories, New Windsor, NY (914) 562-3332

B. ASI – American Specialties Inc., Yonkers, NY (914) 476-9000

C. Bobrick Washroom Equipment Inc., North Hollywood, CA (818) 982-9600

D. Bradley Corp, Mount Laurel, NJ (414) 354-0100

E. GAMCO – General Accessory Manufacturing Co., Dallas, TX (800) 451-5766

F. McKinney/Parker, Scranton, PA (800) 541-1073

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install items in accordance with Manufacturer's instructions. Provide mounting devices proper for base structure.

B. Where possible, mount like items in adjoining compartments back-to-back on same partition.

C. Locate as shown on drawings if location is indicated or as specified below:

1. Restroom

a. Toilet Tissue Dispenser – one at each water closet.

b. Paper Towel Dispenser - one at each water

c. Toilet Seat Cove Dispenser – one at each water closet.

d. Robe Hook – one on restroom door.

e. Liquid Soap Dispenser – one at lavatory.

END OF SECTION 10 28 00

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SECTION 10 44 16 - FIRE EXTINGUISHERS AND CABINETS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall furnish and install all fire extinguishers, cabinets and appurtenant Work, as shown on the Drawings, specified herein, and as needed for a complete and proper installation, in accordance with the requirements of the Contract Documents.

1.2 REFERENCE STANDARDS

A. Supply extinguishers that satisfy the Uniform Fire Code (UFC) as published by the Western Fire Chiefs Association Inc., the International Conference of Building Officials and the National Fire Protection Association publications (NFPA), as referenced herein.

1. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Manufacturer's Standards: In addition to the standards listed above, the fire protection products and their installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.3 CONTRACTOR SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 – Submittal Procedures. Manufacturer's literature, installation instructions, and details shall be submitted.

B. Shop Drawings: Clearly indicate dimensions, capacity, anchorage, construction details and method of installation.

1.4 QUALITY ASSURANCE

A. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

B. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

C. Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

1. Coordinate sizes and locations of fire protection cabinets with wall depths.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.

b. Faulty operation of valves or release levers.

B. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. All fire prevention equipment shall be from the same manufacturer unless otherwise specified and shall meet the requirements of NFPA -Pamphlet No. 10.

2.2 EXTINGUISHER AND CABINET

A. Fire Extinguisher: Provide extinguisher in locations indicated on drawings. Provide 20-pound ABC fire extinguisher with minimum UL rating of 10A:120B:C which are also suitable for use on live electrical equipment, (Class C Fires). Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amerex Corporation.

2. Ansul Incorporated; Tyco International Ltd.

3. Badger Fire Protection; a Kidde company.

4. Buckeye Fire Equipment Company.

5. Fire End & Croker Corporation.

6. J. L. Industries, Inc.; a division of Activar Construction Products Group.

7. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.

8. Larsen's Manufacturing Company.

9. Moon-American.

10. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.

11. Potter Roemer LLC.

12. Pyro-Chem; Tyco Safety Products.

13. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B

B. Fire Extinguisher Cabinet: Provide Surface mounted aluminum cabinets with clear satin anodized finish as manufactured by Fire End & Croker Corporation, Modern Metal Products, Potter-Roemer Inc., or equal, as follows:

1. Equip with full tempered float glass aluminum framed door with satin clear anodized finish.

2. Cabinet finish shall be manufacturer's standard white.

3. The size shall be as necessary to hold fire extinguisher specified or shown at cabinet location.

C. Schedule: Provide a fire extinguisher and cabinet as indicated in the drawings.

D. Other Materials: All other materials not specifically described but required for a complete and proper installation of firefighting devices shall be as selected by the Contractor subject to the review of the Engineer.

PART 3 - EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Manufactured materials shall be delivered in original unbroken packages, or containers, bearing the manufacturer's label with manufacturer's name, product description, and rating.

B. Storage: All materials shall be carefully stored in an area which is protected from deleterious elements as recommended by the material manufacturer. Storage shall be in a manner that will prevent damage to the material and its finish.

3.2 INSPECTION

A. Contractor shall thoroughly examine all substrates, areas and conditions under which installation work of this Section is to be undertaken. Contractor shall not proceed with Work until satisfactory conditions have been corrected.

B. Starting of installation work will be construed as Contractor's acceptance of substrates, surfaces and conditions within any particular area.

3.3 INSTALLATION

A. Brackets: All fire extinguishers shall be provided with and installed on brackets or brackets within cabinets. The Contractor shall block and reinforce wall to support the fire extinguishers.

B. Locations: Fire extinguishers shall be mounted at between 3 and 5 feet above finished floor. Locations shall be verified with the Engineer and Fire Marshall before installation and shall be installed in locations as indicated on the Drawings and where directed per NFPA Pamphlet No.10.

C. Each fire extinguisher shall be serviced, charged and tagged not more than five calendar days prior to the Date of Substantial Completion as that date is determined by the Engineer.

END OF SECTION 10 44 16

SECTION 10 51 13 – METAL LOCKERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall furnish and install steel lockers and all appurtenant Work, all in accordance with the requirements of the Contract Documents.

1.2 REFERENCE STANDARDS

A. Provide lockers that satisfy all applicable codes as specified in Section 01 42 19 – Reference Standards.

1.3 SUBMITTALS

A. Shop Drawings: The Contractor shall provide shop drawings of all products in accordance with the requirements in Section 01 33 00 – Submittal Procedures.

B. The following shall be submitted for Owner review and approval:

1. Materials of construction
2. Finishes
3. Manufacturer’s standard colors
4. Manufacturer catalog layout drawings showing elevation views and dimensions

PART 2 - PRODUCTS

2.1 GENERAL

A. Lockers shall be as manufactured by Lyon Metal Products, Inc., Republic Steel Corporation, Interior Steel Equipment Company, or equal. Colors shall be selected by the Owner from manufacturer's standard colors. Shop drawings and color selections shall be submitted for each product.

B. Lockers shall be constructed of 24-gage steel body and 16-gage steel semi-flexible type door with inverted louvers. Legs shall be provided if curb is not shown on drawings.

C. Hardware shall be provided and shall consist of not less than the following:

1. Live rubber silencers for doors, handles, locking device, and hinges.
2. Each locker shall be provided with one rustproof steel single prong hook, coat rod and non-corrosive number plates with 3/8 inch black filled figures in sequence.
3. Door holders (chain and spring type restrainer) shall be provided on end-of-line doors.
4. Built-in keyed locks shall be provided for each locker. Lockers shall be keyed and master keyed as directed by the Owner.

D. Lockers, steel parts, and accessories shall be thoroughly cleaned, given a bonding and rust inhibitive phosphate treatment, and coated with a heavy coat of epoxy resin or synthetic enamel. Enamel shall be baked to a hard durable finish of not less than one mil minimum dry thickness. Doors, frames, panel tops, and ends shall receive the same finish to provide a total minimum dry enamel thickness of 1.5 mils.

2.2 LOCKER UNITS

A. Lockers shall consist of four (4) one-person, double tier lockers, 12 inches by 12 inches by 72 inches high for mounting on concrete curb, securely tied in a bank. Furnished complete with sloping hood (including dead corners), number plates, built-in master flat keyed locks, and pad lockable handles.

PART 3 - EXECUTION

3.1 LOCKERS

A. Lockers shall be fastened to the structures in accordance with manufacturer’s printed recommendations and in conformance with applicable codes. Frames and doors shall form a flush exterior when installed. Lockers shall be securely fastened in banks.

END OF SECTION 10 51 13

SECTION 10 51 14 – LOCKER ROOM BENCHES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall furnish and install locker room benches and all appurtenant work, all in accordance with the requirements of the Contract Documents.

1.2 REFERENCE STANDARDS

A. Provide benches that satisfy all applicable codes as specified in Section 01 42 19 - Reference Standards.

B. Benches shall comply with ADA standards when required.

1.3 SUBMITTALS

A. Shop Drawings: The Contractor shall provide shop drawings of all products in accordance with the requirements in Section 01 33 00 – Submittal Procedures.

B. The following shall be submitted for Owner review and approval:

1. Materials of construction

2. Finishes

3. Manufacturer’s standard colors

4. Manufacturer catalog layout drawings showing elevation views and dimensions

PART 2 - PRODUCTS

2.1 GENERAL

A. Benches shall be manufactured by Scantron Products, Salsbury Industries, Columbia Lockers, Summit Lockers, or equivalent. All benches shall be supplied from the same manufacturer.

B. Colors shall be selected by the Owner from manufacturer's standard colors. Color and finish shall match lockers if applicable, unless otherwise specified.

C. Shop drawings and color selections shall be submitted for each product.

D. Provide maintenance costs for products submitted, to include typical repair and painting costs for each product over the 25-year warranty period. Provide manufacturer’s 25-year warranty against breakage, corrosion, and delamination under normal conditions.

2.2 BENCHES

A. Benches dimensions shall meet the following requirements:

1. Height: 16 to 18 inches

2. Width: 12 inches to comply with ADA standards

3. Bench tops: 1 to 1-1/2 inches thick with all edges rounded to a 1/4 inch radius

4. Length: as shown on plans and not to exceed 48 inches for one single piece.

B. Unless noted otherwise, benches shall be made of HDPE plastic and pedestals shall be made of powder-coated aluminum or stainless steel. Substitutions permitted with prior approval of engineer.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Inspect benches upon receipt for visible damage. Further inspection if necessary for hidden damage.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Sequence deliveries to avoid project delays but minimize on-site storage.

3.2 INSTALLATION

A. Benches shall be fastened to the structures in accordance with manufacturer’s printed recommendations and in conformance with applicable codes. Floor and wall penetrations shall be coordinated with structural plans.

B. Install benches rigid, straight, plumb, and level. No evidence of drilling, cutting, and patching shall be visible in finished work.

END OF SECTION 10 51 14

SECTION 22 00 00 – PLUMBING, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, material and equipment as required for the installation of all plumbing, fixtures and related accessories.

B. Piping, apparatus and equipment are shown on the Project Plans at approximate locations only. Change locations to suit the job conditions, as directed by the Engineer, or rearranged as required for built-in fixtures or equipment. Install all parts of the system to avoid obstructions, preserve headroom (8 feet 0 inches minimum), and to keep openings and passageways clear. Install a commercial water hammer arrester in the water supply system.

C. No holes are to be made in any structural member without the Engineer's written consent. Where pipes pass through any structural member, or where notching, boring or cutting of structure if necessary, the Contractor shall proceed as directed by the Engineer.

1.2 REFERENCE STANDARDS

A. Comply with the local plumbing code.

B. All applicable code laws and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of these specifications.

1.3 SUBMITTALS

A. Submit product literature in accordance with Section 01 33 00 – Submittal Procedures for all plumbing equipment and materials.

B. Where cutting of concrete, masonry, or wood or work by other trades is required, furnish information for all openings, recess and chases for plumbing.

C. Submit shop drawings and isometric views of water and DWV systems from Building E in the plan set, for approval. Submit in accordance with Section 01 33 00 – Submittal Procedures.

PART 2 - PRODUCTS

2.1 GENERAL

A. All pipes are to be properly graded, according to the applicable plumbing code, and securely supported with pipe brackets and insulating strips, to prevent transmission of noise through pipes.

B. Provide drain valves at low points of water systems, and any other piping and connections to obtain a complete and workable system. Such systems shall be provided with shutoff and drain valves at low points, with continuous grade down to drainage points to enable evacuation of the piping back to a safe location.

C. All hot and cold water piping is to be insulated, except for short, exposed fixture connections. Provide ½" preformed polyethylene insulation with vapor barrier.

D. Plumbing piping, fixtures, specialties, and equipment shall be installed as recommended by the manufacturer for the intended usage.

E. Laboratory plumbing piping, fixtures, specialties, shall compatible for use with acid waste and vent systems. Installation of all materials shall be as recommended by the manufacturer for the intended usage.

F. Floor sinks shall be provided for all equipment drains. No equipment drains shall discharge to floor slabs.

2.2 DOMESTIC PIPING AND FITTINGS

A. Pressurized Systems (Above-ground): All above-ground pipe and fittings shall be:

1. Domestic Areas: Type L, hard drawn copper tube with wrought copper fittings and lead-free solder joints.

2. Process Treatment Areas: Welded or threaded schedule 40 type 316 SST pipe and fittings

B. Pressurized Systems (Below-ground): Unless otherwise specified or indicated, all below ground domestic & process treatment water distribution pipe and associated fittings shall be as indicated below:

1. NPS 3/4" & smaller: Type L, soft drawn copper tube with wrought copper fittings and brazing material having melting point of 1465°F.

2. NPS 1" & larger: Type K, annealed seamless copper tube, hard drawn with wrought copper fittings and brazing material having melting point of 1,465°F.

C. Drain, Waste & Vent Systems (Above-ground): Unless otherwise specified or indicated, all drain, waste and vent piping and associated fittings shall be as indicated below:

1. Cast iron soil pipe and fittings with gaskets and compression joints or no hub cast iron soil pipe and fittings with stainless steel couplings and joints, at Contractor's option.

D. Pipe Materials shall be as specified in respective specifications.

E. Vent piping passing through the roof shall be flashed. Flashing shall be per roofing manufacturer's requirements for metal roof systems.

F. Fittings: All fittings shall be as specified in related pipe specification sections.

G. Nipples: Material shall be same as pipe except that when unthreaded part is less than 1-1/2 inches long, use extra strong pipe for nipple. Do not use close nipples.

H. Unions: For pipe 2-1/2 inches and smaller, use screwed type, unless otherwise indicated. Over 2-1/2 inches use flanges.

I. Water Hammer Arrester: A commercial water hammer arrester shall be installed in the water system at an indoor location protected from freezing. The water hammer shall be ASSE 1010-2004 certified and shall be the same pipe size as the pipe it is installed in or 1". The commercial water hammer arrester shall be Sioux Chief Hydra-Rester or approved equal.

2.3 VALVES

A. Water shut off valves shall be the ball type, except on fixture supply piping where globe valves shall be used.

B. Interior hose valves shall be provided as indicated. The hose nipple shown on the detail shall be a female iron pipe thread inlet with hose thread outlet. Hose bibbs shall be 3/4-inch in size.

C. The Contractor shall provide shutoff valves on cold water piping at entrances to pipe chases and other inaccessible areas and wherever indicated or required to obtain the maximum efficiency for shut-off control on the water system. Shut off valves shall be placed on all hot and cold water connections to equipment and fixtures. Lavatory and sink stops with wheel handle shall be brass with chrome plating. Extra-long barrel stops shall be used where supply piping is concealed behind partitions.

D. Valves shall open by turning counterclockwise and shall have suitable handwheels or nuts as required.

E. Provide a temperature and pressure relief valve for each water heater. Provide pressure relief valves at other locations where indicated. Relief valves shall be equipped with manual test levers. The Contractor shall provide piping to convey relief valve discharge to the nearest floor drain, the building exterior, or elsewhere if approved by the Engineer.

2.4 CLEANOUTS

A. Where underground or concealed cleanouts are to be brought to floor level or grade and to accessible locations with access covers and frames, cleanouts are to be as shown on the Project Plans.

B. Clean outs shall have a minimum diameter of 3-inches.

C. Stack cleanouts shall be installed at the base of each stack. Cleanouts shall be galvanized cast iron with ABS plastic cleanout plugs.

2.5 ACCESS COVERS AND FRAMES

A. All inaccessible valves, controls, trap primers, cleanouts, etc., are to be made accessible by means of access doors in ceilings, walls, or floors. Access covers and frames for valves, cleanouts, etc., shall not be smaller than 8-inch by 8-inch, as manufactured by Zurn; Josam; WADE; J.R. Smith, or nickel-bronze, with hinged cover. The floor access covers in unfinished concrete floors, not exposed to chemicals, may be of galvanized cast iron, as manufactured by Alhambra Foundry Company Model A-2015; Neenah Foundry Co., No. R-6660, or equal.

2.6 STOPS

A. Provide 1/2-inch solid bronze, chrome plated, wheel handle, globe or, where appropriate, angle pattern.

2.7 TRAP SEALS AND PRIMERS

A. Where required by code, floor drains and floor sinks connected to the sanitary sewer shall be protected by trap primers connected to the water supply to the nearest plumbing fixture. One half-inch copper tubes shall run from the primers to the traps. Trap primers shall be mounted in accessible locations. Furnish and install the trap seals and primers, as manufactured by Zurn (Model Z-1022; WADE; Josam (Model 88250), or J.R. Smith (Model 2699); Crane; Walworth; James Jones; or equal. The sizes shall be as shown on the Project Plans.

B. Where trap primers are to connect to chemical resistant traps below grade, transition trap primer piping from selected piping material to chemical resistant piping above fixture flood rim.

2.8 PROTECTIVE COATINGS

A. All ferrous metal, except finished, galvanized and machine surfaces, shall have surfaces prepared and primed in the shop in accordance with the requirements of Section 09 90 00 – Painting and Coating. Prime colors shall be compatible with finish coats to be applied in the field.

B. Self-contained units such as wall-mounted hose racks shall be supplied with factory applied finish coats of baked enamel.

C. Field painting shall comply with Section 09 90 00 – Painting and Coating.

PART 3 - EXECUTION

3.1 GENERAL

A. Install all piping, fixtures, equipment and accessories in strict accordance with the plumbing laws, rules, and regulations of the State and of the City, whichever represents the higher standard.

B. Plans do not attempt to show exact details of all piping, and no extra payment will be allowed for obstruction by work of other trades or local obstructions to the work under this contract which require offsets where diagrams have been made to show piping connection. These diagrams must not be used for obtaining material quantities. Changes in location of equipment or piping, advisable in the opinion of the Contractor, will be submitted to the Engineer for approval before proceeding with the work. Verify all measurements and dimensions at the site. Adjust all equipment and leave in a condition satisfactory to the Engineer.

C. Pipe sizes shown on the Plans are inside dimension of piping installed unless noted otherwise. Provide all piping which passes through walls, floors, or ceilings with standard weight pipe sleeves. Provide all pipes which pass through finished walls with chrome-plated canopy flanges. Pipe sleeves installed in water-holding basins are to have a 1/4-inch steel seep ring, 4 inches larger in diameter than the OD of the sleeve. Continuously weld ring to sleeve. Make joint between pipe and sleeve watertight with poured and caulked lead. Dry pack sleeves in existing work in place and provide a finished appearance.

3.2 WORKMANSHIP AND MATERIALS

A. All work shall be in strict accordance with the Uniform State Plumbing Code, and codes of the State of Idaho and Bingham County and any other authorities having jurisdiction. The Contractor shall have required certifications and be thoroughly familiar with the local codes. The Contractor shall obtain and pay for all necessary permits.

B. Care shall be taken at all times to protect floors, stairways, and walls during the make-up and erection of piping and placing of equipment. The Contractor shall remove all stains and repair all damage before final acceptance of the Work.

C. If the Engineer finds materials that have identifying marks removed or lack such marks completely, such items will be rejected until the Contractor has furnished proof that said items conform to the Specifications. Adequacy and extent of such proof will be determined by the Engineer.

3.3 OPENINGS

A. The Contractor shall provide all necessary openings in walls, floors, and roofs for the passage of piping and plumbing equipment within and into the buildings. Openings shall be as indicated or as required to provide passage for the plumbing Work.

3.4 WATER SUPPLY DISTRIBUTION

A. Hot and Cold Water Supply: Provide distribution system from supply valve with mains, risers, branches, gate and check valves, other parts specified under Fixtures herein; connect to fixtures and equipment requiring hot and cold water.

B. Industrial Hot and Cold Water Supply: Provide distribution system from reduced pressure backflow prevention devices to laboratory fixtures indicated in plans. Provide individual mixing valves at single spigot counter sinks and cupsinks. Set mixing valves to provide 104 deg F water supply from lab faucet.

C. Drain Water Supply Piping: Grade horizontal piping at uniform slope of 1/4-inch in ten feet minimum, into low points for purpose of emptying piping of water when needed. Where constant pitch cannot be maintained for long runs, establish intermediate low point and rise to new level. Grade branches to drain to main. At bottom of rise, at low points, provide 3/4-inch brass hose bib valves.

3.5 DRAINAGE SYSTEM

A. Provide building drain with cleanout; building cleanout; soil, waste and vent stacks, extended through roof and flash; branch piping and fixture traps; connect to fixtures, floor drains, whether equipment indicated or specified, all requiring soil, waste, drain, vent facilities.

B. Drainage Specialties: Floor drains for toilet and other like areas in waterproof floors for trap; cast iron, adjustable c-p brass strainer, double drainage flange with weep holes, flashing clamp device.

C. Traps: Provide traps for fixtures and other equipment requiring connections to drainage system, except where trap is an integral part of unit design; type, size, finish of traps are specified under their fixtures and equipment. Set traps as close as possible to fixtures and equipment.

D. Plastic Risers: Where plastic pipe is used for vertical risers to untrapped floor drains, the vertical section of pipe shall be completely embedded in concrete at least 3 inches thick all around the pipe.

E. Building Cleanout: Set building cleanout flush with the finish floor in the location shown on the Plans.

F. Floor Drains: Provide drains complete with deep seal P-traps where required. Install so that the double drainage flange is cast into the floor concrete.

G. Cleanout, Access Covers: Provide cleanouts where indicated and if not indicated, in following locations: at junction of building drain with building sewer, at points of change in direction in horizontal drains, at intervals of 50 feet in long horizontal runs; at or close to base of leaders soil and waste stacks.

H. Roof Stack Terminal: Provide flashing for stacks passing through roofs according to roof manufacturer’s requirements.

I. For Threaded Pipe: Provide cast iron recessed pipe coupling with double threads to connect stack to its extension with a recessed portion to extend over flashing which will serve as counter flashing or rain guard; from recessed coupling enclosed in chimney, carry stack extension to heights above as directed. Paint extensions above on prime and one finished coat asphalt paint outside and at least 12 inches down from top inside page.

3.6 PIPING INSTALLATION

A. Arrange, install piping approximately as indicated, straight, plumb and as directed as possible; form right angles or parallel lines with building walls. Pipes close to wall partitions, ceilings; offset only where necessary to follow walls as directed. Locate groups of pipes parallel to each other; space at distance to permit applying full insulation and to permit for service valves.

B. Routing: Install horizontal piping as high as possible without sags or humps. Grade water piping as specified under Water Supply Distribution. Grade drainage piping in uniform slope of 1/4-inch per foot minimum; where this is possible, maintain slopes as directed, but in no case less than 1/8-inch per foot.

C. Fittings: Where changes in pipe size occur, use only reducing fittings. For drainage piping changes in direction, use long sweep, where possible, otherwise short sweep 1/4 bends, or combination Y and 1/8 bends, also Y's or combination with other bends; use sanitary T branches only for horizontal branches discharging into stacks.

D. Unions: Provide unions, screwed or flanged, where required and in following locations if not indicated. In long runs of piping in water supply or other services, except drainage at intervals to permit convenient disassembling for alteration, repair. In bypasses around equipment. Connection to hot water heaters, pumps, other equipment requiring disconnection for replacement; locate between shut-off and equipment.

E. Valve: Locate valves for easy access and operation; where concealed, provide access doors. Do not locate valves with stems below horizontal. All valves and appurtenances used in connection with the gas and vacuum shall be of a type designed and approved for use with fuel gas.

F. Concealed Piping: Where so indicated or specified, conceal piping in building construction or underground. Install such piping in time so as to cause delay to work of other trades and allow ample time for tests and approvals; do not cover before approval is obtained. Keep fixture branches concealed to points above floor close to fixtures; expose only as much as necessary for final connection.

G. Pipes Over Electrical Equipment: Avoid locating water and drain piping over electrical equipment; where this is unavoidable, obtain permission to do so; provide drip pan under such pipes.

H. Protect Open Piping: Keep piping free from scale and dirt; protect open pipe end wherever work is excavated over during construction, to prevent foreign bodies entering and lodging there; use temporary cap plugs, burlap or other approved material for protection.

3.7 FIXTURE INSTALLATION

A. Connect all fixtures shown on the Project Plans to piping as needed to make a complete installation. Provide p-trap and tubing to wall as required. All plumbing faucets, handles, exposed piping, fixtures, and trim shall be brass with chrome-plated finish. Equip all sinks or lavatories mounted in counter with deck rims in satin finished aluminum material on all sinks.

3.8 EYE WASH AND EMERGENCY SHOWER

A. Install emergency eye wash and shower per the requirements of 29 CFR 1910.151© and ANSI 2358.1 requirements.

3.9 ACCEPTABLE TESTS

A. Test all piping provided under this section. Test piping to be buried before backfilling or pouring concrete. Where piping is laid below or within concrete, maintain test pressure during concrete pour. Where piping is laid below or within concrete, maintain test pressure during concrete pour. Where air tests are specified, each joint shall be covered with a soap solution or leak detector fluid. Clean piping after completion of soap test. Test shall be as follows:

1. Pressure Lines: Pressurize all pressure systems to twice the working pressure and repair any leaks that develop.

2. Drain Lines: Test all drain lines either as an entire system or by sections. All system openings closed, except highest one in the test section, and the system filled with water. Provide sufficient overlapping of sections so that very joint and connection will be subjected to a static head of at least 10 feet. Allow water to stand for 2 hours before beginning inspection. Repair all leaks which occur and repeat test until a satisfactory job is obtained.

END OF SECTION 22 00 00

SECTION 22 11 24 – AIR GAP SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall furnish and install a skid-mounted air gap system that includes a variable speed packaged pumping system, pressure tank, water storage tank, control panel, and all associated piping, valves, electrical and control wiring and instrumentation required for a complete and operable air gap system as shown on the drawings and specified herein. System shall be provided such that it utilizes a single electrical and Ethernet connection for operation.

B. The air gap system shall provide secondary water (W2) to the process equipment for polymer dilution, screw press cleaning cycles, pump priming, yard hydrants, washdown water, and headworks screens.

C. The entire pump station and control panel shall be designed, assembled, programmed, and tested by a single manufacturer.

1.2 REFERENCE STANDARDS

A. Hydraulic Institute

B. ANSI – American National Standards Institute

C. NSF/ANSI 61– Drinking Water System Components

D. ASTM – American Society for Testing and Materials

E. IEEE – Institute of Electrical and Electronics Engineers

F. NEMA – National Electrical Manufacturers Association

G. NEC – National Electrical Code

H. ISO – International Standards Organization

I. UL – Underwriters Laboratories, Inc.

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Section 43 05 01 – Equipment General Provisions, Section 43 20 00 – Pumps, General, and Section 01 33 00 – Submittal Procedures.

B. The submittals shall include product literature, technical specifications for all system components including valves and instrumentation, pump curves, electrical wiring diagrams, control strategies, and control panel drawings.

C. Provide software submittal including controller logic and operator interface screens.

D. Submit operation and maintenance information in accordance with Section 01 33 00 – Submittal Procedures and 01 78 23 – Operation and Maintenance Data.

E. Calculations and shop drawings shall be submitted for the skid-mounted air gap system in accordance with Section 01 33 00 – Submittal Procedures. All anchor calculations must be made and signed by a civil or structural engineer currently registered in the State of Idaho.

1.4 MANUFACTURER'S QUALIFICATIONS

A. The manufacturer shall be a UL QCZJ Listed Packaged Pump Station Manufacturer, a UL 508A Listed Control Panel Manufacturer, and an ISO 9001:2015 Certified Manufacturer.

1.5 FACTORY TESTING

A. The pump station manufacturer shall conduct and document a complete factory dynamic test of the pump station prior to shipment. Pump station shall be tested throughout the entire operating range at the net discharge pressure called for in the technical specifications. Individual pump pressure, flow, RPMs, volts, amps, KW and power factor shall be documented for verification by the Owners' Representative prior to delivery upon request.

1. Hydrostatic Testing. The packaged pump station shall undergo hydrostatic testing that meets ANSI/HI specifications and standards.

2. Vibration Testing. The packaged pump station shall undergo vibration testing that meets ANSI/HI 9.6.4—Vibration Measurement and Allowable Values—specifications and standards.

3. Flow Testing. The packaged pump station shall undergo Hydraulic Performance Acceptance testing that meets ANSI/HI 14.6 specifications and standards.

1.6 WARRANTY

A. The Manufacturer shall warrant the original buyer that the packaged pump station shall be free from defects in material and workmanship for a period of 12 months from the date of Substantial Completion.

B. The motor control panel shall be covered under Warranty for 3 years from Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install a prefabricated and tested variable speed packaged Air Gap System to maintain constant water delivery pressure to the process.

B. The complete packaged Air Gap system shall be certified and listed by UL (Category QCZJ – Packaged Pumping Systems) for conformance to U.S. Standards.

C. The packaged Air Gap system shall be a standard product of a single manufacturer who shall be responsible for designing and assembling pumps, sensors, piping, and tanks on a base.

2.2 SYSTEM OPERATION

A. The basis of operation for the Air Gap System is to maintain an adequate level of water in the distribution tank while providing the required flow and pressure to the process system. This shall be accomplished as follows:

1. The distribution tank shall be filled with city water using the pressure and flow available on site. Back flow prevention is accomplished through the use of a positive air gap at the top of the distribution tank. The Air Gap shall be a minimum of 2 x the fill line diameter at the distribution tank. No screens, splash containment or other obstructions that could cause backflow into the incoming water source shall be used at the distribution tank.

2. The process pumps shall take suction through a bulkhead fitting installed in the distribution tank and shall be adequately sized to provide the proper flow and pressure required by the system.

3. If something downstream of the pump changes the system to an over-pressurized state, a PRV is in place to direct flow back to the distribution tank. This will prevent damage to equipment downstream of the pump in the process.

4. An overflow line shall be installed above the max fill line on the distribution tank. In the event that the inflow does not shut off, the overflow line will direct the excess water to drain. There will be no isolation valve in this drain line.

2.3 VARIABLE SPEED PACKAGED PUMPING SYSTEM

A. Furnish and install a prefabricated and tested variable speed packaged pumping system to maintain constant water delivery pressure.

B. The packaged pump system shall be a standard product of a single pump manufacturer. The entire pump system including pumps and pump logic controller, shall be designed, built, and tested by the same manufacturer.

2.4 SYSTEM DESIGN CRITERIA

A. System Flow Range: 10 gpm to 150 gpm, max. when the dewatering screw presses or belt press are in operation. The pumps shall be sized and sequenced such that there are no performance gaps in the specified flow range. The system must meet the performance requirements with any pump out of service.

B. Design Discharge Pressure (constant): 100 psi

C. Pump Design Criteria

1. Duty Pumps:

a. Design Performance: 10 - 75 GPM at 100 psi discharge pressure (each)

b. Motor Rated Horsepower: 10 HP, 460 Volt, 3 Phase

c. Quantity: 3 (2 duty, 1 standby)

2.5 SEQUENCE OF OPERATION

A. The system controller shall operate equal capacity variable speed pumps to maintain a proportional pressure differential pressure setpoint (system setpoint from local mounted sensors). The system controller shall receive an analog signal [4-20mA] from the factory installed pressure transducer on the discharge and suction manifolds, indicating the actual system pressure and inlet pressure. The controller shall be capable of controlling off the subtraction of discharge minus suction transducers for differential pressure across the manifolds.

B. The system controller shall be capable of switching pumps on and off to satisfy system demand without the use of flow switches, motor current monitors or temperature measuring devices.

C. All pumps in the system shall alternate automatically based on demand, time and fault. If flow demand is continuous (no flow shutdown does not occur), the system controller shall have the capability to alternate the pumps every 24 hours, every 48 hours or once per week. The interval and actual time of the pump change-over shall be field adjustable.

2.6 LOW FLOW STOP FUNCTION (CONSTANT PRESSURE APPLICATIONS)

A. The system controller shall be capable of stopping pumps during periods of low-flow or zero-flow without wasting water or adding unwanted heat to the liquid. Temperature based no flow shut- down methods that have the potential to waste water and add unwanted temperature rise to the pumping fluid are not acceptable and shall not be used.

B. Standard Low Flow Stop and Energy Saving Mode: A bladder type diaphragm tank shall be installed with a pre-charge pressure of 70% of system set point. The tank shall be piped to the discharge manifold or system piping downstream of the pump system. When only one pump is in operation the system controller shall be capable of detecting low flow (less than 10% of pump nominal flow) without the use of additional flow sensing devices. When a low flow is detected, the system controller shall increase pump speed until the discharge pressure reaches the stop pressure (system set point plus 50% of programmed on/off band, adjustable).

C. The pumps shall remain off until the discharge pressure reaches the start pressure (system set- point minus 50% of programmed on/off band, adjustable). Upon low flow shut-down a pump shall be restarted in one of the following two ways:

1. Low Flow Restart: If the low flow condition still exists, the pump shall start and the speed shall again be increased until the stop pressure is reached and the pump shall again be switched off.

2. Normal Flow Restart: If the pump system controller determines a low flow condition no longer exists the pump shall start and the speed shall be increased until the system pressure reaches the system set point.

2.7 PUMPS

A. The pumps shall be of the in-line vertical multi-stage design, and shall be Grundfos CRE Series, or equivalent.

B. The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region. The shut-off head shall be a minimum of 20% higher than the head at the best efficiency point.

C. Vertical In-Line Multi-Stage Pumps shall have the following features:

1. The pump impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement.

2. The suction/discharge base shall have ANSI Class 250 flange or internal pipe thread (NPT) connections as determined by the pump station manufacturer.

3. Pump Construction.

a.	Suction/discharge base, pump head, motor stool:	Cast iron (Class 30)
b.	Impellers, diffuser chambers, outer sleeve:	304 Stainless Steel
c.	Shaft:	316 or 431 Stainless Steel
d.	Impeller wear rings:	304 Stainless Steel
e.	Shaft journals and chamber bearings:	Silicon Carbide
f.	O-rings:	EPDM or Viton

Shaft couplings for motor flange sizes 184TC and smaller shall be made of cast iron or sintered steel. Shaft couplings for motor flange sizes larger than 184TC shall be made of ductile iron (ASTM 60-40-18).

Optional materials for the suction/discharge base and pump head shall be cast 316 stainless steel (ASTM CF-8M) resulting in all wetted parts of stainless steel.

4. The shaft seal shall be a balanced O-ring cartridge type with the following features:

a.	Collar, Drivers, Spring:	316 Stainless Steel
b.	Shaft Sleeve, Gland Plate:	316 Stainless Steel
c.	Stationary Ring:	Graphite Embedded Silicon Carbide
d.	Rotating Ring: Graphite Embedded	Silicon Carbide
e.	O-rings:	EPDM or Viton

5. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, shaft coupling and motor. The entire cartridge shaft seal shall be removable as a one-piece component.

2.8 INTEGRATED VARIABLE FREQUENCY DRIVE MOTORS

A. Efficiency: The motors shall be of permanent magnet design meeting IE5 efficiency levels where the combined motor and VFD efficiency exceed NEMA Premium Efficiency standards.

B. Bearing Current Mitigation: Motors shall use WSB (Winding Set Back) and/or CHS (Coil Head Shield) designs that reduce the Bearing Voltage Ratio (BVR) far enough to eliminate damaging bearing currents. Shaft grounding rings/brushes or common mode filters shall not be required.

C. Motor Enclosure/Cooling: The motor shall be Totally Enclosed Fan Cooled (TEFC), inverter-duty rated, with a standard NEMA C-Face with Class F insulation.

D. The cooling design of the motor and VFD shall be such that a Class B motor temperature rise is not exceeded at full rated load and speed at a minimum switching frequency of 9.0 kHz.

E. The power and control electronics shall be housed in a UL Type 3 enclosure and the combined motor/VFD rating shall be IP55 (protection against dust and nozzle directed water from any direction).

F. The VFD shall be of the PWM (Pulse Width Modulation) design using IGBT (Insulated Gate Bipolar Transistor) technology.

G. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor current suitable for centrifugal pump control and to eliminate the need for motor de-rating.

H. The VFD shall automatically reduce the switching frequency and/or the output voltage and frequency to the motor during periods of sustained ambient temperatures that are higher than the normal operating range. The switching frequency shall be reduced before motor speed is reduced.

I. An integral RFI filter shall be standard in the VFD.

J. The VFD shall have a minimum of two skip frequency bands which can be field adjustable.

K. The VFD shall have internal solid-state overload protection designed to trip within the range of 105-110% of rated current. The integrated VFD motor shall include protection against input transients, phase imbalance, loss of AC line phase, over-voltage, under-voltage, VFD over-temperature, and motor over- temperature. Three-phase integrated VFD motors shall be capable of providing full output voltage and frequency with a voltage imbalance of up to 10%.

L. The integrated VFD motor shall have, as a minimum, the following input/output capabilities:

1. Speed Reference Signal: 0-10 VDC, 4-20mA

2. Digital remote on/off

3. Fault Signal Relay (NC or NO)

4. Fieldbus communication port (RS485)

M. Motor drive end bearings shall be adequately sized so that the minimum L10 bearing life is 20,000 hours at the minimum allowable continuous flow rate for the pump at full rated speed.

2.9 SYSTEM CONSTRUCTION

A. Suction and discharge manifold construction shall be in way that ensures minimal pressure drops, minimize potential for corrosion, and prevents bacteria growth at intersection of piping into the manifold. Manifold construction that includes sharp edge transitions or interconnecting piping protruding into manifold is not acceptable. Manifold construction shall be such that water stagnation cannot exist in manifold during operation to prevent bacteria growth inside manifold.

B. The suction and discharge manifolds material shall be 316 stainless steel. Manifold connection sizes shall be as follows:

1. 4-inch and larger: Flanged.

C. Pump Isolation valves shall be provided on the suction and discharge of each pump. Isolation valve sizes 2 inch and smaller shall be nickel plated brass full port ball valves. Isolation valve sizes 3 inch and larger shall be a full lug style butterfly valve. The valve disk shall be of stainless steel. The valve seat material shall be EPDM and the body shall be cast iron, coated internally and externally with fusion-bonded epoxy.

D. A spring-loaded non-slam type check valve shall be installed on the discharge of each pump. The valve shall be a wafer style type fitted between two flanges. The head loss through the check valve shall not exceed 2 psi at the pump design capacity. Check valves 1-1/2" and smaller shall have a POM composite body and poppet, a stainless steel spring with EPDM or NBR seats. Check valves 2" and larger shall have a body material of stainless steel or epoxy coated iron (fusion bonded) with an EPDM or NBR resilient seat. Spring material shall be stainless steel. Disk shall be of stainless steel or leadless bronze.

E. The base frame shall be constructed of carbon steel with an industrial powder coating. Rubber vibration dampers shall be fitted between each pump and base-frame to minimize vibration.

F. The control panel shall be mounted on a 304 stainless steel fabricated control cabinet stand attached to the system skid.

G. A Pressure Relief Valve shall be provided to prevent the pump from over pressurizing the process system. Provide a spring-operated PRV with lead-free brass body, stainless steel springs, and Buna-N disc. The valve shall be calibrated to open when the system discharge pressure rises to 110% of the setpoint pressure. The valve shall include a calibration feature to allow field adjustment of the pressure relief setpoint. The PRV shall relieve back to the distribution tank. Systems that relieve to drain are not acceptable. Provide Watts LF530C PRV or equal.

H. The pump station shall include a continuous acting air relief valve that shall continuously discharge entrapped air in the system. The relief valve shall be constructed of cast iron with a stainless steel float and trim. Discharge shall be piped to the nearest floor drain. Provide Valmatic air relief valves or equal.

I. Float Type Tank Fill Valve

1. Provide to ensure the tank has enough water to meet system demand. The float valve shall be a non-modulating valve that accurately controls the liquid level in tanks.

2. Valve shall be designed to open fully when the liquid level reaches a pre-set low point and close drip-tight when the level reaches a preset high point.

3. Valve shall be a hydraulically operated, diaphragm valve with the pilot control and float mechanism mounted on the cover of the main valve. The float positions the pilot control to close the valve when the float contacts the upper stop.

4. The fill valve shall be mounted at least 2x its discharge diameter above the distribution tank.

5. The fill valve shall be Cla-Val Model 124-01 or approved equal.

2.10 DISTRIBUTION AND PRESSURE TANKS

A. Air Gap Distribution Tank: Provide a 300-gallon (minimum size) Air Gap Tank with adequately sized opening for fill water and pressure relief discharge line while maintaining a minimum of 2 times the inflow pipe diameter for the required air gap. It shall be High-density linear polyethylene (HDLPE), natural white color that complies with FDA Regulation 177.1520. All materials shall be UV stabilized and shall have molded in Gallons on the side of the tank.

B. Pressure Tank: Pump station shall include a pre-pressurized diaphragm-type well tank certified to meet NSF 61. The pressure tank shall be constructed of a steel shell with a heavy duty Butyl diaphragm, polypropylene liner, and Tuf-Kote coating.

2.11 INSTRUMENTATION

A. A pressure transducer shall be factory installed on the discharge manifold (or field installed as specified on plans). Systems with positive inlet gauge pressure shall have a factory installed pressure transducer on the suction manifold for water shortage protection. Pressure transducers shall be made of 316 stainless steel. Transducer accuracy shall be +/- 1.0% full scale with hysteresis and repeatability of no greater than 0.1% full scale. The output signal shall be 4-20 mA with a supply voltage range of 9-32 VDC.

B. Pressure Gauge: Bourdon-tube pressure gauges shall be installed on the suction and discharge manifolds. Gauges shall be liquid filled with a 304 stainless steel case and bezel. Gauges shall be 4″ diameter, with a ¼″ NPT pressure sensing connection.

C. Electromagnetic Flow Meter

1. The pump station shall have a flow meter installed as shown on the technical drawing and in accordance with manufacturer’s recommendations. Pump station shall be provided with minimum straight pipe as required in front of the meter by Manufacturer, and minimum length of required straight pipe downstream from meter for connection by Contractor to plant water system.

2. The flow meter shall be NSF-61 rated for potable water applications.

3. The flow meter shall be electromagnetic design comprising of two major components, a primary head and a signal converter. The primary meter head shall incorporate a straight-thru flow design with no moving parts or pressure loss.

4. The flow meter signal converter shall produce two separate signals, pulse and 4-20ma, in linear proportion to flow rate. Flow data, including flow rates and flow totals, shall be accessible via the door-mounted PLC touchscreen interface.

5. Flow meter shall read flows from 0.10 - 39 FT/S, with an accuracy of +/- 0.25%. Flow meter shall be sized so that maximum system flow lies between 5 and 15 FT/S through the meter.

6. The meter shall be fully tested during the pump station full run performance testing while at the factory prior to shipment. The magnetic flow meter on the pump station shall be calibrated against a master meter.

7. The flow meter shall be Badger Meter M2000 series or equal

D. Level Transmitter:

1. A solid state level transmitter shall provide a noise free, linear output proportional to reservoir level. Transmitter shall be solid-state, strain gauge type with integral voltage regulation and output accuracy not less than 0.25%. Transmitter shall be constructed of stainless steel and rated for pressures up to 600 PSI. The cable shall be polyurethane molded vented with Kevlar. The vent tube shall be protected in such a way as to prevent moisture from entering. The level transmitter shall be Keller Levelgage or equal.

E. Low Water Float Switch

1. The system shall have a float switch to be used to signal the pump station to shut down if the intake source water level becomes too low. The switch shall work in conjunction with the PLC (programmable logic controller). In the event that the supply drops below a safe operating level, the PLC will shut down the pump system. The PLC shall be programmed to attempt to restart the pumping system two times. If after two attempts the water supply is still too low, the system will require a manual reset. The Low Water Float switch shall be 2900 Mercury series manufactured by Conery or equal.

F. Systems with a flooded suction inlet or suction lift configuration shall have a factory installed water shortage protection device on the suction manifold.

2.12 PUMP SYSTEM CONTROLLER AND OPERATOR INTERFACE

A. The pump system controller shall be a standard product supported by the pump system manufacturer.

B. Programmable Logic Controller (PLC)

1. To maintain consistency with city equipment, the PLC and modules shall be Allen-Bradley CompactLogix, no equal.

2. Required Hardware Features

a. Dual Ethernet w/DLR capability to communicate with plant SCADA system.

b. 1MB Memory

c. 8 I/O Expansion

d. 8 Ethernet IP Nodes

e. 2GB SD Card

C. Operator Interface

1. The operator interface shall be a color LCD touchscreen, with a minimum diagonal length of 5.7″. The touchscreen shall allow operator access to all system settings and monitoring data. The touchscreen shall be mounted to the motor control panel door.

2. The operator interface shall be manufactured by Allen-Bradley, IDEC, or equal.

D. PLC Monitoring and Control Functions

The PLC and Operator Interface shall include, but are not limited to, the following monitoring and control functions:

1. Monitoring Functions

a. Pump status, including lead pump designation, VFD frequency, and current draw.

b. Alarm conditions, with the ability to manually reset alarms.

c. Current values of all system sensors, including pressure and flow.

d. Fault Log

1) The PLC shall have a system fault log that displays the precise times of fault occurrences and recoveries, as well as message indicating the fault type.

2) The fault log shall include a fault diagnosis utility that provides possible causes of and solutions to all system faults and warnings.

e. Trend Log

1) Trend graphing screen capable of detailing pressure, flow, and current data.

2) Graphing function shall give the option to graph and plot a point at user adjustable intervals.

3) All data shall be capable of being downloaded to a USB drive and allow an operator to upload the data to a spreadsheet type program.

2. Control Functions

a. Tank Fill Valve Settings

1) Automatic: Valve opens and closes based on user selectable level settings.

2) Off: Valve is de-energized to close.

3) Test: Valve is energized to open.

b. Pressure Settings

1) Pressure transmitter calibration, discharge pressure setpoint, and high and low pressure alarm/fault conditions.

c. Flow Settings

1) A display of total gallons pumped with user reset button and time/date stamp of last reset.

2) Low and high flow alarm conditions.

3) Flow meter sensor calibration settings.

d. Level Settings

1) A display of total tank level.

2) Low and high level alarm and fault conditions.

3) Level sensor calibration settings.

e. Pump Settings

1) Pump detail screens showing total run hours of each pump since last reset and any modes, options, or functions specific to that pump.

2) Pump Sleep settings.

a) The pump shall enter sleep mode via user adjustable settings based on either of two thresholds: VFD frequency or system flow. The user shall also be able to adjust the sleep delay mode. The pump shall enter operating mode when the system pressure reaches a user adjustable "Wake-Up" pressure setting.

3) Pump Alternation Settings

a) Lead/lag designations for the pumps shall be user adjustable, with both automated and manual alternation settings.

f. Remote Start/Stop Signal Relay

1) The PLC shall be able to start and stop the system based on a remote signal relay.

g. Pre-programmed Start-Up Routines

1) The PLC shall be programmed with various start-up routines that limit and/or delay the starting and acceleration of the pump, ensuring that excessive velocity and pressure do not damage the distribution system.

2) The program shall include individual routines for initial start-up, mainline fill, re-start after a power outage, and re-start after a system fault.

3) The operator shall be able to adjust the timing of the routines via the operator interface.

h. Password Protection

i. Loading and Saving System Default Settings

1) The system shall allow the operator to Load Factory Default PLC settings, Save New Operator settings, and Load previously saved Operator PLC settings.

j. System Data and Time

1) The PLC shall allow the operator to change the system date and time.

k. System Protections

Controls shall shut down the pump station in the event of the alarm conditions described in this Section, as well as otherwise indicated. The system controls shall attempt to restart the system after alarm shutdown or loss of power. After a user-adjustable number of attempts to re-pressurize the system, the controls shall go into hard shut down and remain so until manually reset.

l. The PLC shall have the following user adjustable system protections:

1) Low Flow Shutdown

a) The PLC shall automatically shut down the system if there is no, or too little flow, based on signals received from a flow switch. The low flow shutdown shall have a user adjustable time delay.

2) Low Suction Pressure Shutdown

a) The PLC shall automatically shut down the system if the suction pressure reaches a user-adjustable pressure value. The low suction pressure shutdown shall have a user adjustable time delay.

3) High Pressure Shutdown

a) In addition to the pressure data received from the pressure transmitter, the PLC shall automatically shut-down the system based on signals from a high-pressure switch.

4) Low Tank Level Shutdown

a) The system shall shut down upon receiving low level signal from the tank level transmitter. A low water float switch shall also shut-down the system.

5) Electrical Fault Shutdowns

a) Incoming power high, low, and imbalance limits in addition to shut down and restart time delays shall be user adjustable.

b) Analog transmitter failure. Input levels of all connected transmitters and meters shall be monitored for failures.

c) Motor starter failure. Circuit breaker and/or motor overload contacts shall be monitored to indicate a motor failure.

d) VFD Faults

3. Controller User Guide

a. The pump station manufacturer shall supply an owner's manual in digital form that includes graphic images of all touch screens with explanations of all settings and modes.

2.13 MOTOR CONTROL PANEL (MCP)

A. Enclosure Rating

1. The VFDs, PLC, and all associated electrical equipment shall be mounted in a NEMA 3R enclosure. Enclosure shall comply with Division 40. Enclosure shall be mounted on the air gap skid as shown on the drawings.

B. Electrical Connection

1. Electrical connection, by purchaser, shall consist of a single conduit from owners disconnect to the pump station main disconnect.

C. Manufacturer Requirements

1. The pump control panel shall be manufactured and listed by a UL508A Panel Shop. The panel shall be UL labeled as an "Enclosed Industrial Control Panel". The pump control panel shall be completely manufactured, tested and programmed prior to delivery to the job site.

D. Panel Documentation

1. A full-color wiring schematic, pump nameplate information, and factory calibrated setpoints shall be permanently affixed to the inside of the control enclosure. All field terminal connections shall be numbered and labeled.

E. External Operating Devices and Internal Components

1. All external operating devices shall be dustproof and weatherproof. All internal components of the enclosure shall be mounted on a removable back panel. Mounting screws for components shall not be tapped into the enclosure wall. No pressure gauges, pressure switches, water activated devices, or water lines of any sort shall be installed in any electrical control panel.

F. Pilot Devices

1. The control panel shall include following industrial grade, watertight/oil-tight pilot devices:

a. 3-Position Selector (HOA) Switches

b. Speed Potentiometer

c. Pilot Lights: A red light shall indicate system faults; a green light shall indicate pump is running.

d. Audible Alarm

e. Emergency Stop Button

G. Service Rated Main Disconnect

1. A three-pole, main station disconnect shall be contained within the MCP. It shall be non-fused and isolate all power to the control enclosure.

2. The main disconnect shall have an operating handle mounted in the enclosure door, mechanically interlocked to prevent entry while disconnect is in the ON position.

3. The disconnect switch shall be mounted within sight of the pump motors on the Air Gap System.

H. MCP Temperature Regulation

1. Provide a NEMA 4X AC cooling unit, appropriately sized to the local maximum ambient conditions, plus component cooling requirements. Cooling should be sized such that internal panel temperature does not exceed 104F.

I. Voltage Monitor

1. The control panel shall include an industrial three phase line voltage monitor with a fully programmable LED backlit display.

2. It shall protect the system against voltage unbalance, high/low voltage, phase loss, faulty power, incorrect sequencing, and rapid short cycling.

J. Surge Protection. The control panel shall include an industrial surge protector with the following features:

1. Protector Type:

a. UL 1449 3rd Edition: SPD Type 4

b. IEC 61643-1: SPD Class II

2. Current Ratings:

a. Nominal Discharge Current: 20kA

b. Maximum Discharge Current: 50kA

c. Maximum Surge Current: 60kA

d. Voltage Protection Rating: 1500V

3. Manufacturer:

a. Surge protector shall be Raycap Strikesorb Series 30 or equal.

K. Secondary Control Circuit Breakers

1. Single-pole secondary distribution breakers with appropriate ratings shall supply power to each pump starter coil circuit, the control system, as well as the motor control panel and pump station enclosure and ventilation circuits.

L. Control Transformer

1. The control transformer shall provide 120 volt power to the pump station controls. The primary side shall be protected with appropriately sized fuses; the secondary side shall be protected by a group of supplementary miniature circuit breakers.

M. Uninterruptable Power Supply (UPS) System

1. The control panel shall include a UPS system to automatically provide power to the station control circuits in the event of a power failure. UPS shall comply with Division 40. It shall include the following features:

a. Capacity: 850VA, 510 Watts

b. Input/output Power: 120 VAC, 60 Hz

c. A surge protection device shall provide point of use protection to the UPS system. The device shall provide a minimum of 50,000 amps of surge protection.

2.14 FINISHES

A. As specified in Section 09 90 00 – Painting and Coating.

2.15 TESTING

A. Each Air Gap System shall be factory performance tested as a unit prior to shipment. The performance test shall consist of five (5) points over the operating range of the system. One point will be the specified primary design point of the pump. Verified test data shall be submitted to Engineer and shall include head vs. capacity, motor output amps, motor frequency.

B. The system shall undergo a factory hydrostatic test at the end of the production cycle. The system shall be filled with water and pressurized to 1.5 times the nameplate maximum pressure. The pressure shall be maintained for a minimum of 15 minutes with no leakage prior to shipment. A report certifying the passage of the hydrostatic test shall be submitted to Engineer.

2.16 MANUFACTURERS, OR EQUAL

A. PumpTech, Inc.

PART 3 - EXECUTION

3.1 DELIVERY AND STORAGE

A. All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt or dust, or other contaminants.

B. All parts shall be properly lubricated and protected so that no damage or deterioration will occur even during a prolonged delay from the time of shipment until installation is completed and the pumps are ready for operation.

C. Skid-mounted equipment shall be properly crated or covered to protect against damage during shipment.

3.2 INSTALLATION

A. Install Air Gap System in accordance with manufacturer's installation instructions and as indicated on the drawings.

3.3 FIELD QUALITY CONTROL

A. Provide the services of a factory-trained representative to check installation and to place air gap system into service.

1. Factory representative shall have complete knowledge of proper installation, operation and maintenance of equipment supplied.

2. Representative shall inspect the final installation and supervise a start-up test of the equipment. Representative shall be onsite a minimum of two (2) working days to inspect and start up the equipment. Contractor shall provide additional time as required to complete Work in accordance with the specifications.

3.4 DEMONSTRATION

A. Demonstrate operation of equipment as specified in Section 43 05 60 - Process Equipment Testing, Level 2, and Section 01 75 16 – Startup Procedures.

B. Technical start-up procedures by the pump station technician shall include the following:

1. Station start-up and pressurization.

2. Pressure, flow, and programming adjustments.

3. Monitoring of complete operational cycle when possible.

4. Testing of all alarms and fault conditions.

5. Customer training and the presentation of the station operation and maintenance manual.

3.5 TRAINING

A. As specified in Section 01 75 00 – Equipment Testing and Startup, Provide one (1) day onsite for training, minimum.

END OF SECTION 22 11 24

SECTION 22 13 13.01 – CAST IRON SOIL PIPE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide cast iron soil pipe, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A. ASTM A 74 Cast Iron Soil Pipe and Fittings

B. ASTM C 564 Rubber Gaskets for Cast Iron Soil Pipe and Fittings

C. Standard 301 of the Cast Iron Soil Pipe Institute

1.3 CONTRACTOR SUBMITTALS

A. Submit shop drawings in accordance with requirements listed in Section 40 05 00 – Piping, General.

PART 2 - PRODUCTS

2.1 PIPE MATERIAL

A. Unless otherwise indicated, cast iron waste and vent piping shall be service weight cast iron soil pipe with hub and spigot ends in accordance with ASTM A 74 - Cast Iron Soil Pipe and Fittings, or hubless pipe per Standard 301 of the Cast Iron Soil Pipe Institute. All pipes and fittings shall be lined and coated with the manufacturer's standard protective coating.

2.2 PIPE JOINTS

A. Hub and spigot pipe shall have rubber compression gaskets in accordance with ASTM C 564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

B. Hubless pipe shall have joints made up with Neoprene sleeves and Type 304 or 316 stainless steel clamps with stainless steel bolts per Standard 301 of the Cast Iron Soil Pipe Institute.

2.3 FITTINGS

A. Cast iron soil pipe shall have drainage pattern hub and spigot, hub and hub, or hubless fittings per ASTM A 74, or Standard 301 of the Cast Iron Soil Pipe Institute, respectively. Fittings shall be made of gray cast iron and be of service weight, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Cast iron soil pipes shall be installed in a neat and workmanlike manner, in accordance with the prevailing plumbing and building codes. Pipes shall have the required grades for proper drainage. Pipes inside buildings shall be coordinated with the work from all other trades to avoid interferences and to provide sufficient headroom. Installations shall be acceptable to the Engineer and to the local plumbing inspector.

B. Supports: Pipes shall be firmly supported with fabricated or commercial hangers and supports in accordance with Section 40 05 07 – Hangers and Supports for Process Piping. Horizontal runs shall have at least one support for each length of pipe.

3.2 PROTECTIVE COATING

A. Exposed pipes shall be coated over the pipe manufacturers standard protective coating, with the manufacturers recommended prime coat and a finished coat per Section 09 90 00 – Painting and Coating.

B. If encased in concrete, pipe shall be encased in a polyethylene plastic jacket.

3.3 INSPECTION AND FIELD TESTING

A. Inspection: Field installations shall be carefully inspected for proper joints and supports, interferences, and damage to pipe, fittings, and coating. Temporary plugs and covers shall be removed from openings and floor drains. Damage shall be repaired to the satisfaction of the Engineer and the plumbing inspector.

B. Field Testing: Prior to enclosure or burying, drains and vents shall be tested in the presence of the local plumbing inspector and the Engineer as required in the Piping Schedule (See Drawings GM-1) and in Section 01 74 20 – Gravity Pipe Testing, for a period of not less than one hour, or as requested by the plumbing inspector. The Contractor shall furnish all test equipment, labor, material, and devices at no extra cost to the Owner. Leaks shall be repaired to the satisfaction of the Engineer and the plumbing inspector, and the system shall be re-tested until no leaks are found.

END OF SECTION 22 13 13.01

SECTION 22 14 29.16 - SUBMERSIBLE SUMP PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide submersible sump pumps and appurtenant work, complete and operable, in accordance with the Contract Documents.

B. The Supplier shall examine the Site conditions, intended application, and operation of the pump system and recommend the pump which will satisfy the indicated requirements.

1.2 CONTRACTOR SUBMITTALS

A. The Contractor shall furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

PART 2 - PRODUCTS

2.1 SUMP PUMPS (SP-8101)

A. Operating Conditions: The Work of this Section shall be suitable for long term operation under the following conditions:

No.	Items	SP-8101
1	Location	Building E – Sludge Pump Area
2	Duty	Intermittent
3	Drive	Constant Speed
4	Ambient environment	Indoors
5	Ambient temperature; degrees F	0 to 100
6	Fluid service	Washdown Water
7	Fluid temperature, degrees F	45-60
8	Fluid pH range	6 to 8
9	Fluid specific gravity	1.0
10	Project site elevation, ft. ASL	4385
11	Total Dynamic Head (TDH), ft	19
12	Maximum size (diameter) of spheres to pass, inches	1 1/2

B. Performance Requirements

No.	Items	Unit	
1	Maximum shutoff head	ft	19
2	Design flow capacity	gpm	40
3	Design flow pump head (TDH)	ft	13
4	Design flow minimum pump efficiency	percent	55
5	Maximum pump speed	rpm	1800
6	Maximum motor speed	rpm	1800
7	Minimum motor size	hp	0.5

C. Pump Dimensions

No.	Items	Unit	
1	Sump dimensions	in	36” x 36”
2	Sump depth	in	36"
3	Sump top	--	Alum Lid
4	Pump discharge size	in	2

2.2 PUMP REQUIREMENTS

A. Construction: Construction of submersible sump pumps shall conform to the following requirements:

No.	Items	
1	Pump casing/Base	Cast iron
2	Impeller	Recessed vortex
3	Bearings	Permanently lubricated ball and sleeve type
4	Shaft	Stainless steel, series 420
5	Seal	Mechanical seal
6	Mounting Method	Stainless steel chain and hook
7	Pump Connection	Flanged

B. Drive: Enclosed, submerged, electric motor, suitable for 120-volt, 1-phase, 60 Hz AC power supply, with armored cable, in accordance with Section 40 05 93 – Common Motor Requirements for Process Equipment.

C. Control: Single sump pump installation shall have float switches for on/off operation and a high-level alarm.

2.3 PROTECTIVE COATING

A. Pumps shall be coated in accordance with Section 09 90 00 – Painting and Coating.

2.4 MANUFACTURERS, OR EQUAL

A. Zoeller Pumps, 270-4270

B. Myers Pumps

C. Goulds Pumps Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Pumping equipment shall be installed in accordance with the Shop Drawings and as indicated.

B. General Installation requirements shall be in accordance with Section 43 20 00 – Pumps, General.

END OF SECTION 22 14 29.16

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SECTION 22 30 00 – PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall furnish and install electric water heaters and other plumbing equipment as shown, complete with all plumbing fixtures, specialties and water, and/or electric connections and hook-ups for a complete and operable installation as specified herein and in accordance with the requirements of the Contract Documents.

1.2 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

B. The submittals shall include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

PART 2 - PRODUCTS

2.1 GENERAL

A. All plumbing piping, fixtures, specialties, equipment, etc., shall be new, first-quality products manufactured for the intended usage. Materials, capacities, features, finishes, and manufacturers shall be as specified herein and shall be compatible with elements of the work to which they relate or connect.

2.2 PLUMBING FIXTURES

A. All plumbing fixtures are to be new without flaws, according to the schedule listed on the drawings. All exposed brass, faucets, wastes, traps, etc., are to be chrome-plated. Provide each fixture with individual stops and anchor firmly to the building wall or floor. Unless otherwise specified, all fixtures are to be by Crane Co.; Kohler; American Standard; Zurn; Mifab; Lasco Bathware; and Briggs/Sayco/ProFlo or equal.

B. Insulation at lavatories requiring handicapped persons protection shall conform to the wheelchair accessibility requirements of ADA and other governing authorities. The insulation shall be easily removable, bacteria resistant, molded to piping and fixture configurations, closed cell vinyl assembles. Fasteners shall be corrosion resistive and reusable. Handicapped persons protection shall be Lav Guard as manufactured by Truebro, Inc., Pro-Wrap as manufactured by McGuire, Inc., or equal.

C. Unless specified below, refer to fixture schedule on drawings as basis for alternatives allowed prior to bid.

1. Emergency Eye-Wash and Shower.

   a. The emergency eye wash and shower shall be a combination eye-wash and shower safety station with two spray type outlet heads to deliver a flood of water for rinsing eyes with a minimum 10" diameter shower head.

   b. Drench Shower

      1) The shower head shall be ABS plastic or stainless steel.

      2) The shower valve shall be a chrome plated brass stay-open ball valve with Teflon seals. The valve shall be furnished with a stainless-steel actuating arm and pull rod.

      3) The unit shall regulate the shower flow to 20 gpm.

   c. Eye Wash

      1) The eye wash shall have two spray heads. Each head shall have a 'flip top" dust cover, internal flow control, and filter to remove impurities from the water.

      2) The eye wash valve shall be a chrome plated brass stay-open ball valve with Teflon seals.

      3) The eye wash bowl shall be a minimum 11" diameter and stainless steel.

   d. Pipe and Fittings.

      1) The eye wash/shower shall be schedule 40 stainless steel furnished with orange polyethylene covers for the vertical piping.

      2) The water supply connections shall be a 1-1/4" NPT female fittings on the top and side. The side fitting shall be fitted with a threaded plug.

      3) There shall be a 1-1/4" waste outlet near the bottom of the unit.

   e. Sign. Provide an ANSI compliant identification sign.

   f. Quality Assurance. The eye wash and shower shall be factory assembled and tested prior to shipping.

   g. The eye wash and shower shall be Fisher Hamilton Model 32L53300. HAWS Model No. 8300; Bradley Corp., Model S-19-310 with S90-094A Eye-Face Wash, Guardian G1902, or approved equal.

2. Laboratory sinks (counter mounted cup and wash sinks): Laboratory counter sinks and cup sinks shall be compatible with chemical piping waste and vent systems. All fixtures shall meet the intent of the design conditions listed on the equipment schedule or approved equal, refer to project drawings schedules for more information.

3. Water Closets (WC): WC's shall be ADA compliant and situated in an ADA compliant stall and installed to ADA standards. WC's shall be white china porcelain, with an open front seat. WC's shall be capable of being anchored to a closet flange. Closet rings or gaskets shall be of an approved type and such connection shall be warrantied from failure for a minimum of 1 year. Closet flanges shall be securely fastened to the subfloor with non-corrosive bolts or anchors. Tank type WC's shall be supplied with an UPC approved water fill valve (with an air gap fitting) and a flush valve. Flushometer type toilets shall be supplied with a UPC approved 1" flushometer with an approved type vacuum breaker. WC manufacturer shall be as listed in the Plumbing schedules or an approved equal.

D. Lab Sink

1. Drop-in Sinks formed as a lipped, one-piece tub with coved corners and bottoms pitched to the drain outlet. Made from a combination of modified epoxy resins, selected curing resins and inert fillers, cured at high temperatures to ensure maximum chemical impact and thermal shock resistance. Designed to be mounted in the countertops with no support from below.

2. Approximate dimensions: 33" long, 22" wide, and 8" deep

a. Slight variance in finish dimensions acceptable based on availability

3. Manufacturer or Approved Equal

a. Kemresin

2.3 ELECTRIC WATER HEATERS

A. Electric water heaters shall be furnished as shown, complete with electric, cold water, and hot water connections; 3/4–inch drain valve piped to drain; ¾-inch (min) temperature and pressure relief valve piped to floor sink or drain; and aquastat. The tank shall be of welded steel construction for a working pressure of not less than 150 psi, glass-lined, with magnesium anode, minimum R-16 fiber glass insulation, built-in heat traps, enameled steel jacket, and feet.

B. Heater Specification:

1. Electric water heaters requirements are listed on MP-601 of the plan set.

C. Electric water heaters shall be one of the following listed products, or equal:

1. Rheem

2. National Steel Const. Co.,

3. A.O. Smith;

4. State Industries Inc.

D. Expansion Tanks: Provide diaphragm-type expansion tanks with welded steel, rated for 125-psi working pressure and 375 degrees F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. The diaphragm shall be securely sealed into tank to separate air charge from system water to maintain required expansion capacity. The air charge fittings shall include a stainless schrader valve with EPDM seats. Acceptable manufacturers include:

1. Amtrol, Inc.

2. Armstrong Pumps, Inc.

3. Bell & Gossett Domestic ump; a division of ITT industries

2.4 FLOOR AND EQUIPMENT DRAINS

A. Provide cast iron floor drains and equipment drains where shown. No equipment drains shall discharge to floor slabs. Drains are to be manufactured by Zurn; Josam; Wade; Jay R. Smith; or equal.

B. Provide acid resistant coated floor drains for use in Laboratory area. Drains are to be manufactured by Zurn; Josam; Wade; Jay R. Smith; Greenheck or equal. Dimensions as shown on drawings.

C. Equipment drains are to be as shown on the Project Plans.

2.5 PREMANUFACTURED TRENCH DRAINS

A. Provide premanufactured trench drains were shown on the plans.

B. Trench drains shall be premanufactured high strength polymer concrete.

C. Channels shall be pre-sloped and interconnecting.

1. Width shall be 4” or 6” channels as indicated in the contract drawings.

D. Fittings:

1. End Caps

2. Side or Bottom outlet as specified in the plans.

E. Grating

1. Class C traffic rated, unless otherwise specified in the plans.

2. Corrosion resistant ie. SST or coated Ductile Iron, see plans for more information.

3. Grating shall include a locking type mechanism.

F. Mounting

1. Shall be provided with manufacture's carrier system. Other mounting methods not approved by the manufacturer shall be prohibited.

2. Top of grate shall be set to the elevation as indicated in the plans.

3. Cast concrete in place only after all trench channels, piping and interconnected sections have been installed and tested.

G. Catch Basins

1. Provide catch basins were indicated in the plans.

2. Catch basins shall be precast polymer and provided by the same manufacturer that provides the trench drain.

H. Manufacturer or approved equal:

1. Zurn

2. MIFAB

I. Equipment drains are to be as shown on the Project Plans.

2.6 HOSE BIBS AND HYDRANTS

A. Hose bibbs and hydrants in exposed locations subject to freezing shall be the non-freeze type. Hose bibbs connected to a non-potable water supply shall be provided with plastic or stainless-steel warning signs reading "DO NOT DRINK" in clearly legible letters, permanently attached at the hose bibb. Where indicated, hose bibbs shall be provided with vacuum breakers as furnished by Crane Co., American Standard, or equal.

B. Furnish and install the following bibs, as manufactured by Zurn; WADE; Josam, or J.R. Smith; Crane; Walworth; James Jones; or equal. The sizes shall be as shown on the Project Plans.

2.7 THERMOSTATIC MIXING VALVE

A. Large Type TM Thermostatic water mixing valve

1. Inlet check wall support with 1 " inlets and 1 1/4" outlet (25mm X 32mm) with adjustable high temperature limit stop.

2. 1 GPM (3.71 /min) minimum flow capacity and 125 psi max operating pressure

3. Color-coded dial thermometer (0 to 140°F, -10 to 60°C) with inlet manifold piping and locking temperature regulators. Set to 72 Deg F

4. Must be the factory assembled and tested.

B. Manufacturer or approved equal.

1. Leonard model no. TM-5100-LF

2.8 BACKFLOW PREVENTOR

A. A Reduced Pressure Zone assembly shall be installed at each potential health hazard location to prevent backflow due to backpressure. The assembly shall consist of an internal pressure differential relief valve located in a zone between two positive seating check modules with captured springs and silicone seat discs. Seats and seat discs shall be replaceable in both check modules and the relief valve. There shall be no threads or screws in the waterway exposed to line fluids. Service of all internal components shall be through a single access bronze cover secured with stainless steel bolts. The assembly shall also include two resilient seated isolation valves, four resilient seated test cocks, and an air gap drain fitting.

B. Assembly Requirements:

1. USC
2. ASSE Std. 1013
3. AWWA Std. C511-92
4. CSA B64.4.

C. Accessories:

1. Single access cover and modular check construction for ease of maintenance
2. Top entry to all internals for immediate accessibility
3. Captured springs for safe maintenance
4. Internal relief valve for reduced installation clearances
5. Replaceable seats for economical repair
6. Bronze body construction for durability (1⁄4" – 2") - Size per plans
7. Ball valve test cocks — screwdriver slotted (1⁄4" – 2")
8. Large body passages provides low pressure drop
9. Compact, space saving design
10. No special tools required for servicing
11. Sensor on the relief valve for flood detection (1⁄2" – 2")

D. Manufacturers or approved equal:

1. Watts Series 009

PART 3 - EXECUTION

3.1 GENERAL

A. Install engraved plastic-laminate equipment nameplate or sign on or near each neutralizing basin. Coordinate sign location with Owner. Include additional signs for maintenance of neutralizing basin as suggested by manufacturer.

3.2 WATER HEATER INSTALLATION

A. The Contractor shall install water heaters in accordance with manufacturer's printed instructions.

B. The work hereunder shall be coordinated with plumbing piping and related electrical work to achieve operating system and shall conform to all applicable codes.

C. The Contractor shall provide steel pipe support for tanks, independent of building structural framing members.

D. Tank shall be cleaned and flushed prior to delivery to site. All openings shall be sealed until pipe connections are made.

E. The Contractor shall provide and install floor restraints and a cable that conform with Seismic Zone 2 requirements.

3.3 EXPANSION TANK INSTALLATION

A. Install expansion according to manufacturer's written instructions. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

END OF SECTION 22 30 00

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SECTION 23 00 00 – GENERAL HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Work consists of, but is not necessarily limited to, the furnishing of all labor, equipment, appliances and materials and the performance of all operations in connection with the installation of all mechanical HVAC work described by these Contract Documents. All Work shall be completed in strict accordance with Specifications, Drawings and applicable codes, including incidental materials necessary and required for their completion.

B. Intent of Drawings: Drawings, plans and schematics, and diagrams indicate general location and arrangement of piping systems.

1. The HVAC Contractor is responsible for installation of satisfactory and complete work in accordance with the intent of Drawings and Specifications. Provide, at no extra cost, incidental items required for completion of work even though not specifically mentioned or indicated in Specifications or on Drawings.

2. Conflicts discovered during construction shall be immediately called to the attention of the Engineer for decision. Do not proceed with installation in area of question until conflict has been fully resolved.

C. Interferences: Project design took into account potential interferences between trades (e.g. mechanical ductwork with piping or with electrical light fixtures), however, not every interference can be eliminated. It shall be the responsibility of the Bidder and potential Contractor to field verify all mechanical piping and duct routing, making allowances for existing and new beams, pipes, ducts, hangers, and other obstructions. The cost associated with interferences shall be at no additional expense to Owner.

D. Discrepancies: Prior to submitting Bid, Contractor shall refer any apparent discrepancies or omissions to Engineer for clarification. The more stringent provisions shall take precedence where Codes, Specifications and Drawings differ with one another. The Contractor shall bid the more expensive requirement, unless an Addendum prior to bid addresses the discrepancy.

E. Prior Approvals: The Engineer shall receive all proposed substitutions 10 days prior to Bid. Approval requests received after 3 p.m. on the 10th day will be rejected. Supply technical data and dimensional Drawings showing that substitutes are equivalent to product specified.

F. HVAC Contractor shall pay for all permits, inspections, reviews and fees in connection with this work.

G. HVAC Contractor shall provide training to the Owner.

1.2 DEFINITIONS

A. "PROVIDE" – Furnished and installed complete.

B. "OR APPROVED EQUAL" – Items may be deemed equal as approved by submitting a quote to the Engineer, 10 days prior to Bid.

C. Intent of Drawings: Drawings, plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1.3 REFERENCE STANDARDS

A. HVAC Contractor shall conform to the latest edition or the edition adopted by the Local Governing Authority, State and National Codes and Ordinances, the State Fire Marshal, and utility company regulations

B. All material shall conform to applicable standards.

1.4 SUBMITTALS

A. Submit HVAC material and equipment submittals and shop drawings for final and official in accordance with Section 01 33 00 – Submittals.

B. Complete shop drawings and manufacturers literature submittal shall conform to the following:

1. Indicate the type, make, manufacturer’s name, supplier and trade designation of materials and equipment proposed.

2. The submittal shall include outline dimensions sufficiently accurate and complete to permit layout and coordination of pipe and duct connections, foundation, and setting of anchor bolts and base plates, procurement and setting of embedded items, etc. Drawings shall show clearances required for interferences to be avoided. Electrical connections, number of conductors and other pertinent electrical power data shall also be shown.

3. Shop drawings or submittals that cover substitutions or alternates not previously approved will not be acceptable.

1.5 QUALITY CONTROL

A. Warranty: This Contractor shall warrant and guarantee the following:

1. That all HVAC work executed under these Contract Documents will be free from defects of materials and workmanship for a period of one year from the date of final acceptance of this work.

2. The Contractor agrees to, at the Contractor's own expense, repair and replace all such defective materials and work and all other work damaged thereby which becomes defective during the term of warranty. Agreement does not include damages done by Owner.

B. Workmanship: Work shall be accomplished by workmen skilled in particular trade, in conformance with best practices and accepted standards. Work shall contribute to efficiency of operation, accessibility, maintenance and appearance. No part of installation shall interfere with operation of any other system or part of building. Non-satisfactory work shall be corrected at no additional expense to Owner.

1.6 SUBSTANTIAL COMPLETION

A. At substantial completion of Project, the Contractor shall be ready to demonstrate compliance with the list of items below. If this is not possible, the Contractor shall inform the General Contractor and Engineer no less than one week prior to substantial completion site visit.

1. Provide documentation that HVAC has been tested and balanced.

2. Demonstrate that labeling of all mechanical and ducting systems are 100 percent complete in accordance with Specification.

1.7 RECORD DOCUMENTS

A. Provide two (2) full size sets (Mechanical and HVAC drawings), one for Engineer, one for Owner. In addition to the requirements specified in Division 1, indicate the following installed conditions:

1. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes and terminal units requiring periodic maintenance or repair.

2. Main and branches of piping systems, with valves and control devices located and numbered, and with items requiring maintenance located. Indicate actual inverts and horizontal locations of underground piping.

3. Equipment locations (exposed and concealed) dimensioned from prominent building lines.

4. Addendum items, change order items and all changes made to drawings from bidding phase through to project completion.

1.8 OPERATIONS & MAINTENANCE MANUALS

A. In accordance with Section 01 78 23 - Operation and Maintenance Manuals, prepare three (3) copies of Operating and Maintenance manuals for the mechanical systems and equipment as described below. Partial or separate data will be returned for completion.

1. Manuals shall be assembled in three ring binders. All information shall be arranged in sections, with each section having a heavy paper divider with a protruding tab clearly labeled. Sections shall be arranged in the same order that the equipment is listed in the Specification.

2. Include a cover page which lists project name, date and Contractor’s name, address and telephone number.

3. Include index sheet for each specification section indicating equipment, with supplier and supplier’s telephone number.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 SYSTEM TESTING

A. Refer to Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC

3.2 SYSTEM TRAINING

1. Contractor to initiate and coordinate training schedule with the Owner.
2. Provide two-hour training and demonstration at the site.
3. Training shall include:
    a. Overview of the HVAC system
    b. System control strategy
    c. Control panel demonstration
        1) How to adjust setpoint
    d. Operations and maintenance procedures for all equipment

END OF SECTION 23 00 00

SECTION 23 05 93 – TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section includes testing, adjusting and balancing HVAC systems to produce design objectives, including the following:

1. Balancing airflow and waterflow within distribution systems, including submains, branches and terminals, to indicated quantities according to specified tolerances.

2. Adjusting total HVAC systems to provide indicated quantities.

3. Measuring electrical performance of HVAC equipment.

4. Setting quantitative performance of HVAC equipment.

5. Verifying that automatic control devices are functioning properly.

6. Reporting results of the activities and procedures specified in this Section.

1.2 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches and terminals, according to design quantities.

C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

E. Report Forms: Test data sheets for recording test data in logical order.

F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

K. Test: A procedure to determine quantitative performance of a system or equipment.

L. Testing, Adjusting and Balancing Agent: The entity responsible for performing and repor1ing the testing, adjusting and balancing procedures.

M. AABC: Associated Air Balance Council.

N. AMCA: Air Movement and Control Association.

O. NEBB: National Environmental Balancing Bureau.

P. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.3 SUBMITTALS

A. Provide submittals in accordance with Specification Section 01 33 00 – Submittal Procedures.

B. Certified Testing, Adjusting and Balancing Reports: Submit two (2) copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting and balancing Agent.

C. Provide copies in O&M manual.

1.4 QUALITY ASSURANCE

A. Agent Qualifications: Engage a testing, adjusting and balancing agent certified by either AABC or NEBB.

B. Certification of Testing, Adjusting and Balancing Reports: Certify the testing, adjusting and balancing field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting and balancing reports.

2. Certify that the testing, adjusting and balancing team complied with the approved testing, adjusting and balancing plan and the procedures specified and referenced in this Specification.

C. Testing, Adjusting and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting and Balancing."

D. Testing, Adjusting and Balancing Reports: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems."

E. Instrumentation Type, Quantity and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

F. Instrumentation Calibration: Calibrate instruments at least every six (6) months or more frequently if required by the instrument manufacturer.

1.5 PROJECT CONDITIONS

A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire testing, adjusting and balancing period. Cooperate with the Owner during testing, adjusting and balancing operations to minimize conflicts with the Owner's operations.

1.6 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting and balancing activities.

B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.

C. Perform testing, adjusting and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine approved submittal data of HVAC systems and equipment.

B. Examine equipment performance data including fan and pump curves. Relate performance data to project conditions and requirements including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10 or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

C. Examine system and equipment installations to verify that they are complete, and that testing, cleaning, adjusting and commissioning specified in individual Specification Sections have been performed.

D. Examine system and equipment test reports.

E. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings and manual volume dampers, are properly installed and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

F. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

G. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight and equipment with functioning controls is ready for operation.

H. Examine strainers for clean screens and proper perforations.

I. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

K. Examine equipment for installation and for properly operating safety interlocks and controls.

L. Examine automatic temperature system components to verify the following:

1. Dampers, valves and other controlled devices operate by the intended controller.

2. Dampers and valves are in the position indicated by the controller.

3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in mixing boxes.

4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.

5. Thermostats are located to avoid adverse effects of sunlight, drafts and cold walls.

6. Sensors are located to sense only the intended conditions.

7. Sequence of operation for control modes is according to the Contract Documents.

8. Controller setpoints are set at design values. Observe and record system reactions to changes in conditions. Record default setpoints if different from design values.

9. Interlocked systems are operating.

10. Changeover from heating to cooling mode occurs according to design values.

M. Report deficiencies discovered before and during performance of testing, adjusting and balancing procedures.

3.2 PREPARATION

A. Prepare a testing, adjusting and balancing plan that includes strategies and step-by- step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.

2. Hydronic systems are filled, clean and free of air.

3. Automatic temperature-control systems are operational.

4. Equipment and duct access doors are securely closed.

5. Balance, smoke and fire dampers are open.

6. Isolating and balancing valves are open and control valves are operational.

7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

8. Windows and doors can be closed so design conditions for system operations can be met.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards and this Section.

B. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems" and this Section.

C. Cut insulation, ducts, pipes and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this project.

D. Mark equipment settings with paint or other suitable, permanent identification material including damper-control positions, valve indicators, fan-speed-control levers and similar controls and devices to show final settings.

3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

C. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

D. Locate start-stop and disconnect switches, electrical interlocks and motor starters.

E. Verify that motor starters are equipped with properly sized thermal protection.

F. Check dampers for proper position to achieve desired airflow path.

G. Check for airflow blockages.

H. Check condensate drains for proper connections and functioning.

I. Check for proper sealing of air-handling unit components.

3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

A. The procedures in this Article apply to constant-volume supply-, return- and exhaust-air systems. These additional procedures are specified in other articles in this Section.

B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

    a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.

    b. Measure static pressure directly at the fan outlet or through the flexible connection.

    c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.

    d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each air-handling unit component.

    a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices under final balanced conditions.

4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.

5. Adjust fan speed higher or lower than design with the approval of the Architect. Make required adjustments to pulley sizes, motor sizes and electrical connections to accommodate fan-speed changes.

6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating and economizer modes to determine the maximum required brake horsepower.

C. Adjust volume dampers for main duct, submain ducts and major branch ducts to design airflows within specified tolerances.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

a. Where sufficient space in sub mains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each sub main and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.

D. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer's written instructions and calculating factors.

E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.

1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model and serial numbers.

2. Motor horsepower rating.

3. Motor rpm.

4. Efficiency rating if high-efficiency motor.

5. Nameplate and measured voltage, each phase.

6. Nameplate and measured amperage, each phase.

7. Starter thermal-protection-element rating.

3.7 CONDENSING UNITS

A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

3.8 TEMPERATURE TESTING

A. During testing, adjusting and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.

3.9 FUME HOODS

A. Determine total airflow into the room where the fume hood is located and balance systems to ensure adequate air supply to all hoods.

1. Set fume-hood door opening at position of normal use.

2. Energize the exhaust fan and adjust airflow to provide the indicated average fume-hood face velocity at hood opening.

3. Measure exhaust airflow volume by measuring airflow by Pitot-tube duct traverse.

4. Measure air velocity using Pitot-tube traverse method.

5. Record each face velocity measurement taken at 4" to 6" increments over the entire hood door opening.

6. Calculate the average face velocity by averaging all velocity measurements.

7. Calculate the airflow volume of exhaust-hood face velocity by multiplying the calculated average face velocity by the opening area. Compare this quantity with exhaust volume at exhaust fan and report duct leakage.

8. Measure airflow volume supplied by make-up fan. Verify that the make-up system supplies the proper amount of air to keep the space at the indicated pressure with the exhaust systems in all operating conditions.

9. Retest for average face velocity. Adjust hood baffles, fan drives and other parts of the system to provide the indicated average face velocity and the indicated auxiliary air-supply percentages.

10. Retest and adjust the systems until fume-hood performance complies with Contract Documents.

3.10 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between setpoints and actual measurements.

D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Verify free travel and proper operation of control devices such as damper and valve operators.

F. Note operation of electric actuators using spring return for proper fail-safe operations.

3.11 TOLERANCES

A. Set HV AC system airflow and waterflow rates within the following tolerances:

1. Supply, Return and Exhaust Fans: Plus 5 to plus 10 percent.

2. Air Outlets and Inlets: 0 to plus 10 percent.

3. Heating-Waterflow Rate: 0 to plus 10 percent.

3.12 FINAL REPORT

A. General: Typewritten or computer printout in letter-quality font on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of the instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to the certified field report data, include the following:

1. Pump curves.

2. Fan curves.

3. Manufacturers' test data.

4. Field test reports prepared by system and equipment installers.

5. Other information relative to equipment performance, but do not include approved shop drawings and product data.

D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:

1. Title page.

2. Name and address of testing, adjusting and balancing Agent.

3. Project name.

4. Project location.

5. Architect's name and address.

6. Engineer's name and address.

7. Contractor's name and address.

8. Report date.

9. Signature of testing, adjusting and balancing Agent who certifies the report.

10. Summary of contents including the following:

a. Design versus final performance.

b. Notable characteristics of systems.

c. Description of system operation sequence if it varies from the Contract Documents.

11. Nomenclature sheets for each item of equipment.

12. Data for terminal units including manufacturer, type size and fittings.

13. Notes to explain why certain final data in the body of reports vary from design values.

14. Test conditions for fans and pump performance forms including the following:

    a. Settings for outside-, return- and exhaust-air dampers.

    b. Conditions of filters.

    c. Cooling coil, wet- and dry-bulb conditions.

    d. Face and bypass damper settings at coils.

    e. Fan drive settings including settings and percentage of maximum pitch diameter.

    f. Other system operating conditions that affect performance.

E. Air-Handling Unit Test Reports: For air-handling units with coils include the following:

1. Unit Data: Include the following:

    a. Unit identification.

    b. Location.

    c. Make and type.

    d. Model number and unit size.

    e. Manufacturer's serial number.

    f. Sheave make, size in inches and bore.

    g. Sheave dimensions, center-to-center and amount of adjustments in inches.

    h. Number of belts, make and size.

    i. Number of filters, type and size.

2. Motor Data: Include the following:

    a. Make and frame type and size.

    b. Horsepower and rpm.

    c. Volts, phase and hertz.

    d. Full-load amperage and service factor.

    e. Sheave make, size in inches and bore.

    f. Sheave dimensions, center-to-center and amount of adjustments in inches.

3. Test Data: Include design and actual values for the following:

   a. Total airflow rate in cfm.

   b. Total system static pressure in inches wg.

   c. Fan rpm.

   d. Discharge static pressure in inches wg.

   e. Filter static-pressure differential in inches wg.

   f. Preheat coil static-pressure differential in inches wg.

   g. Cooling coil static-pressure differential in inches wg.

   h. Heating coil static-pressure differential in inches wg.

   i. Outside airflow in cfm.

   j. Return airflow in cfm.

   k. Outside-air damper position.

   l. Return-air damper position.

   m. Airflow rate in cfm.

   n. Average face velocity in fpm.

   o. Air pressure drop in inches wg.

   p. Outside-air, wet- and dry-bulb temperatures in deg F.

   q. Return-air, wet- and dry-bulb temperatures in deg F.

   r. Entering-air, wet- and dry-bulb temperatures in deg F.

   s. Leaving-air, wet- and dry-bulb temperatures in deg F.

   t. Water flow rate in gpm.

   u. Water pressure differential in feet of head or psig.

   v. Entering-water temperature in deg F.

   w. Leaving-water temperature in deg F.

F. Fan Test Reports: For supply, return and exhaust fans include the following:

1. Fan Data: Include the following:

a. System identification.

b. Location.

c. Make and type.

d. Model number and size.

e. Manufacturer's serial number.

f. Sheave make, size in inches and bore.

g. Sheave dimensions, center-to-center and amount of adjustments in inches.

2. Motor Data: Include the following:

a. Make and frame type and size.

b. Horsepower and rpm.

c. Volts, phase and hertz.

d. Full-load amperage and service factor.

e. Sheave make, size in inches and bore.

f. Sheave dimensions, center-to-center and amount of adjustments in inches.

g. Number of belts, make and size.

3. Test Data: Include design and actual values for the following:

a. Total airflow rate in cfm.

b. Total system static pressure in inches wg.

c. Fan rpm.

d. Discharge static pressure in inches wg.

e. Suction static pressure in inches wg.

G. Round, Flat-Oval and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data: Include the following:

a. System and air-handling unit number.

b. Location and zone.

c. Traverse air temperature in deg F.

d. Duct static pressure in inches wg.

e. Duct size in inches.

f. Duct area in sq. ft.

g. Design airflow rate in cfm.

h. Design velocity in fpm.

i. Actual airflow rate in cfm.

j. Actual average velocity in fpm.

k. Barometric pressure in psig.

H. Air- Terminal-Device Reports: For terminal units include the following:

1. Unit Data: Include the following:

a. System and air-handling unit identification.

b. Location and zone.

c. Test apparatus used.

d. Area served.

e. Air-terminal-device make.

f. Air-terminal-device number from system diagram.

g. Air-terminal-device type and model number.

h. Air-terminal-device size.

i. Air-terminal-device effective area in sq. ft.

2. Test Data: Include design and actual values for the following:

   a. Airflow rate in cfm.

   b. Air velocity in fpm.

   c. Preliminary airflow rate as needed in cfm.

   d. Preliminary velocity as needed in fpm.

   e. Final airflow rate in cfm.

   f. Final velocity in fpm.

   g. Space temperature in deg F.

I. Pump Test Reports: For pumps include the following data. Calculate impeller size by plotting the shutoff head on pump curves.

   1. Unit Data: Include the following:

      a. Unit identification.

      b. Location.

      c. Service.

      d. Make and size.

      e. Model and serial numbers.

      f. Water flow rate in gpm.

      g. Water pressure differential in feet of head or psig.

      h. Required net positive suction head in feet of head or psig.

      i. Pump rpm.

      j. Impeller diameter in inches.

      k. Motor make and frame size.

      l. Motor horsepower and rpm.

      m. Voltage at each connection.

      n. Amperage for each phase.

      o. Full-load amperage and service factor.

2. Test Data: Include design and actual values for the following:

   a. Static head in feet of head or psig.

   b. Pump shutoff pressure in feet of head or psig.

   c. Actual impeller size in inches.

   d. Full-open flow rate in gpm.

   e. Full-open pressure in feet of head or psig.

   f. Final discharge pressure in feet of head or psig.

   g. Final suction pressure in feet of head or psig.

   h. Final total pressure in feet of head or psig.

   i. Final water flow rate in gpm.

   j. Voltage at each connection.

   k. Amperage for each phase.

J. Boiler Test Reports: For boilers include the following:

1. Unit Data: Include the following:

   a. Unit identification.

   b. Location.

   c. Service.

   d. Make and type.

   e. Model and serial numbers.

   f. Voltage at each connection.

   g. Amperage for each phase.

2. Test Data: Include design and actual values for the following:

   a. Operating pressure in psig.

   b. Operating temperature in deg F.

   c. Entering-water temperature in deg F.

   d. Leaving-water temperature in deg F.

e. Number of safety valves and sizes in NPS.

f. Safety valve settings in psig.

g. High-limit setting in psig.

h. Voltage at each connection.

i. Amperage for each phase.

K. Instrument Calibration Reports: For instrument calibration include the following:

1. Report Data: Include the following:

a. Instrument type and make.

b. Serial number.

c. Application.

d. Dates of use.

e. Dates of calibration.

3.13 ADDITIONAL TESTS

A. Within 90 days of completing testing, adjusting and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial testing, adjusting and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing and adjusting during near-peak summer and winter conditions.

END OF SECTION 23 05 93

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SECTION 23 09 00 – INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units, condenser fans and motorized dampers, exhaust fans and motorized dampers that are not supplied with factory-wired controls.

B. Control system consists of sensors, indicators, actuators, final control elements, interface equipment, adjustment and other apparatus and accessories to control mechanical systems.

C. Furnish and provide programming and control equipment as required to satisfy sequences of operation as described on the Drawings.

1.2 REFERENCE STANDARDS

A. NFPA 70, Article 100

B. NFPA 90A Installation of Air Conditioning and Ventilation Systems

C. AMCA 500D

1.3 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device in accordance with Section 01 33 00 – Submittal Procedures. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials and installation and startup instructions for each type of product indicated.

B. Each control device labeled with setting or adjustable range of control.

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components and location and size of each field connection.

1. Schematic flow diagrams showing fans, coils, dampers, valves and control devices.

2. Wiring Diagrams: Power, signal and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

3. Written description of sequence of operation.

4. Schedule of dampers including size, leakage and flow characteristics.

5. Schedule of valves including leakage and flow characteristics.

D. Maintenance Data: Include the following for systems to include in maintenance manuals specified in Section 01 78 23 – Operation and Maintenance Data.

1. Maintenance instructions and lists of spare parts for each type of control device.

2. Interconnection wiring diagrams with identified and numbered system components and devices.

3. Inspection period, cleaning methods, cleaning materials recommended and calibration tolerances.

4. Calibration records and list of setpoints.

E. Project Record Documents: Record actual locations of control components including control units, thermostats and sensors. Revise shop drawings to reflect actual installation and operating sequences.

1.4 QUALITY CONTROL

A. Installer Qualifications: An experienced installer who is a certified installer of the automatic control system manufacturer for both installation and maintenance of units required for this project.

B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature control systems similar to those indicated for this project and with a record of successful in-service performance.

C. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

D. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems”

1.5 COORDINATION

A. Coordinate with the Mechanical contractor for actual mechanical equipment being supplied to the project site. Low voltage actuators for outside air damper operation are required to be interlocked with ducted condenser air conditioning units and laboratory fume hood exhaust fan.

B. Coordinate location of thermostats and other exposed control sensors with plans and room details before installation.

C. Coordinate supply of conditioned electrical circuits for control units.

D. Coordinate equipment with Division 26 to achieve compatibility with starter coils and annunciation devices.

PART 2 - PRODUCTS

2.1 THERMOSTATS

A. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater.

B. Room thermostat accessories include the following:

1. Insulating Bases: For thermostats located on exterior walls.

C. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

D. Manufacturers, or Equal:

1. Chromalox, Inc.

2. Delta Controls, Inc.

3. Hayward Industrial Products, Inc.

4. Honeywell, Inc.; Home & Building Control

5. ICM Corp

6. Johnson Controls, Inc.; Controls Group

7. Sensidyne, Inc.

8. Texas Instruments, Inc.; Commercial Sensors & Controls

2.2 DUCT SMOKE DETECTORS

A. Ducts with an air flow rate of over 2000 cubic feet per minute shall be equipped with a photoelectric, high temperature rated duct smoke detector.

1. Manufacturer, or Engineer approved equal:

a. Air Products and Controls, Inc. (Model: SL-2000-P)

2.3 FAN CONTROL PANEL

A. The Contractor shall provide Fan Control Panels as part of the HVAC package.

B. Fan Control Panels shall be designed and certified by a UL 508a listed shop.

C. Fan Control Panel design shall include all components necessary to meet the intent of the HVAC Sequence of Operation, FCP design details, and Control Strategy as outlined in the Project Plans.

D. Fan Control Panels designs shall be submitted for approval prior to construction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation.

B. Verify that duct-, pipe- and equipment-mounted devices and wiring are installed before proceeding with installation.

3.2 INSTALLATION

A. Install equipment level and plumb.

B. Verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate all 60-inches above the floor.

C. Install labels and nameplates to identify control components according to Section 43 05 50 – Equipment Mounting.

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes and cabinets according to Division 26.

B. Install building wire and cable according to Division 26.

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.

2. Install exposed cable in raceway.

3. Install concealed cable in raceway.

4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.

5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.

6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

3.4 CONNECTIONS

A. Ground all equipment per Division 26 requirements.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 4868.

3.5 CONTROL SEQUENCES

A. Refer to Drawings.

END OF SECTION 23 09 00

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SECTION 23 09 23.14 – AIR FLOW MONITORING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide and install air flow monitoring equipment as specified herein and install a complete and operable system in accordance with the equipment schedule shown herein.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Provide operation and maintenance data in HVAC Operation and Maintenance Manual.

1.3 QUALITY CONTROL

A. Warranty: Sensors shall be provided with industry standard two-year unconditional warranty.

PART 2 - PRODUCTS

2.1 AIR FLOW SENSORS

A. Provide Explosion Proof Air Monitor and Alarm System which monitors duct air flow and provides audible and visual alarm if airflow drops below safe levels. The technology used in the system shall be thermal dispersion. As the duct flow drops due to failure of the ventilation system the flow change in the duct triggers the low flow alarm.

B. The thermal dispersion principle of operation shall use no moving parts and provide an extremely reliable and repeatable switch for demanding industrial applications. The sensor head shall use two temperature sensors with a constant very low power heating source physically attached to one of the temperature sensors. The second temperature sensor shall be isolated from the heating source and provides compensation for changing air temperatures. As flow changes so does the temperature differential. This allows the device to be used as a flow/no flow sensor and to be used to switch at any velocity. Extremely low flow rates shall be detected with rangeability up to 300:1. The device shall be suitable for use in virtually all liquids, gases, and slurries. With no moving parts exposed to the process and be reliable and repeatable instrument in corrosive applications.

C. The electronics shall provide single switch point. Provide temperature monitoring output. Provide SPDT relay contacts. Provide remote mounting of the electronics is also available.

D. The sensors shall include:

1. Explosion proof sensor shall consist of UL or FM listed enclosures for Class I Division 1 Group D Hazardous Arears.

2. Sensor Material: 316L Stainless Steel.

3. Power: 12 VDC.

4. The unit shall be capable of operating from -40 Degrees F to 167 Degrees F.

E. Manufacturer

1. EBTRON Model GTx108e-F

2. Approved Equal

2.2 CONTROL ALARM PANEL

A. Control alarm panel shall in a NEMA 4X enclosures and include main circuit board, operator display, horn and switches furnished complete and factory mounted. The monitor shall have green and red light emitting diode display, which provides clear indication of safe or airflow condition. Control panel shall be factory wired and tested and UL Labeled UL508 as a completed unit. Calibration is the responsibility of the contractor and is required once the room exhaust and room supply systems are balanced. A preliminary calibration shall be factory set into the alarm's system only to determine that the alarm is functional and ready for shipment.

B. Power Supply: Provide a 12 volt DC regulated power supply, fused input and fused output to provide power of the flow sensor.

C. Alarm Signal: Audible signal at 88 db at 10 feet and a visual, red light emitting diode for low air flow and a green light emitting diode for normal air flow with silence capability shall be by momentarily covering the light sensor on the front of the safety monitor, which temporarily disables the audible alarm. When the alarm condition is corrected and face velocity and volume returns to specified levels monitor shall automatically reset and begin routine monitoring. Provide test circuit to verify proper operation. Test function shall be accessed while alarm is indicating a safe condition and is initiated by momentarily covering the operator display. Provide monitor with remote alarm output including both normally open and normally closed contacts for connection to plant SCADA alarm system.

D. A remote red visual beacon LED Strobe light shall also be provided at the entrance to the facility, see construction plans for location.

1. UL Listed

2. Suitable for Hazardous locations

3. 120 VAC, 60Hz, 0.20A

4. Fixed

5. NEMA 4X enclosure

6. Glass-reinforced thermoplastic polyester resin

7. Brass Hardware

8. Double Fresnel Lens made from Polycarbonate

E. Manufacturer, RKI Industries or approved equal.

F. Electrical rating: 120 VAC, and maximum current rating of 0.25A. Mains breaker rated at 15A. Includes one (1) Relay Output rated 05A at 125 VAC/1A at 24VDC.

PART 3 - EXECUTION

3.1 GENERAL

A. Air flow monitoring devices shall be mounted in accordance with manufacturer instructions. The Contractor shall verify installation requirements prior to mounting the devices. Install air flow sensors for supply fans in the duct on the downstream side of the fan. Install air flow sensors for exhaust fans in the duct on the upstream side of the fan.

B. HVAC installer shall provide explosion proof wiring materials and hazardous area seal offs for onsite final connection from flow detection switches to the control alarm panel. Provide and install rigid steel conduit. Provide and install sensor cable as recommended by the sensor manufacturer.

C. Set the alarm at velocity at 300 feet per minute.

D. Layout the differential pressure monitoring system including power wiring, relay output, monitor panel, sensor tubing and fan sensors as recommended by the monitor system manufacturer. Mount the monitor panels in the locations shown on the plans. Install the static pressure sensors at the fans to obtain the maximum differential pressure at the fans relative to ambient pressure. Run pressure sensor tubing from the monitor to the static pressure sensor at the fan.

3.2 AIR FLOW MONITORING SCHEDULE

Building	Room	Supply Fan Monitoring	Exhaust Fan Monitoring	Local Alarms	Plant SCADA Alarms
E	DEWATERING	Yes	Yes	Supply Fan Fail Exhaust Fan Fail	Supply Fan Fail Exhaust Fan Fail

END OF SECTION 23 09 23.14

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SECTION 23 31 13 – METAL DUCTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section includes metal ducts for air supply, exhaust and air-distribution systems in pressure classes from minus 2 to plus 2 inches wg. Furnish complete all ductwork, including liner, sealant and duct hangers for a complete and operable system.

1. Unless otherwise specified, all ductwork shall be constructed of stainless steel.

B. The duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.2 REFERENCE STANDARDS

A.	NUSIG	National Uniform Seismic Installation Guidelines
B.	NFPA 90A	Installation of Air Conditioning and Ventilating System
C.	NFPA 90B	Installation of Warm Air Heating and Air Conditioning Systems
D.	SMACNA	HVAC Duct Construction Standards - Metal and Flexible
E.	SMACNA's	Seismic Restraint Manual: Guidelines for Mechanical Systems
F.	AWS D1.1	Structural Welding Code Steel, for hangers and supports
G.	AWS D9.1	Sheet Metal Welding Code, for duct joint and seam welding
H.	NAIMA AH116	Fibrous Glass Duct Construction Standards

I. ASTM B 209 (ASTM B 209M)

J. ASTM A 653/A 653M

K. ASTM C 916

L. ASTM C 1071

1.3 SUBMITTALS

A. Product Data: Submit product information in accordance with Section 01 33 00 – Submittals. At a minimum, include information for the following items:

1. Sheet metal materials;

2. Duct liner;

3. Sealant materials

B. Provide product literature in operation and maintenance manual as per Section 01 78 23 – Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, Structural Welding Code Steel, for hangers and supports and AWS D9.1, Sheet Metal Welding Code, for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 GENERAL

A. All duct installed shall be stainless steel, or galvanized steel as indicated on drawings.

B. Comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible" for acceptable materials, material thicknesses and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations and other imperfections.

C. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:

1. Supply Ducts: 2-inch wg.

2. Return Ducts (Negative Pressure): 1-inch wg.

3. Fume Exhaust Ducts (Negative Pressure): 2-inch wg.

4. Exhaust Ducts: 1-inch wg.

2.2 SHEET METAL MATERIALS

A. Provide ducts and hardware constructed of the following materials as indicated on the Drawings:

1. Stainless Steel: Provide Type 304 stainless steel round exhaust duct for laboratory fume exhaust application. Duct shall be fabricated according to standard procedures listed.

2. Galvanized Sheet Steel Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

3. Reinforcement Shapes and Plates: Reinforcement where installed on sheet metal ducts.

4. Tie Rods: Stainless or Galvanized steel, 1/48 minimum diameter for lengths 368 or less; 3/88 minimum diameter for lengths longer than 368.

B. Fabrication: Fabricate ducts, elbows, transitions, offsets, branch connections and other construction according to SMACNA's "HVAC Duct Construction Standards-Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.

2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards-Metal and Flexible."

2.3 DUCT LINER

A. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 9OB and with NAIMA AH124 and insulation requirements specified

B. Materials: Provide liner with material conforming to ASTM C 1071. All surfaces exposed to airstream shall be coated to prevent erosion of glass fibers. Material shall be coordinated with the duct material specified for the application, refer to the plans for more information.

1. Thickness: 1 inch

2. Thermal Conductivity (k-Value): 0.26 at 75 degree F mean temperature.

3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.

4. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

5. Mechanical Fasteners: Stainless steel, Galvanized steel, or suitable non-corrosive material suitable for adhesive attachment, mechanical attachment or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.

a. Tensile Strength: Indefinitely sustain a 50-Ib tensile dead-load test perpendicular to duct wall.

b. Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/88 into airstream.

c. Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.

C. Application of Liner in Rectangular Ducts: Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing. Butt transverse joints without gaps and coat joint with adhesive.

1. Fold and compress liner in comers of rectangular ducts or cut and fit to ensure butted- edge overlapping.

2. Do not apply liner in rectangular ducts with longitudinal joints, except at comers of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

3. Secure liner with mechanical fasteners 4-inches from comers and at intervals not exceeding 128 transversely, at 3-inches from transverse joints and at intervals not exceeding 18-inches longitudinally.

4. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or “2” profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

a. Fan discharges.

b. Intervals of lined duct preceding unlined duct.

5. Terminate inner ducts with buildouts attached to dampers, turning vane assemblies or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets or welds.

D. Manufacturers, or Equal:

1. CertainTeed Corp.; Insulation Group.

2. Johns Manville International, Inc.

3. Knauf Fiber Glass GmbH.

4. Owens Coming.

2.4 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term “sealant” is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics. All sealants shall comply with requirements of Section 07 92 00 – Joint Sealers.

B. Joint and Seam Tape: Provide 2-inch-wide glass fiber reinforced fabric.

C. Water-Based Joint and Seam Sealant: Flexible adhesive sealant, resistant to UV light when cured, UL 723 listed and complying with NFPA requirements for Class 1 ducts.

D. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.

E. Flanged Joint Mastic: One part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use “0”.

F. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.5 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners or SMACNA-approved attachment structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4-inch thick.

2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4-inch thick.

B. Duct Attachments: Screws, blind rivets or self-tapping metal screws; compatible with duct materials.

C. Trapeze Supports: Provide stainless or galvanized steel duct support based on the spatial requirements, refer to the plans for more information. Ensure materials are electrolytically separated from ducts.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Install ducts with hangers and braces designed to withstand without damage to equipment, seismic force required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." Hangers shall be installed such that equipment hangs level.

B. Coordinate ductwork layout with suspended ceiling, fire rated walls and ceilings, lighting layouts, fire protection piping layout, structural components, and plumbing system.

C. Drawings indicate the net inside dimension of ductwork. No allowance for interior acoustic duct liner thickness has been made. The metal duct dimension will need to be increased to keep the net inside dimension when insulation lining is required.

D. Seal all joints and seams on ductwork.

E. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards- Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous glass ducts. Provide duct accessories of materials suited to duct materials.

F. Install turning vanes in all square and rectangular elbows.

G. Install backdraft dampers on exhaust fans or ducts nearest to outside and where indicated.

H. Install fire, smoke and fire/smoke dampers with fusible links, according to manufacturer's UL approved written instructions.

I. Roof mounted equipment curbs shall be constructed such that equipment is level.

J. Flexible ducts shall be limited to a maximum of 5 feet long.

K. Install ducts with fewest possible joints.

L. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

M. Install ducts close to walls, overhead construction, columns and other structural and permanent enclosure elements of building.

N. Protect duct interiors from the elements and foreign materials until building is enclosed.

O. Protect duct interiors from the elements and foreign materials until building is enclosed.

3.2 SEAM AND JOINT SEALING

A. Seal duct seams and joints according to SMACNA's HVAC Duct Construction Standards-Metal and Flexible for duct pressure class indicated.

1. For pressure classes lower than 2-inch wg, seal transverse joints.

B. Seal ducts before external insulation is applied.

3.3 HANGING AND SUPPORTING

A. Support horizontal ducts within 24-inch of each elbow and within 48-inch of each branch intersection.

B. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

C. Install concrete inserts before placing concrete.

D. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4-inch thick.

3.4 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 23 33 00 – Air Duct Accessories.

B. Comply with SMACNA's “HVAC Duct Construction Standards – Metal and Flexible” for branch, outlet and inlet and terminal unit connections.

END OF SECTION 23 31 13

SECTION 23 33 00 – AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section includes volume dampers, motorized control dampers, turning vanes, duct-mounted access doors, flexible connectors, and duct accessory hardware.

1.2 REFERENCE STANDARDS

A. NFPA 90A “Installation of Air Conditioning and Ventilating System”

B. NFPA 90B "Installation of Warm Air Heating and Air Conditioning Systems”

C. SMACNA's "HVAC Duct Construction Standards - Metal and Flexible”

1.3 SUBMITTALS

A. Shop Drawings: Submit detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location and size of each field connection detail in accordance with Section 01 33 00 – Submittal Procedures. At a minimum, submit information for the following:

1. Manual Volume dampers
2. Motorized control dampers
3. Turning vanes
4. Duct-mounted access doors
5. Flexible ducts
6. Flexible connectors
7. Special fittings.

B. Provide product literature in operation and maintenance manual as per Section 01 78 23 – Operation and Maintenance Data.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. All sheet metal shall be compatible with ductwork and shall be constructed of materials specified in Section 23 13 23 – Metal Ducts. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses and duct construction methods, unless otherwise indicated.

2.2 VOLUME DAMPERS

A. Provide factory fabricated dampers with required hardware and accessories. Stiffen all damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

B. Standard Volume Dampers: Provide dampers with multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications. Provide dampers fabricated of materials called out on the drawings; where no material is called out on the drawings, use aluminum dampers on aluminum and stainless steel ducts, use galvanized dampers on galvanized steel ducts.

1. Aluminum Frames: Hat-shaped, 0.10 thick aluminum sheet channels, frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.

2. Roll-Formed Aluminum Blades: 0.10 thick aluminum sheet.

3. Extruded-Aluminum Blades: 0.050 thick extruded aluminum.

4. Blade Axles: Nonferrous.

5. Bearings: Molded synthetic.

6. Tie Bars and Brackets: Galvanized Steel.

7. Steel Frames: Hat-shaped, galvanized stainless sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.

8. Roll-Formed Steel Blades: 0.064-inch thick, galvanized sheet steel.

C. Manufacturers, or Equal.

1. Air Balance, Inc.

2. American Warming and Ventilating.

3. Flexmaster U.S.A., Inc.

4. McGill Airflow Corporation.

5. Louvers & Dampers.

6. Nailor Industries Inc.

7. Penn Ventilation Company, Inc.

8. Ruskin Company.

9. Vent Products Company, Inc.

2.3 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

B. Manufactured Turning Vanes: Fabricate of 1-1/2-inch wide, single-vane curved blades of galvanized sheet steel set per SMACNA, support with bars perpendicular to blades set 2-inch o.c. and set into vane runners suitable for duct mounting.

C. Manufactures, or Equal.

1. Ductmate Industries, Inc.

2. Duro Dyne Corp.

3. METALAIRE, Inc.

4. Ward Industries, Inc.

2.4 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class.

B. Door: Double-wall duct mounting and rectangular fabricated of aluminum with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-inch by 1-inch butt or piano hinge and cam latches.

C. Frame: Aluminum with bend-over tabs and foam gaskets.

D. For all access doors less than 12-inch square, secure with two sash locks.

E. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

F. Insulation: 1-inch thick fibrous-glass or polystyrene-foam board.

G. Manufacturers, or Equal.

1. American Warming and Ventilating.

2. CESCO Products.

3. Ductmate Industries, Inc.

4. Flexmaster U.S.A., Inc.

5. Louvers & Dampers.

6. McGill AirFlow Corporation.

7. Nailor Industries Inc.

8. Ventfabrics, Inc.

9. Ward Industries, Inc.

2.5 FLEXIBLE CONNECTORS

A. General Description: Flame-retarded or noncombustible fabrics, coatings and adhesives complying with UL 181, Class 1.

B. Metal-Edged Connectors: Factory fabricated with a strip of fabric 3 ½-inch wide attached to two strips of 2 ¾-inch wide, 0.032-inch thick aluminum sheets. Select metal compatible with ducts.

C. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weather-proof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd.

2. Tensile Strength: 530 lbr/inch in the warp and 440 lbf/inch in the filling.

3. Service Temperature: Minus 50 degree to plus 250 degree F.

D. Manufactures, or Equal.

1. Ductmate Industries, Inc.

2. Duro Dyne Corp.

3. Ventfabrics, Inc.

4. Ward Industries, Inc.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's “HVAC Duct Construction Standards-Metal and Flexible” for metal ducts.

B. Provide duct accessories of materials suited to duct materials; use aluminum accessories in aluminum ducts.

C. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.

E. Provide balancing dampers at points on supply, return and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.

F. Install duct access doors to allow for inspecting, adjusting and maintaining accessories and terminal units as follows:

1. Downstream from volume dampers, turning vanes and equipment.

2. On sides of ducts where adequate clearance is available.

G. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

H. Connect diffusers or light troffer boots to low-pressure ducts directly.

I. Adjust duct accessories for proper settings.

END OF SECTION 23 33 00

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SECTION 23 34 23 – HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section includes requirement for Exhaust and Propeller Fans.

1.2 REFERENCE STANDARDS

A. AMCA 99

B. AMCA 210 Laboratory Methods of Testing Fans for Rating

C. AMCA 300 Reverberant Room Method for Sound Testing of Fans

D. AMCA 301 Methods for Calculating Fan Sound Ratings from Laboratory Test Data

E. NFPA 70, Article 100

F. UL 705

G. AMCA Compliance

H. NEMA Compliance

1.3 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties and accessories for each type of product indicated in equipment schedules in accordance with Section 01 33 00 – Submittal Procedures. At a minimum, include the following:

1. Certified fan performance curves with system operating conditions indicated.

2. Certified fan sound-power ratings.

3. Motor ratings and electrical characteristics, plus motor and electrical accessories.

4. Material gauges and finishes including color charts.

5. Dampers including housings, linkages and operators.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components and location and size of each field connection.

1. Wiring Diagrams: Provide information defining power signal and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance Data: Provide technical manuals in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

A. All electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. All motors and electrical accessories shall comply with NEMA standards

D. All power ventilators shall comply with UL 705.

PART 2 - PRODUCTS

2.1 GENERAL

A. Sound-Power Level Ratings: Comply with AMCA 301 – Methods for Calculating Fan Sound Ratings from Laboratory Test Data. Factory test fans according to AMCA 300 – Reverberant Room Method for Sound Testing of Fans. All fans shall be labeled with AMCA – Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation and efficiency by factory tests and ratings according to AMCA 210, Laboratory Methods of Testing Fans for Rating.

2.2 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base air ratings on actual site elevations. See Drawings for listed project elevation.

B. Operating Limits: Classify according to AMCA 99.

2.3 CENTRIFUGAL FANS

A. Description: Provide belt-driven or direct-driven centrifugal exhaust and supply fans consisting of housing, wheel, fan shaft, bearings, and complete with motor and disconnect switch, drive assembly, and accessories. All fans shall meet the intent of the design conditions listed on the equipment schedule, such as being explosion proof, inverter rated, etc., refer to project drawings schedules for more information.

B. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

C. Belt-Driven Drive Assembly: Resiliently mounted to housing with the following features:

1. Fan Shaft: Turned, ground and polished steel; keyed to wheel hub.

2. Shaft Bearings: Permanently-lubricated, permanently-sealed, self-aligning ball bearings.

3. Pulleys: Cast-iron adjustable-pitch motor pulley.

4. Provide spark resistant and explosion proof.

D. Accessories: Provide the following accessories with each fan:

1. Disconnect Switch: Non-fusible type with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

2. Birdscreens: Removable, ½-inch mesh, aluminum or brass wire.

E. Manufacturers, or Equal:

1. Acme Engineering & Mfg. Corp.

2. Aerovent; a Twin City Fan Company.

3. Carnes Company HVAC.

4. Cook, Loren Company

5. Greenheck Fan Corp.

6. Penn Ventilation Companies, Inc.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

3.2 COORDINATION

A. Coordinate size and location of structural support members.

B. Coordinate installation of roof curbs, equipment supports and roof penetrations.

3.3 INSTALLATION

A. Install power ventilators level and plumb.

B. Support suspended units from structure using threaded steel rods.

1. In seismic zones, restrain support units.

C. Install units with clearances for service and maintenance.

D. Label units according to requirements specified in Division 15.

3.4 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 33 00 – Air Duct Accessories.

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment.

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 4866.

3.5 FIELD QUALITY CONTROL

A. Equipment Startup Checks:

1. Verify shipping, blocking and bracing are removed.

2. Verity unit is secure on mountings and supporting devices and connections to ducts and electrical components are complete. Verify proper thermal-overload protection is installed in motors, starters and disconnect switches.

3. Verify cleaning and adjusting are complete.

4. Disconnect fan drive from motor, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts and install belt guards.

5. Verify lubrication for bearings and other moving parts.

6. Verify manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.

7. Disable automatic temperature-control operators.

B. Starting Procedures:

1. Energize motor and adjust fan to indicated rpm.

2. Measure and record motor voltage and amperage.

C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units and retest.

D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Shut unit down and reconnect automatic temperature-control operators.

F. Refer to Section 23 00 00 – General HVAC Requirements for testing, adjusting and balancing procedures.

G. Replace fan and motor pulleys as required to achieve design airflow.

H. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

3.7 CLEANING

A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt and construction debris and repair damaged finishes.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owners maintenance personnel to adjust, operate and maintain power ventilators.

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing and maintaining equipment and schedules.

2. Review data in maintenance manuals provided under Section 01 78 23 – Operation and Maintenance Data.

3. Schedule training with Owner, through Engineer, with at least seven days' advance notice.

END OF SECTION 23 34 23

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SECTION 23 37 00 – DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide ceiling and wall-mounted diffusers, registers and grilles as indicated on the drawings and per the requirements of this specification.

1.2 REFERENCE STANDARDS

A. ASHRAE 70 Method of Testing for Rating the Performance of Air Outlets and Inlets

1.3 SUBMITTALS

A. Provide product data for each product in accordance with Section 01 33 00 – Submittal Procedures. At a minimum, the following information shall be provided:

1. Data Sheet: Indicate materials of construction, finish and mounting details and performance data including throw and drop, static-pressure drop and noise ratings.

2. For each diffuser, register and grille provided indicate Drawing designation, room location, quantity, model number, size and accessories furnished.

B. Provide product literature in operation and maintenance manual as per Section 01 78 23 – Operation and Maintenance Data.

1.4 QUALITY CONTROL

1. Verification of Performance: Rate diffusers, registers and grilles according to ASHRAE 70, Method of Testing for Rating the Performance of Air Outlets and Inlets.

PART 2 - PRODUCTS

2.1 DIFFUSERS, REGISTERS AND GRILLES

A. Provide as scheduled on the drawings.

B. Approved manufacturers: Titus, Tuttle and Bailey, Price, and Krueger.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers and grilles level and plumb.

B. Install diffusers, registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers and grilles to air patterns indicated or as directed before starting air balancing.

END OF SECTION 23 37 00

SECTION 23 81 26 – DIRECT EXCHANGE SPLIT AIR CONDITIONING SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section covers direct exchange split systems including ducted and ductless and accessories.

1.2 SUBMITTALS

A. Product Data: Product Data and Shop Drawings shall be submitted in accordance with Section 01 33 00 – Submittal Procedures. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members to which fan-coil units will be attached.

2. Method of attaching hangers to building structure.

D. Provide operation and maintenance manual as per Section 01 78 23 – Operation and Maintenance Data.

1.3 QUALITY ASSURANCE

A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.

B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

C. The units shall be rated in accordance with Air-conditioning Refrigeration Institute's (ARI) Standard 210 and bear the ARI Certification label.

D. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

E. A dry air holding charge shall be provided in the indoor section.

F. The outdoor unit shall be pre-charged with R-410a refrigerant for 70 feet (20 meters) of refrigerant tubing.

G. System efficiency shall meet or exceed 13.0 SEER.

1.4 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled according to the manufacturer's recommendations.

B. The wireless controller shall be shipped inside the carton with the indoor unit and able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

1.5 WARRANTY

A. The units shall have a manufacturer's parts and defects warranty for a period of one (1) year from date of installation. The compressor shall have a warranty of 6 years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty does not include labor.

1.6 PERFORMANCE

A. Each system shall perform in accordance to the ratings shown on the drawings. Cooling performance shall be based on 80°F DB, 67°F WB for the indoor unit, and 95°F DB, 75°F WB for the outdoor unit. Heating performance shall be based on 70°F DB, 60°F WB for the indoor unit, and 47°F DB, 15°F WB for the outdoor unit.

PART 2 - PRODUCTS

2.1 DUCTLESS INDOOR UNIT

A. The indoor unit shall meet the intent of the design conditions listed on the equipment schedule, refer to project drawings schedules for more information.

B. The indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, control circuit board and fan motor. The unit in conjunction with the wired, wall mounted controller shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be purged with dry nitrogen before shipment from the factory.

C. Unit Cabinet: The casing shall be steel with enamel paint. Cabinet shall be designed for suspension mounting and horizontal operation. The rear cabinet panel shall have provisions for a field-installed filtered outside air intake connection.

D. Fan: The evaporator fan shall have three high performance, double inlet, forward curve sirocco fans driven by a single motor. The fans shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor fan shall a minimum of four (4) speeds: Low, M1, M2, and Hi.

E. Vane

1. There shall be a motorized horizontal vane to automatically direct air flow in a horizontal and downward direction for uniform air distribution. The horizontal vane shall provide a choice of five (5) vertical airflow patterns selected by remote control: 100% horizontal flow, 80% horizontal flow (plus 20% downward airflow), 60% horizontal airflow (plus 40% downward airflow), 40% horizontal airflow (plus 60% downward airflow), and swing. The horizontal vane shall significantly decrease downward air resistance for lower noise levels, and shall close the outlet port when operation is stopped.

2. There shall also be a set of vertical vanes to provide horizontal swing airflow movement selected by remote control.

F. Filter: Return air shall be filtered by means of an easily removable washable filter.

G. Coil: The evaporator coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. The multi-angled heat exchanger shall have a modified fin shape that reduces air resistance for a smoother, quieter airflow. All tube joints shall be brazed with PhosCopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil.

H. Electrical: The electrical power of the unit shall be 208 volts, 1 phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 198 volts to 215 volts. The power to the indoor unit shall be supplied from a separate circuit from the outdoor unit.

I. Control

1. The control system shall consist of two (2) microprocessors, one on each indoor and outdoor unit. Field wiring shall run directly from the indoor unit interconnected by a single non-polar two-wire AWG-16 stranded cable to the wall mounted controller with no splices. The control system between the outdoor unit and indoor unit shall be supplied from the outdoor unit.

2. The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller panel.

3. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from the wired controller, providing emergency operation and controlling the outdoor unit.

4. The indoor unit shall be controlled by either a wireless remote or a wall mounted wired controller to perform input functions necessary to operate the system. The wired controller shall have a large multi-language DOT liquid crystal display (LCD).

5. The controller shall display operating conditions such as set temperature, room temperature, pipe temperatures (i.e. liquid, discharge, indoor and outdoor), compressor operating conditions (including running current, frequency, input voltage, On/Off status and operating time), LEV opening pulses, sub cooling and discharge super heat.

6. Normal operation of the controller shall provide individual system control in which the controller and indoor unit are installed in the same room.

7. The control voltage from the wired controller to the indoor unit shall be 12 volts, DC. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Up to two wired controllers shall be able to be used to control one unit.

8. Control system shall control the continued operation of the air sweep louvers, as well as provide On/Off and mode switching. The controller shall have the capability to provide sequential starting with up to fifty seconds delay.

2.2 DUCTED INDOOR UNIT

A. The indoor unit shall meet the intent of the design conditions listed on the equipment schedule, refer to project drawings schedules for more information.

B. AHRI certified, ETL listed.

C. The indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, control circuit board and fan motor. The unit in conjunction with the wired, wall mounted controller shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be purged with dry nitrogen before shipment from the factory.

D. Unit Cabinet: The casing shall be steel with enamel paint. Cabinet shall be designed for vertical or horizontal mounting based on the project requirements.

E. Expansion Valve: Equipped with electronic expansion valve for use with the heat pump.

F. Blower: The blower shall have three high performance, double inlet, forward curve sirocco fans driven by a single motor. The blower shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The blower shall a minimum of four (4) speeds: Low, M1, M2, and Hi. The blower shall have an ECM variable speed motor.

G. Filter: A filter box shall be field installed on the return duct and provided by the HVAC contractor.

H. Coil: The evaporator coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. The multi-angled heat exchanger shall have a modified fin shape that reduces air resistance for a smoother, quieter airflow. All tube joints shall be brazed with PhosCopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil.

I. Supplemental Heater: 6 kW electric heater kits.

J. DecaBDE-free thermoplastic drain pan with secondary drain connections.

K. Screw-less sides and back to reduce condensation when installed in humid locations.

L. Foil-faced insulation covers the internal casing to reduce cabinet condensation.

M. Galvanized and leather grain-embossed finish.

N. Glue-less cabinet insulation retention.

O. Tool-less filter access.

P. Electrical: The electrical power of the unit shall be 230 volts, 1 phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 197 volts to 253 volts. The power to the indoor unit shall be supplied from a separate circuit from the outdoor unit.

Q. Control

1. The control system shall consist of two (2) microprocessors, one on each indoor and outdoor unit. Field wiring shall run directly from the indoor unit interconnected by a single non-polar two-wire AWG-16 stranded cable to the wall mounted controller with no splices. The control system between the outdoor unit and indoor unit shall be supplied from the outdoor unit.

2. The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller panel.

3. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from the wired controller, providing emergency operation and controlling the outdoor unit.

4. The indoor unit shall be controlled by either a wireless remote or a wall mounted wired controller to perform input functions necessary to operate the system. The wired controller shall have a large multi-language DOT liquid crystal display (LCD).

5. The controller shall display operating conditions such as set temperature, room temperature, pipe temperatures (i.e. liquid, discharge, indoor and outdoor), compressor operating conditions (including running current, frequency, input voltage, On/Off status and operating time), LEV opening pulses, sub cooling and discharge super heat.

6. Normal operation of the controller shall provide individual system control in which the controller and indoor unit are installed in the same room.

7. The control voltage from the wired controller to the indoor unit shall be 12 volts, DC. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Up to two wired controllers shall be able to be used to control one unit.

8. Control system shall control the continued operation of the air sweep louvers, as well as provide On/Off and mode switching. The controller shall have the capability to provide sequential starting with up to fifty seconds delay.

2.3 OUTDOOR UNIT

A. General

1. The outdoor unit shall meet the intent of the design conditions listed on the equipment schedule, RE: project drawings schedules.

2. The outdoor unit shall be equipped with a control board that interfaces with the indoor unit to perform all necessary operation functions.

3. The outdoor unit shall be capable of operating at 0°F (-18°C) ambient temperature without additional low ambient controls; provide wind baffle.

4. System shall have a maximum refrigerant tubing length of 165 feet between indoor and outdoor units without the need for line size changes, traps or additional oil.

5. Heat pump cabinets shall be installed six (6) inches above the equipment pad.

B. Cabinet: The casing shall be constructed from galvanized steel plate, coated with a finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection.

C. Fan: Furnish with an AC fan motor. The fan motor shall be of aerodynamic design for quiet operation, and the fan motor bearings shall be permanently lubricated. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent contact with moving parts.

D. Coil: The L-shaped condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build up. The coil shall be protected with an integral metal guard. Refrigerant flow from the condenser shall be controlled by means of linear expansion valve (LEV) metering orifice. The LEV shall be control by a microprocessor controlled step motor.

E. Compressor: The compressor shall be a scroll compressor with variable speed technology. The compressor shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the room load for significantly increasing the efficiency of the system which results in vast energy savings. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be intermittently applied to the compressor motor to maintain enough heat. The outdoor unit shall have an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

F. Electrical: The electrical power of the unit shall be 208 volts, 1 phase, 60 hertz. The outdoor unit shall be controlled by the microprocessor located in the indoor unit. The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC. The unit shall have Pulse Amplitude Modulation circuit to utilize 98% of input power supply.

2.4 SCHEDULE

A. Refer to Project Drawings for AC Mini-Split Unit Schedules.

END OF SECTION 23 81 26

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SECTION 23 83 23 – ELECTRIC UNIT HEATERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section includes industrial Electric Unit Heaters with electric-resistance coils.

1.2 SUBMITTALS

A. Product Data: Product Data and Shop Drawings shall be submitted in accordance with Section 01 33 00 – Submittals. Include rated capacities, furnished specialties, and accessories for each unit type and configuration.

B. Shop Drawings: Submit the following for each unit type and configuration:

1. Plans, elevations, sections, and details.

2. Wiring Diagrams: Power, signal, and control wiring.

3. Equipment schedules include rated capacities, furnished specialties, and accessories.

C. Operation and Maintenance Data: Industrial heaters to be included in operation and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Indeeco

2. Markel

3. Modine Manufacturer Company.

4. Sterling Radiator.

B. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

C. Comply with UL 2021 and D. Comply with UL 823.

D. Casing:

1. Cabinet: Removable panels for maintenance access to controls.

2. Cabinet Finish: Manufacturer's standard powder coat finish applied to factory-assembled and -tested galvanized steel propeller unit heater before shipping.

3. Discharge Louver: Adjustable outlet grille with 45° angled louvers.

E. Electrical-Resistance Heating Elements:

F. Fan: Propeller type, aluminum wheel directly mounted on motor shaft in the fan venturi.

2.2 FAN MOTORS

A. Motor Type: High performance permanently lubricated, total enclosed, multi-speed with integral thermal-overload protection.

2.3 CONTROLS

A. Refer to Sheet MH-001 for controls strategy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install propeller unit heaters level and plumb.

B. Install propeller unit heaters to comply with NFPA 90A.

C. Where required install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls.

3.2 CONNECTIONS

A. Installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Ground Equipment.

3.3 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing.

1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Operate electric heating elements through each stage to verify proper operation and electrical connections.

3. Test and adjust controls and safeties.

B. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain propeller unit heaters.

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.

2. Review data in maintenance manuals. Refer to Section 01 77 00 – Closeout Procedures.

3. Schedule training with Owner, through ENGINEER, with at least seven days advance notice.

END OF SECTION 23 83 23

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SECTION 23 83 23.13 – ELECTRIC INFRARED RADIANT HEATER

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section includes industrial Electric Infrared Radiant Heaters with electric-resistance coils.

1.2 SUBMITTALS

A. Product Data: Product Data and Shop Drawings shall be submitted in accordance with Section GC-12 – Submittals. Include rated capacities, furnished specialties, and accessories for each unit type and configuration.

B. Shop Drawings: Submit the following for each unit type and configuration:

1. Plans, elevations, sections, and details.

2. Wiring Diagrams: Power, signal, and control wiring.

3. Equipment schedules include rated capacities, furnished specialties, and accessories.

C. Provide operation and maintenance manual as per Section 01 78 23 – Operation and Maintenance Data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ETL listed for indoor and outdoor commercial use

C. Comply with UL 2021 and D.

D. Warranty: All components 1-year

PART 2 - PRODUCTS

2.1 INFRARED RADIANT HEATERS

A. Manufacturers or Approved Equal:

1. WATTCO, JAK series

2. Detroit Radiant Products Co., Re-Verber-Ray, SW2

3. Indeeco, InvizaTherm

B. Description: Short-wave electric infrared heaters shall be furnished and installed in accordance with governing codes and as shown per drawings provided.

C. Heater Construction

1. The heater shall be constructed of 304 brushed stainless steel

2. High temperature nylon louvered end caps

3. Reflector shall have a multi-faceted design and be constructed of anodized aluminum.

4. Heating Elements shall be quartz with a tungsten element and stainless-steel end caps. Quartz tubing shall be clear in or red sleeve for reduced glare.

D. Power

1. Refer to HVAC schedules in the drawing set for power demands.

2. Facility electrical design is based on 10kW per each heater. If a manufacturer is submitted on and accepted which has differing power requirements, it shall be the responsibility of the Contractor to ensure that sufficient heaters are provided to meet the total heating demand; to include all required conduit, wire and panel upgrades.

2.2 CONTROLS

A. Control Devices:

1. Wall-mounted thermostat.

2. Wall mounted disconnect switch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install heaters level and plumb.

B. Install heaters to comply with NFPA 90A.

C. Coordinate placement with facility lighting and ceiling fan layout.

D. Suspend heaters from structure with factory supplied mounting brackets.

E. Where required install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls.

3.2 CONNECTIONS

A. Installation requirements are specified in other Division 23 sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Equipment shall be properly grounded.

3.3 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing.

1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Operate electric heating elements through each stage to verify proper operation and electrical connections.

3. Test and adjust controls and safeties.

B. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain propeller unit heaters.

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.

2. Review data in maintenance manuals. Refer to Section 01 77 00 – Closeout Procedures.

3. Schedule training with Owner, through Enginer, with at least seven days advance notice.

END OF SECTION 23 83 23.13

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SECTION 26 05 00 – ELECTRICAL, GENERAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to all of Division 26 Specifications. This Specification section applies to all Division 26 Specifications and Electrical Drawings.

B. Division 26 contractor shall review all other division specifications and drawings for additional requirements.

1.2 QUALITY ASSURANCE

A. Comply with latest NEC, NFPA, UBC, UFC, UL and applicable Local and State Codes. Also comply with Utility Company regulations and industry standards and these Drawings.

B. Work shall be done by only trained, licensed, and experienced workmen familiar with the requirements.

C. All microprocessor-based equipment and software with equipment shall utilize 4 digits for the year part of all dates. A two-digit date shall be an option for printing at Owner’s preference.

D. Hazardous Location Rating of Equipment: Equipment manufacturer shall reference the hazardous-area classification drawing in the Contract Documents and provide equipment in compliance with the defined NEC- classification requirements. It will be the manufacturer's sole responsibility to submit equipment in compliance with the Contract Documents, NFPA 820, and NEC requirements.

1.3 EXTENT OF DRAWINGS / SPECIFICATION

A. Drawings indicate intent and general layout of electrical systems for the Project. Drawings are partly diagrammatic and do not indicate all fittings and accessories which may be required. Provide such fittings and accessories as required to form a complete and operating system in general conformance with Specifications and Drawings.

1.4 PRIOR APPROVALS

A. Unless directed otherwise by Division 1, all products submitted for prior approval shall be received by the Engineer 10 business days prior to Bid. Supply technical data, photometrics and dimensional Drawings showing that substitutes are equal to product specified. Faxed prior approvals will not be accepted.

1.5 DISCREPANCIES

A. Prior to submitting Bid, Contractor shall refer any apparent discrepancies or omissions to Engineer for clarification. The more stringent provisions shall take precedence where codes, Specifications and Drawings differ with one another. The Contractor shall Bid the more expensive requirement, unless discrepancy is addressed by Addendum prior to Bid.

1.6 TEMPORARY LIGHTING/POWER

A. Provide temporary electrical power and lighting for all trades that require service during the course of this Project. Provide temporary service and distribution as required. Provide temporary power for all electrical equipment that will need to be installed due to the phased construction of this project. Comply with the NEC and OSHA requirements. Energy Costs by General Contractor.

1.7 SHOP DRAWING SUBMITTALS

A. General: Follow the procedures specified in Section 01 33 00 – Submittal Procedures. Submit for final and official approval through the General Contractor.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate electrical equipment installation with other building components.

B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for electrical installations.

C. Coordinate installing required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning prior to closing in the building.

E. Coordinate connecting electrical service to components furnished under other Sections.

F. Coordinate connecting electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Coordinate requirements for access panels and doors where electrical items requiring access are concealed by finished surfaces.

1.9 SUBSTANTIAL COMPLETION

A. At Substantial Completion of Project, be ready to demonstrate the following list of items below. If this is not possible, inform the General Contractor and Engineer no less than 1 week prior to Engineer’s visitation of the site for Substantial Completion.

B. Demonstrate the operation and test of the emergency lighting system.

C. Demonstrate the main service ground, bonding to neutral and resistance readings obtained at time of installation. This will involve having some covers removed from the main panels at the time of the Engineer's visitation.

D. All electrical systems and items specified shall be installed and operational.

E. Demonstrate exterior lighting controls.

F. Demonstrate the operation of all emergency power systems including generators, uninterruptible power supplies and inverter systems.

G. Demonstrate compliance with IEEE 519 for harmonic distortion within “Idaho Power Company’s” distortion limit requirement of “8%”. Distortion limits apply to the entire plant load measured at the primary meter. This point in the system shall be defined as the point of common coupling (PCC). Meeting these requirements is a condition of service and a requirement of this project. Refer to Section 26 29 23 – Variable-Frequency Motor Controllers (VFCs/VFDs), Part 2.3.I.

1.10 RECORD DOCUMENTS

A. Prepare Record Documents in accordance with the requirements in Section 01 77 00 – Closeout Procedures. In addition to the requirements specified in Division 1, indicate the following installed conditions:

1. Actual location of all electrical service gear/feeders, panel/motor/special equipment feeders, all major underground or underslab conduits, all conduit stubs for future use, any change in branch circuitry from Drawings, key junction boxes and pull boxes not indicated on Drawings, any control locations or indicator lights not shown on Drawings.

2. Addendum items, Change Order items and all changes made to Drawings from Bidding phase through to Project completion.

3. Actual equipment and materials installed. Where manufacturer and catalog number are indicated on Drawings, generally or in fixture or equipment schedules, change to reflect actual products installed.

4. Change service panel and branch panel breaker locations and schedules to reflect actual installed conditions.

1.11 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Section 01 77 00 – Closeout Procedures. In addition to the requirements specified in Division 1 assemble O & M Manuals as follows:

1. Compile Operating and Maintenance Manuals for the electrical systems and equipment. The manuals shall be provided to the Engineer for approval complete and at one time, prior to requesting final payment. Partial or separate data will be returned for completion.

2. Manuals shall be assembled in three-ring binders. Binders shall be 3 inch thick or less and have slip sleeve jacket on binder side and front. More than one binder shall be used for each set of data if required to prevent overfilling of one binder. All information shall be arranged in Sections and each Section shall have a blank buff colored, heavy paper divider with a protruding tab clearly labeled. Sections shall be arranged in the same order that the equipment is listed in the Specification and each Specification section shall have a separate tab. Shop Drawings which are larger than 8-1/2-inch by 11 inch shall be individually folded so they are 8-1/2-inch by 11 inch or less and inserted behind the appropriate tab.

3. Tabs shall be labeled and arranged as follows:

   a. Index: Furnish under the first tab an index of Sections listing name of Section and Specification numbers.

   b. Equipment Manufacturers: Furnish under the second tab a complete typed list of equipment suppliers and manufacturers' representative including type of equipment, name, address, and phone number. The company listed here should be the one which could furnish replacement parts and offer technical information about the equipment.

   c. Product Literature: Each tab, starting with the third shall contain the name of a Specification Section. Behind each tab shall be the previously submitted and approved Shop Drawing, factory published operation and maintenance instructions and parts lists. Also include description of function, normal operating characteristics and limitations, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions. Servicing instructions and lubrication charts and schedules.

4. Upon completion and approval of the booklets, one copy shall be given to the Architect, and two to the Owner. Using the booklet, the Electrical Contractor shall explain in detail and instruct the Owner's operating personnel in the correct operation and maintenance of the equipment.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

A. Channel and angle support systems, hangers, anchors, sleeves, brackets, fabricated items, and fasteners are designed to provide secure support from the building structure for electrical components.

1. Material: Steel, except as otherwise indicated, protected from corrosion with zinc coating or with treatment of equivalent corrosion resistance using approved alternative finish or inherent material characteristics.

2. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel, except as otherwise indicated.

B. Steel channel supports have 9/16-inch diameter holes at a maximum of 8 inches o.c., in at least 1 surface.

1. Fittings and accessories mate and match with channels and are from the same manufacturer.

C. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps or "click"- type hangers.

D. Sheet-Metal Sleeves: 0.0276-inch or heavier galvanized sheet steel, round tube, closed with welded longitudinal joint.

E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

F. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable iron casting with hot-dip galvanized finish.

G. Expansion Anchors: Carbon-steel wedge or sleeve type.

H. Toggle Bolts: All-steel springhead type.

I. Powder-Driven Threaded Studs: Heat-treated steel.

2.2 CONCRETE EQUIPMENT BASES

A. Forms and Reinforcing Materials: As specified in Section 03 30 00 – Cast-In-Place Concrete.

B. Concrete: 3000 psi, 28-day compressive strength as specified in Section 03 33 00 – Cast-In-Place Concrete.

C. RACEWAY AND CABLE LABELS

D. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

1. Color: Black letters on orange field.

2. Legend: Indicates voltage.

E. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear, weather- and chemical-resistant coating.

F. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.

G. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

H. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.

1. Not less than 6 inches wide by 4 mils thick.

2. Compounded for permanent direct-burial service.

3. Embedded continuous metallic strip or core.

4. Printed legend indicating type of underground line.

I. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

2.3 NAMEPLATES

A. Engraved Plastic Nameplates: Engraving stock, melamine plastic laminate, minimum 1/16-inch thick for signs up to 20 sq. in. and 1/8-inch thick for larger sizes.

1. Engraved legend with white letters on black face.

2. Punched or drilled for mechanical fasteners.

2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16-inch.

2. Tensile Strength: 50 lb. minimum.

3. Temperature Range: Minus 40 to plus 185 deg F.

4. Color: According to color-coding.

B. Paint: Formulated for the type of surface and intended use.

1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.

2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.

3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.

4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION REQUIREMENTS

A. Install components and equipment to provide the maximum possible headroom where mounting heights or other location criteria are not indicated.

B. Install items level, plumb, and parallel and perpendicular to other building systems and components, except where otherwise indicated.

C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Give right of way to raceways and piping systems installed at a required slope.

3.2 ELECTRICAL SUPPORTING METHODS

A. Damp Locations and Outdoors: Hot-dip galvanized materials, U-channel system components.

B. Dry Locations: Steel materials.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Conform to manufacturer's recommendations for selecting supports.

E. Strength of Supports: Adequate to carry all present and future loads, times a safety factor of at least 4; 200 lb. minimum design load.

3.3 GENERAL INSTALLATION OF MATERIALS

A. Install wires according to manufacturer's written instructions and NECA's "Standard of Installation."

B. Conductor Splices: Keep to the minimum and comply with the following:

1. Install splices and taps that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

2. Use splice and tap connectors that are compatible with conductor material.

C. Connect outlets and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

D. Install devices to securely and permanently fasten and support electrical components.

E. Raceway Supports: Comply with NFPA 70 and the following requirements:

1. Conform to manufacturer's recommendations for selecting and installing supports.

2. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

3. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

4. Spare Capacity: Size supports for multiple conduits so capacity can be increased by a 25 percent minimum in the future.

5. Support individual horizontal raceways with separate, malleable iron pipe hangers or clamps.

6. Hanger Rods: 1/4-inch diameter or larger threaded steel, except as otherwise indicated.

7. Spring Steel Fasteners: Specifically designed for supporting single conduits or tubing. May be used in lieu of malleable iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to channel and slotted angle supports in accordance with NEC.

8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports, with no weight load on raceway terminals.

F. Vertical Conductor Supports: Install simultaneously with conductors.

G. Miscellaneous Supports: Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices except where components are mounted directly to structural features of adequate strength.

H. Sleeves: Install for cable and raceway penetrations of concrete slabs and walls, except where core-drilled holes are used. Install for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

I. Fastening: Unless otherwise indicated, securely fasten electrical items and their supporting hardware to the building structure. Perform fastening according to the following:

1. Fasten by means of wood screws or screw-type nails on wood; toggle bolts on hollow masonry units; concrete inserts or expansion bolts on concrete or solid masonry; and by machine screws, welded threaded studs, or spring-tension clamps on steel.

2. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts, machine screws, or wood screws.

3. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or any other items.

4. In partitions of light steel construction use sheet-metal screws.

5. Drill holes in concrete beams so holes more than 1-1/2 inches deep do not cut main reinforcing bars.

6. Drill holes in concrete so holes more than 3/4-inch deep do not cut main reinforcing bars.

7. Fill and seal holes drilled in concrete and not used.

8. Select fasteners so the load applied to any fastener does not exceed 25 percent of the proof-test load.

J. Install concrete pads and bases where indicated.

K. Install utility-metering equipment according to utility company's written requirements. Provide grounding and empty conduits as required by company.

3.4 LABEL INSTALLATION

A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before applying.

E. Install painted identification according to manufacturer's written instructions and as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.

2. Prime surfaces using type of primer specified for surface.

3. Apply one intermediate and one finish coat of enamel.

F. Color Identification of Junction boxes: Identify with spray paint. Apply colors as follows:

1. Emergency lighting and power: Orange.

2. Mechanical/Electrical Supervisory System: Blue

3. Security System: Yellow.

G. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.

H. Circuit Identification Labels on Boxes: Install labels externally.

1. Exposed Boxes: Permanent black marker indicating panel and circuit designation.

2. Concealed Boxes: Permanent black marker indicating panel and circuit designation.

I. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.

J. Color-Coding of Secondary Phase Conductors: Use the following colors for service, feeder and branch-circuit phase conductors:

1. 208/120-V Conductors:

a. Phase A: Black.

b. Phase B: Red.

c. Phase C: Blue.

d. Neutral: White.

e. Ground: Green.

2. 480/277-V Conductors:

a. Phase A: Brown.

b. Phase B: Orange

c. Phase C: Yellow.

d. Neutral: Gray.

e. Ground: Green.

3. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:

a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1 inch wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.

K. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.

1. Legend: 1/4-inch steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.

2. Tag Fasteners: Nylon cable ties.

3. Band Fasteners: Integral ears.

L. Apply identification to conductors as follows:

1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.

2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.

3. Multiple Control and Communication Circuits in the Same Enclosure. Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

M. Apply warning, caution, and instruction signs as follows:

1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

N. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch high lettering on 1-1/2 inch high label; where two lines of text are required, use labels 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:

1. Panelboards, electrical cabinets, and enclosures.

2. Access doors and panels for concealed electrical items.

3. Electrical switchgear and switchboards.

4. Emergency system boxes and enclosures.

5. Disconnect switches.

6. Enclosed circuit breakers.

7. Motor starters.

8. Push-button stations.

9. Power transfer equipment.

10. Contactors.

11. Remote-controlled switches.

12. Control devices.

13. Transformers.

14. Battery racks.

15. Power-generating units.

O. For panelboards, provide framed type circuit schedules with identification of items controlled by each breaker. Indicate room numbers of items controlled or room name where appropriate for Owners convenience. Final schedules shall be typed or printed for clarity. Hand written schedules are not acceptable. Schedules shall be posted inside each panel door mounted in transparent card holder upon project completion.

END OF SECTION 26 05 00

SECTION 26 05 05 – SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section describes general requirements and methods of execution relating to the demolition or portions of the electrical system for the Project.

1.2 DEMOLITION/REMODEL WORK

A. The Contractor shall carefully examine the Drawings and Specifications, visit the site, and make note of all existing conditions, dimensions, and limitations prior to Bid and make allowances thereto.

B. No Change Orders will be issued for Contractor 's failure to visit site, remodel work necessary for a complete installation of systems shown, and Contractor's lack of understanding of amount or difficulty of work involved.

C. The Contractor shall also notify all corporations, companies, individuals or local authorities owning, or having jurisdiction over existing utilities and services which interfere in any manner with the execution of the Work under this Contract, and shall remove, relocate or protect such utilities or equipment as required by the parties having jurisdiction over same.

D. If existing active or nonactive services (which may not be shown on Plans) are encountered that require relocation or disconnecting, the Contractor shall make written request for decision on proper handling of the services. The Contractor shall not proceed with the Work until so authorized by the Engineer.

E. When areas of the existing buildings are adjacent to the area of construction in which work is going on and are occupied, then the Contractor shall arrange the Work so as to reduce to minimum the periods of interruption or outrages in the various services.

F. Not less than one week before any system is to be put out of service, the Contractor shall notify and coordinate with other trades and the Owner of such necessity including the extent of the Work to be done during the outrage, possible length of Time required for that phase of the Work, and the desired time at which the outage is to begin.

G. The Contractor shall balance additional loads to the existing circuitry between phases and furnish a revised, typed panel directory on existing panel boards where circuitry is changed.

H. The Contractor shall carefully lay out all work in advance to minimize cutting, channeling, or drilling and where necessary, all cutting and patching shall be done in a manner approved by the Engineer. The Contractor shall not endanger the stability of any structure and will restore any damaged surfaces to original conditions at no cost to the Owner.

I. The Contractor shall remove or relocate existing conduits, wires, equipment, devices, or fixtures indicated on Drawings and as required by remodel operations. Where the reuse of existing conduits, wires, devices, or fixture is permitted, the Contractor shall verify that wiring is continuous.

J. Existing equipment which is indicated as being removed and not indicated for re-use shall be disposed of unless stated otherwise.

K. The Contractor shall coordinate with the owner for project phasing and removal of the existing generator. Owner to remove the generator. The contractor shall be responsible for demolition and removal of the concrete slab and underground conduits.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 26 05 05

SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes wires, cables and connectors for power, lighting, signal, control and related systems rated 600 V and less.

1.2 SUBMITTALS

A. Furnish in accordance with Section 01 33 00 – Submittal Procedures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers complying with the Quality Assurance requirements are acceptable.

2.2 WIRES AND CABLES

A. General: Provide wire and cable suitable for the temperature, conditions and location where installed.

B. Power Conductors: Provide solid conductors for power and lighting circuits No. 10 AWG and smaller. Provide stranded conductors for sizes No. 8 AWG and larger.

C. Control Conductors: Provide stranded conductors.

D. Conductor Material: Copper for all wires and cables. Aluminum conductors are not acceptable.

E. Insulation: Provide THHN/THWN insulation for all conductors size 500 kcmil and larger, and No. 8 AWG and smaller. For all other sizes provide THW, THHN/THWN or XHHW insulation as appropriate for the locations where installed. Type THHN insulation may be used for branch circuit and feeder sizes for 100 amp under. Adjust conduit size.

F. Color coding for phase identification in accordance with Section 26 05 00 –Electrical, General.

G. VFD Cables: Provide VFD cable for all VFD applications.

1. Cable shall contain all phase conductors plus ground.

2. Contain a braided shield with 85% coverage and foil shield with 100% coverage.

3. Insulation to be XLPE.

4. For retrofit applications where conduit fill is limited, modifications to the above

5. For retrofit applications where conduit fill is limited, modifications to the above requirements to reduce cable size may be required. Submit product for review and approval by Engineer.

2.3 CONNECTORS FOR CONDUCTORS

A. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

PART 3 - EXECUTION

3.1 WIRING METHOD

A. Use the following wiring methods as indicated:

1. Wire: Install all wire in raceway, minimum size for light and power circuits shall be #12 AWG. Minimum size for control wire shall be 14 AWG.

3.2 INSTALLATION OF WIRES AND CABLES

A. General: Install electrical cables, wires, and connectors in compliance with NEC.

B. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary.

C. Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced. No joints or taps permitted in service or feeder circuits.

D. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.

E. Install VFD cables per VFD manufacturer requirements. VFD cable shielding must be connected at both the drive and the motor ends unless the drive manufacturer provided different guidelines. The shielding must be connected at a 360° contact.

3.3 FIELD QUALITY CONTROL

A. Prior to energizing, test wires and cables for electrical continuity and for short-circuits.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1. Comply with UL 467.

B. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.

C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Section 26 05 19 – Low-Voltage Conductors and Cables.

B. Material: Copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

E. Grounding Electrode Conductors: Stranded cable.

F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

G. Bare Copper Conductors: Comply with the following:

1. Solid Conductors: ASTM B 3.

2. Assembly of Stranded Conductors: ASTM B 8.

H. Copper Bonding Conductors: As follows:

1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4-inch in diameter.

2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.

3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16-inch thick.

4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

I. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Sectional type; copper-clad steel.

1. Size: 3/4 inch in diameter by 120 inches in length.

PART 3 - EXECUTION

3.1 APPLICATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.

D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

E. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.

F. Underground Grounding Conductors: Use copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

3.2 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits.

C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:

1. Feeders and branch circuits.

2. Lighting circuits.

3. Receptacle circuits.

4. Single-phase motor and appliance branch circuits.

5. Three-phase motor and appliance branch circuits.

6. Flexible raceway runs.

7. Armored and metal-clad cable runs.

D. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

E. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

F. Water Heater: Bond conductor to heater units, piping, connected equipment, and components.

G. Signal and Communication Systems: Provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

H. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.

1. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.3 INSTALLATION

A. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NEC. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation. Bond grounding conductor by cadweld process to reinforce steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

B. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.

1. Drive ground rods until tops are 6 inches below finished floor or final grade, unless otherwise indicated.

2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

C. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

D. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

E. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

F. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

G. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

H. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

3.4 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.

2. Make connections with clean, bare metal at points of contact.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

3.5 FIELD QUALITY CONTROL

A. Test ground resistance of entire system and at each building/structure where electrical equipment is installed.

B. Where maximum allowable ground resistance of 5 ohms is exceeded, install additional grounding mats or ground rods until ground resistance is equal to or below maximum allowable ground resistance.

C. Terminate ground and shield for VFD cables per VFD manufacturer requirements. VFD cable shielding must be connected at both the drive and the motor ends unless the drive manufacturer provided different guidelines. The shielding must be connected at a 360° contact. Provide and install cable claps or metal fittings as required for proper connection.

END OF SECTION 26 05 26

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SECTION 26 05 29 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers complying with the Quality Assurance requirements are acceptable.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

C. Manufacturers: Subject to compliance with requirements, provide products by the following or equal:

1. Thomas & Betts.

2. Power-Strut.

3. Unistrut.

4. Cooper B-Line.

5. Robroy.

6. Aickinstrut.

2.2 COATINGS

A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized.

2.3 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

B. Fasteners: Types, materials, and construction features as follows:

1. Expansion Anchors: Carbon steel wedge or sleeve type.

2. Toggle Bolts: All steel springhead type.

3. Powder-Driven Threaded Studs: Heat-treated steel, designed specifically for the intended service.

C. U-Channel Systems: 16 gauge steel channels, with 9/16-inch diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacturer.

2.4 FABRICATED SUPPORTING DEVICES

A. Pipe Sleeves: Provide pipe sleeves of one of the following:

1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snap lock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal for sleeve diameter noted:

a. 3 inch and smaller: 20 gauge.

b. 4-inch to 6-inch: 16 gauge.

c. Over 6-inch: 14 gauge.

2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.

3. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with the building structural system and with other electrical installation.

C. Raceway Supports: Comply with the NEC and the following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.

2. Strength of each support shall be adequate to carry the load plus a minimum of 200 lbs safety allowance.

3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

4. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2 inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.

5. Space supports for raceways in accordance with NEC.

6. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.

D. In open overhead spaces, support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.

E. Sleeves: Install in concrete slabs and walls and all other fire-rated floors and walls for raceways and cable installations. For sleeves through fire rated-wall or floor construction, apply UL-listed firestopping sealant in gaps between sleeves and enclosed conduits and cables in accordance with "Fire Resistant Joint Sealers" requirement of Section 07 92 00 – Joint Sealants.

F. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:

1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

2. All device boxes in sheetrock walls will be tight before, during and after installation of sheetrock.

G. Cutting and Patching: Obtain Engineer's approval before cutting and patching on structural members of building surfaces.

END OF SECTION 26 05 29

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SECTION 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes raceways for electrical wiring. Types of raceways in this Section include only the following:

1. Metal conduit and tubing.
2. Nonmetallic conduit and ducts.
3. Flexible metal, liquid-tight conduit.
4. Conduit bodies.
5. Outlet and device boxes.
6. Junction and pull boxes.
7. Wireway.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Action Submittals: Manufacturer’s Literature:

1. Rigid galvanized steel conduit.
2. Intermediate metal conduit.
3. PVC conduit.
4. PVC-coated rigid galvanized steel conduit
5. Flexible metal, liquid-tight conduit.
6. Conduit fittings.
7. Device boxes for use in hazardous areas.
8. Junction and pull boxes used at or below grade.
9. Large junction and pull boxes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers complying with the Quality Assurance requirements are acceptable.

2.2 METAL CONDUIT AND TUBING

A. Rigid Metal Conduit (RMC):

1. Meet requirements of NEMA – ANSI C80.1 and UL 6.

2. Material: Hot-dip galvanized with chromated protective layer or compatible organic layer.

3. Threads shall be hot galvanized after cutting.

B. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of NEMA RN 1 and ETL.

2. Material:

a. Meet requirements of NEMA – ANSI C80.1 and UL 6.

b. Exterior Finish: PVC coating, 40-mil nominal thickness; bond to metal shall have tensile strength greater than PVC.

c. Interior finish: Urethane coating, 2-mil nominal thickness.

3. Threads: Hot-dipped galvanized and factory coated with urethane.

4. Bendable without damage to interior or exterior coating.

C. Intermediate Metal Conduit (IMC):

1. Meet requirements of NEMA – ANSI C80.6 and UL 1242.

2. Material: Hot-dip galvanized with chromated and lacquered protective layer.

D. Electrical Metallic Tubing (EMT) and Fittings: ANSI C80.3.

E. Flexible Metal Conduit: UL 1, zinc-coated steel.

F. Flexible Metal, Liquid-Tight Conduit:

1. UL 360 listed for 105 degrees C insulated conductors.

2. Material: Galvanized steel with extruded PVC jacket.

2.3 NONMETALLIC CONDUIT AND DUCTS

A. Electrical Nonmetallic Tubing (ENT) not allowed.

B. Rigid Nonmetallic Conduit (RNC): Schedule 40 PVC.

1. Meet requirements of NEMA TC 2 and UL 651.

2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.

C. PVC Conduit and Tubing Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.

D. Flexible, Nonmetallic, Liquid-Tight Conduit and Fittings: UL 1660. Fittings shall be specifically approved for use with this raceway.

1. Material: PVC core with fused flexible PVC jacket.

2. UL 1660 listed for:

a. Dry Conditions: 80 degrees C insulated conductors.

b. Wet Conditions: 60 degrees C insulated conductors.

3. Manufacturers and Products:

a. Carlon; Carflex, or X-Flex.

b. T & B; Xtraflex LTC, or EFC.

c. Approved equal.

E. Innerduct:

1. Resistant to spread of fire, per requirements of UL 2024.

2. Smooth or corrugated HDPE.

3. Textile Manufacturer: Maxcell or approved equal.

F. Conduit, Tubing, and Duct Accessories: Types, sizes, and materials complying with manufacturer's published product information. Mate and match accessories with raceway.

2.4 CONDUIT BODIES

A. General: Types, shapes, and sizes as required to suit individual applications and NEC requirements.

B. Provide matching gasketed covers secured with corrosion-resistant screws.

C. Metallic Conduit and Tubing: Use metallic conduit bodies. Use bodies with threaded hubs for threaded raceways.

D. Manufacturers and Products (For Normal Conditions):

1. Appleton; Form 8 conduit bodies.

2. Crouse-Hinds; Form 8 threaded condulets.

3. Killark; Series O electrolets.

4. Thomas & Betts; Form 8.

5. Approved equal.

E. Manufacturers (For Hazardous Locations):

1. Appleton.

2. Crouse-Hinds.

3. Killark.

4. Approved equal.

2.5 FITTINGS

A. Rigid Galvanized Steel and Intermediate Metal Conduit:

1. General:

a. Meet requirements of UL 514B.

b. Type: Threaded, galvanized. Set screw and threadless compression fittings not permitted.

2. Bushing:

a. Material: Malleable iron with integral insulated throat, rated for 150 degrees C.

b. Manufacturers and Products:

1) Appleton; Series BU-I.

2) O-Z/Gedney; Type HB.

3) Approved equal.

3. Grounding Bushing:

   a. Material: Malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs.

   b. Manufacturers and Products:

      1) Appleton; Series GIB.

      2) O-Z/Gedney; Type HBLG.

      3) Approved equal.

4. Conduit Hub:

   a. Material: Malleable iron with insulated throat with bonding screw.

   b. UL listed for use in wet locations.

   c. Manufacturers and Products:

      1) Appleton, Series HUB-B.

      2) O-Z/Gedney; Series CH.

      3) Meyers; ST Series.

      4) Approved equal.

5. Couplings: As supplied by conduit manufacturer.

6. Unions:

   a. Concrete tight, hot-dip galvanized malleable iron.

   b. Manufacturers and Products:

      1) Appleton; Series SCC bolt-on coupling or Series EC three-piece union.

      2) O-Z/Gedney; Type SSP split coupling or Type 4 Series, three-piece coupling.

      3) Approved equal.

7. Conduit Sealing Fitting:

   a. Manufacturers and Products:

      1) Appleton; Type EYF, EYM, or ESU.

      2) Crouse-Hinds; Type EYS or EZS.

3) Killark; Type EY or Type EYS.

4) Approved equal.

8. Drain Seal:

a. Manufacturers and Products:

1) Appleton; Type EYD.

2) Crouse-Hinds; Type EYD or Type EZD.

3) Approved equal.

9. Drain/Breather Fitting:

a. Manufacturers and Products:

1) Appleton; Type ECDB.

2) Crouse-Hinds; ECD.

3) Approved equal.

10. Expansion Fitting:

a. Manufacturers and Products:

1) Deflection/Expansion Movement:

a) Appleton; Type DF.

b) Crouse-Hinds; Type XD.

c) Approved equal.

2) Expansion Movement Only:

a) Appleton; Type XJ.

b) Crouse-Hinds; Type XJ.

c) Thomas & Betts; XJG-TP.

d) Approved equal.

11. Cable Sealing Fitting:

a. To form watertight nonslip cord or cable connection to conduit.

b. For Conductors with OD of 1/2 inch or less: Neoprene bushing at connector entry.

c. Manufacturers and Products:

1) Appleton; CG-S.

2) Crouse-Hinds; CGBS.

3) Approved equal.

B. PVC Conduit:

1. Meet requirements of NEMA TC 3.

2. Type: PVC, slip-on.

C. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of UL 514B.

2. Fittings: Rigid galvanized steel type, PVC coated by conduit manufacturer.

3. Conduit Bodies: Form 8, Cast metal hot-dipped galvanized or urethane finish. Cover shall be screw type only and of same material as conduit body. PVC coated by conduit manufacturer.

4. Finish: 40-mil PVC exterior, 2-mil urethane interior.

5. Overlapping pressure-sealing sleeves.

6. Conduit Hangers, Attachments, and Accessories: PVC-coated.

7. Manufacturers:

a. Robroy Industries

b. Ocal

c. Plasti-Bond

d. Approved equal.

8. Expansion Fitting:

a. Manufacturer and Product: Ocal; OCAL-BLUE XJG.

b. Approved equal.

D. Flexible Metal, Liquid-Tight Conduit:

1. Metal insulated throat connectors with integral nylon or plastic seal rings rated for 105 degrees C.

2. Manufacturers and Products:

a. Thomas & Betts; Series 5333.

b. O-Z/Gedney; Series 4Q.

c. Approved equal.

E. Flexible, Nonmetallic, Liquid-Tight Conduit:

1. Meet requirements of UL 514B.

2. Type: High strength plastic body, complete with lock nut, O-ring, threaded ferrule, sealing ring, and compression nut.

3. Body/compression nut (gland) design to ensure high mechanical pullout strength and watertight seal.

4. Manufacturers and Products:

a. Carlon; Type LT.

b. O-Z/Gedney; Type 4Q-P.

c. Thomas & Betts; Series 6300.

d. Approved equal.

F. Flexible Coupling, Hazardous Locations:

1. Approved for use in atmosphere involved.

2. Rating: Watertight and UL listed for use in Class I, Division 1 and 2 areas.

3. Outer bronze braid and an insulating liner.

4. Conductivity equal to a similar length of rigid metal conduit.

5. Manufacturers and Products:

a. Crouse-Hinds; Type ECGJH or Type ECLK.

b. Appleton; EXGJH or EXLK.

c. Approved equal.

G. Watertight Entrance Seal Device:

1. New Construction:

a. Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.

b. Manufacturer and Product: O-Z/Gedney; Type FSK or Type WSK or approved equal, as required.

2. Cored-Hole Application:

a. Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.

b. Manufacturer and Product: O-Z/Gedney; Series CSM or approved equal.

2.6 OUTLET AND DEVICE BOXES

A. Sheet Steel: One-piece drawn type, zinc-plated or cadmium-plated.

B. Cast Metal:

1. Box: Malleable iron.

2. Cover: Gasketed, weatherproof, malleable iron, or cast ferrous metal, with stainless steel screws.

3. Hubs: Threaded.

4. Lugs: Cast Mounting.

5. Manufacturers and Products, Nonhazardous Locations:

a. Crouse-Hinds; Type FS or Type FD.

b. Appleton; Type FS or Type FD.

c. Killark.

d. Approved equal.

6. Manufacturers and Products, Hazardous Locations:

a. Crouse-Hinds; Type GUA or Type EAJ.

b. Appleton; Type GR.

c. Killark.

d. Approved equal.

C. PVC-Coated Cast Metal:

1. Type: One-piece.

2. Material: Malleable iron, cast ferrous metal, or cast aluminum.

3. Coating:

a. Exterior Surfaces: 40-mil PVC.

b. Interior Surfaces: 2-mil urethane.

4. Manufacturers:

a. Robroy Industries.

b. Ocal.

c. Approved equal.

D. Nonmetallic:

1. Box: PVC.

2. Cover: PVC, weatherproof, with stainless steel screws.

3. Manufacturer and Product: Carlon; Type FS or Type FD, with Type E98 or Type E96 covers, or approved equal.

2.7 JUNCTION AND PULL BOXES

A. Outlet Box Used as Junction or Pull Box: As specified under Article Outlet and Device Boxes.

B. Conduit Bodies Used as Junction Boxes: As specified under Article Fittings.

C. Large Sheet Steel Box:

1. NEMA 250, Type 1.

2. Box: Code-gauge, galvanized steel.

3. Cover: Hinged with ¼ turn fasteners.

D. Large Cast Metal Box:

1. NEMA 250, Type 4.

2. Box: Cast malleable iron or electrogalvanized finished, with drilled and tapped conduit entrances and exterior mounting lugs.

3. Gasket: Neoprene.

4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.

5. Manufacturer and Products, Surface Mounted, Hinged Type:

a. Cover: Hinged with bolt/wing nut fasteners.

b. O-Z/Gedney; Series YW

c. Approved equal.

6. Manufacturers and Products, Recessed Type:

a. Crouse-Hinds; Type WJBF.

b. O-Z/Gedney; Series YR.

c. Approved equal.

E. Large Cast Metal Box, Hazardous Locations:

1. NEMA 250 Type 7 or Type 9 as required for Class, Division, and Group involved.

2. Box: Cast ferrous metal, electro-galvanized finished or copper-free aluminum with drilled and tapped conduit entrances.

3. Cover: As required by space classification.

4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.

5. Manufacturers and Products:

a. Crouse-Hinds; Type EJB.

b. O-Z/Gedney; Series AJBEW.

c. Approved equal.

F. Large Stainless-Steel Box:

1. NEMA 250 Type: 4X

2. Box: 14-gauge, ASTM A240/A240M, Type: 316 stainless steel, with white enamel painted interior mounting panel.

3. Cover: Hinged with ¼ turn fasteners.

4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.

5. Manufacturers:

a. Hoffman Engineering Co.

b. Robroy Industries.

c. Wiegman.

d. Approved equal.

G. Large Steel Box:

1. NEMA 250 Type 3R

2. Box: 14 gauge steel, with white enamel painted interior and gray primed exterior, over phosphated surfaces. Provide gray finish as approved by Engineer.

3. Cover: Hinged with ¼ turn fasteners.

4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.

5. Manufacturers:

   a. Hoffman Engineering Co.

   b. Robroy Industries.

   c. Wiegman.

   d. Approved equal.

H. Large Nonmetallic Box:

1. NEMA 250 Type A: 4X.

2. Box: High-impact, fiberglass-reinforced polyester or engineered thermoplastic with stability to high heat.

3. Cover: Hinged with ¼ turn fasteners.

4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.

5. Conduit hubs and mounting lugs.

6. Manufacturers and Products:

   a. Crouse-Hinds; Type NJB.

   b. Carlon; Series N, C, or H.

   c. Robroy Industries.

   d. Approved equal.

I. Underground Pull Box, Nontraffic Areas:

1. Box: Material type HDPE, with extension.

2. Cover: HDPE with locking bolts.

3. Cover Marking: ELECTRICAL, CONTROL, SIGNAL, TELEPHONE, or as shown.

4. Size: 10 inches by 17 inches, minimum.

5. Manufacturers and Products:

a. Oldcastle/Carson Industries; L Series 1220-12

b. Hubble-Quarzite; 1220-12

c. Approved equal.

J. Concrete Box, Traffic Areas:

1. Box: Reinforced, cast concrete with extension and bottom slab.

2. Cover: Steel checked plate; H/20 loading. Traffic-rated boxes to have hinged lid to allow access.

3. Cover Marking: ELECTRICAL, CONTROL, SIGNAL, TELEPHONE, or as shown.

4. Manufacturers and Products:

a. Oldcastle Precast; Model 3030-LA (3030-SB with No. 3030-P Cover).

b. Christy, Concrete Products, Inc.; B1017.

c. Approved equal.

K. Provide conduit entrance boxes for large motors connections when parallel conduits are required for proper motor assembly, reference specification 40 05 93 – Common Motor Requirements for Process Equipment.

2.8 TERMINAL JUNCTION BOX

A. Cover: Hinged with ¼ turn fasteners, unless otherwise shown.

B. Interior Finish: Paint with white enamel or lacquer.

C. Terminal Blocks:

1. Separate connection point for each conductor entering or leaving box.

2. Spare Terminal Points: 25 percent, minimum.

2.9 WIREWAYS

A. General: Electrical wireways shall be of types, sizes, and number of channels as indicated. Fittings and accessories including but not limited to couplings, offsets, elbows, expansion joints, adapters, hold-down straps, and end caps shall match and mate with wireway as required for complete system.

B. Where features are not indicated, select to fulfill wiring requirements and comply with applicable provisions of NEC.

C. METAL WIREWAYS

1. Meet requirements of UL 870.

2. Type: Steel-enclosed, lay-in type.

3. Cover: Removable, screw type.

4. Rating: Outdoor raintight.

5. Finish: Rust inhibiting phosphatizing primer and gray baked enamel.

6. Hardware: Plated to prevent corrosion; screws installed toward the inside protected by spring nuts or otherwise guarded to prevent wire insulation damage.

7. Knockouts: Without knockouts, unless otherwise indicated.

8. Manufacturers:

a. Circle AW.

b. Hoffman.

c. Square D.

d. Approved equal.

D. NONMETALLIC WIREWAY

1. Rating: Outdoor, corrosion resistant, raintight, NEMA Type 12 and Type 3R.

2. Type: Fiberglass-enclosed, with removable cover.

3. Captivated, corrosion-resistant cover screws.

4. Oil-resistant gaskets.

5. Meet UL cold impact test to minus 35 degrees C.

6. Manufacturer: Hoffman or approved equal.

2.10 PRECAST HANDHOLES

A. Concrete Strength: Minimum, 3,000 psi compressive, in 28 days.

B. Loading: AASHTO, H-20 in accordance with ASTM C857.

C. Drainage:

1. Slope floors toward drain points, leaving no pockets or other nondraining areas.

2. Provide drainage outlet or sump at low point of floor constructed with a heavy, cast iron, slotted or perforated hinged cover, and a minimum 4-inch outlet and outlet pipe.

D. Raceway Entrances:

1. Provide on all four sides.

2. Provide knockout panels or precast individual raceway openings.

3. At entrances where raceways are to be installed by others, provide minimum 12-inch-high by 24-inch-wide knockout panels for future raceway installation.

E. Embedded Pulling Iron:

1. Material: 3/4-inch-diameter stock, fastened to overall steel reinforcement before concrete is placed.

2. Location:

a. Wall: Opposite each raceway entrance and knockout panel for future raceway entrance.

b. Floor: Centered below manhole or handhole cover.

F. Cable Racks:

1. Arms and Insulators: Adjustable, of sufficient number to accommodate cables for each raceway entering or leaving manhole, including spares.

2. Wall Attachment:

a. Adjustable inserts in concrete walls. Bolts or embedded studs not permitted.

b. Insert Spacing: Maximum 3 feet on center for inside perimeter of manhole.

c. Arrange in order that spare raceway ends are clear for future cable installation.

G. Handhole Frames and Covers:

1. Material: Steel, hot-dipped galvanized.

2. Cover Type: Solid, bolt-on, torsion spring, of diamond design. Large vaults to have hinged lids.

3. Cover Loading: AASHTO H-20.

4. Cover Designation: Burn by welder, on upper side in integral letters, minimum 2 inches in height, appropriate titles:

a. 600 Volts and Below: ELECTRIC LV, CONTROL, SIGNAL, TELEPHONE.

H. Hardware: Steel, hot-dip galvanized.

I. Furnish knockout for ground rod in each handhole.

J. Manufacturers:

1. Oldcastle Infrastructure

2. Utility Concrete Products

3. Penn-Cast Products, Inc.

4. Jensen Precast

5. Columbia Precast Products

6. Approved equal.

2.11 ACCESSORIES

A. Identification Devices:

1. Raceway Tags:

a. Material: Phenolic.

b. Shape: Rectangular.

c. Raceway Designation: Tag name engraved.

d. Tags relying on adhesives or taped-on markers not permitted.

2. Warning Tape:

a. Material: Polyethylene, 4-mil gauge with detectable strip.

b. Color: Red.

c. Width: Minimum 3 inches.

d. Designation: Warning on tape that electric circuit is located below tape.

e. Identifying Letters: Minimum 1-inch-high permanent black lettering imprinted continuously over entire length.

f. Manufacturers and Products:

1) Panduit; Type HTDU.

2) Reef Industries; Terra Tape.

3) Approved equal.

B. Heat Shrinkable Tubing:

1. Material: Heat-shrinkable, cross-linked polyolefin.

2. Semi-flexible with meltable adhesive inner liner.

3. Color: Black.

4. Manufacturers:

a. Raychem.

b. 3M.

c. Approved equal.

C. Wraparound Duct Band:

1. Material: Heat-shrinkable, cross-linked polyolefin, precoated with hot-melt adhesive.

2. Width: 50 mm minimum.

3. Manufacturer and Product: Raychem; Type TWDB or approved equal.

PART 3 - EXECUTION

3.1 WIRING METHOD

A. Outdoors: Use the following wiring methods:

1. Exposed: PVC coated rigid metal conduit, elbows to be PVC coated RMC.

2. Concealed: Rigid metal conduit, elbows to be PVC coated RMC.

3. Underground: Rigid nonmetallic conduit (sched 80), elbows to be PVC coated RMC.

4. Indoors or Outdoors: Connection to vibrating equipment including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment in moist or humid location or corrosive atmosphere, or where subject to water spray or dripping oil, grease, or water: liquid tight flexible metal conduit.

B. Indoors: Use the following wiring methods:

1. Connection to Vibrating Equipment: Including transformers and hydraulic, pneumatic or electric solenoid or motor-operated equipment: flexible metal conduit.

2. Exposed: Electrical metallic tubing, rigid metal conduit.

3. Concealed: Electrical metallic tubing. AC/MC cable NOT ALLOWED.

4. Underslab: Sch 80 PVC. elbows to be PVC coated RMC.

C. Hazardous Locations

1. As required by the NEC

3.2 INSTALLATION

A. General: Install electrical raceways in accordance with requirements of NEC, and as follows:

B. Conceal Conduit and EMT, unless indicated otherwise, within finished walls, ceilings, and floors. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install raceways level and square and at proper elevations.

C. Elevation of Raceway: Where possible, install horizontal raceway runs above water and steam piping.

D. Complete installation of electrical raceways before starting installation of conductors within raceways.

E. Provide supports for raceways as specified in Specification Section 26 05 00 – Electrical, General.

F. Prevent foreign matter from entering raceways by using temporary closure protection.

G. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

H. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.

I. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location. For rigid metal conduit and intermediate steel conduit, use threaded rigid steel conduit fittings except as otherwise indicated. EMT set screw connectors and couplers are to be steel.

J. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated. This does not apply to conduits in crawl spaces.

K. Raceways embedded in slabs: Not allowed without engineering approval.

L. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical.

M. Run exposed, parallel, or banked raceways together.

N. Join raceways with fittings designed and approved for the purpose and make joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors.

O. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside the box.

P. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

Q. Install pull wires in empty raceways. Use monofilament plastic line having not less than 200 lb tensile strength. Leave not less than 12 inches of slack at each end of the pull wire.

R. Communication and Signal System Raceways 2 Inch Trade Size and Smaller: In addition to the above requirements, install raceways 2 inch and smaller trade size in maximum lengths at 150 feet and with a maximum of two, 90 deg bends or equivalent. Install pull or junction boxes where necessary to comply with these requirements.

S. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this contract, install screwdriver operated threaded flush plugs flush with floor.

T. Flexible Connections: Use short length (maximum of 6 ft.) of flexible conduit for recessed and semi-recessed lighting fixtures, for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid tight flexible conduit in wet locations. Install separate ground conductor across flexible connections.

U. Surface Metal Raceway: Install a separate green ground conductor in raceway from the junction box supplying the raceway to receptacle or fixture ground terminals.

V. Raceway Installed Above Accessible Ceilings: Raceway located above accessible ceilings shall be a minimum of 24 inches above finished ceiling or mounted direct to structure, whichever is less.

3.3 FLEXIBLE CONNECTIONS

A. For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other locations approved by Engineer where flexible connection is required to minimize vibration:

1. Conduit Size 4 Inches or Less: Flexible, liquid-tight.

2. Conduit Size Over 4 Inches: Nonflexible.

3. Wet or Corrosive Areas: Flexible, liquid-tight.

4. Dry Areas: Nonmetallic, if installed on conduits not derived from under slabs; otherwise, flexible, metallic liquid-tight to allow bonding of raceway extending through concrete.

5. Hazardous Areas:

a. Flexible coupling suitable for Class I, Division 1 areas

b. Liquid-tight flexible metal conduit suitable for Class 1, Division 2 areas.

B. Suspended Lighting Fixtures in Dry Areas: Non-metallic, liquid-tight conduit.

C. Outdoor Areas, Process Areas Exposed to Moisture, and Areas Required to be Oiltight and Dust-Tight: Flexible metal, liquid-tight conduit.

D. Flexible Conduit Length: 18 inches minimum, 36 inches maximum; sufficient to allow movement or adjustment of equipment.

3.4 PENETRATIONS

A. Make at right angles, unless otherwise shown.

B. Notching or penetration of structural members, including footings and beams, not permitted.

C. Fire-Rated Walls, Floors, or Ceilings: Firestop openings around penetrations to maintain fire-resistance rating as specified in Section 26 05 04 – Basic Electrical Materials and Methods.

D. Apply a single layer of wraparound duct band to metallic conduit protruding through concrete floor slabs to a point 2 inches above and 2 inches below concrete surface.

E. Concrete Walls, Floors, or Ceilings (Aboveground): Provide non-shrink grout dry-pack or use watertight seal device.

F. Entering Structures:

1. General: In hazardous locations, seal raceway at first box or outlet with oakum or expandable plastic compound to prevent entrance of gases or liquids from one area to another.

2. Concrete Roof or Membrane Waterproofed Wall or Floor:

    a. Provide a watertight seal.

    b. Without Concrete Encasement: Install watertight entrance seal device on each side.

    c. With Concrete Encasement: Install watertight entrance seal device on accessible side.

    d. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.

    e. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.

3. Heating, Ventilating, and Air Conditioning Equipment:

    a. Penetrate equipment in area established by manufacturer.

    b. Terminate conduit with flexible metal conduit at junction box or condulet attached to exterior surface of equipment prior to penetrating equipment.

    c. Seal penetration with sealant.

4. Corrosive-Sensitive Areas:

    a. Seal conduit passing through room walls.

    b. Seal conduit entering equipment panel boards and field panels containing electronic equipment.

    c. Seal penetration with sealant.

5. Existing or Precast Wall (Underground): Core drill wall and install watertight entrance seal device.

6. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement):

    a. Provide Sch 40 galvanized pipe sleeve, or watertight entrance seal device.

    b. Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint, on each side.

7. Handholes:

    a. Metallic Raceways: Provide insulated grounding bushings.

    b. Nonmetallic Raceways: Provide bell ends flush with wall.

    c. Install such that raceways enter as near as possible to one end of wall, unless otherwise shown.

3.5 BENDS

A. Install concealed raceways with a minimum of bends in the shortest practical distance.

B. Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall be not less than 20 times cable diameter, 15 inches minimum.

C. Install with symmetrical bends or cast metal fittings.

D. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.

E. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.

F. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.

G. PVC Conduit:

1. Bends 30 Degrees and Larger: Provide factory-made elbows.

2. 90 Degree Bends: Provide rigid steel elbows, PVC-coated where direct buried.

3. Use manufacturer’s recommended method for forming smaller bends.

H. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

3.6 EXPANSION/DEFLECTION FITTINGS

A. Provide on raceways at structural expansion joints and in long tangential runs.

B. Provide expansion/deflection joints for 25 degrees F maximum temperature variation.

C. Install in accordance with manufacturer’s instructions.

3.7 PVC CONDUIT

A. Solvent Welding:

1. Apply manufacturer recommended solvent to joints.

2. Install in order that joint is watertight.

B. Adapters:

1. PVC to Metallic Fittings: PVC female adapter.

2. PVC to Rigid Metal Conduit or IMC: PVC female adapter.

C. Belled-End Conduit: Bevel un-belled end of joint prior to joining.

3.8 PVC-COATED RIGID STEEL CONDUIT

A. Install in accordance with manufacturer's instructions.

B. Tools and equipment used in cutting, bending, threading and installation of PVC-coated rigid conduit shall be designed to limit damage to PVC coating.

C. Provide PVC boot to cover exposed threading.

3.9 WIREWAYS

A. Install in accordance with manufacturer's instructions.

B. Locate with cover on accessible vertical face of wireway, unless otherwise shown.

C. Applications:

1. Metal wireway in indoor dry locations.

2. Nonmetallic wireway in indoor process/wet, outdoor, and corrosive locations.

3.10 TERMINATION AT ENCLOSURES

A. Cast Metal Enclosure: Install manufacturer's pre-molded insulating sleeve inside metallic conduit terminating in threaded hubs.

B. Nonmetallic, Cabinets, and Enclosures:

1. Terminate conduit in threaded conduit hubs, maintaining enclosure integrity.

2. Metallic Conduit: Provide ground terminal for connection to maintain continuity of ground system.

C. Sheet Metal Boxes, Cabinets, and Enclosures:

1. General:

a. Install insulated bushing on ends of conduit where grounding is not required.

b. Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.

c. Utilize threaded hubs on sides and bottom of NEMA 3R and NEMA 12 enclosures.

d. Terminate conduits at threaded hubs at the tops of NEMA 3R and NEMA 12 boxes and enclosures.

e. Terminate conduits at threaded conduit hubs at NEMA 4 and NEMA 4X boxes and enclosures.

2. Rigid Galvanized Steel and Intermediate Metal Conduit:

a. Provide threaded hubs for each enclosure.

b. Install grounding bushing at source enclosure.

c. Provide bonding jumper from grounding bushing to equipment ground bus or ground pad.

3. Flexible Metal Conduit: Provide liquid tight metallic fittings with insulated throats and rain tight bushings.

4. Flexible, Nonmetallic Conduit: Provide nonmetallic, liquid-tight strain relief connectors.

5. PVC-Coated Rigid Galvanized Steel Conduit: Provide PVC-coated, liquid-tight, metallic connector.

6. PVC Sch 40 Conduit: Provide PVC terminal adapter with lock nut, except where threaded hubs required above.

D. Motor Control Center, Switchgear, and Free-Standing Enclosures:

1. Terminate metal conduit entering bottom with grounding bushing; provide grounding jumper extending to equipment ground bus or grounding pad.

2. Terminate PVC conduit entering bottom with bell end fittings.

3.11 UNDERGROUND RACEWAYS

A. Grade: Maintain minimum grade of 4 inches in 100 feet, either from one manhole, hand-hole, or pull box to the next, or from a high point between them, depending on surface contour.

B. Cover: Maintain minimum 2-foot cover above conduit and concrete encasement, unless otherwise shown.

C. Make routing changes as necessary to avoid obstructions or conflicts.

D. Couplings: In multiple conduit runs, stagger so couplings in adjacent runs are not in same transverse line.

E. Union type fittings not permitted.

F. Spacers:

1. Provide preformed, nonmetallic spacers designed for such purpose, to secure and separate parallel conduit runs in a trench or concrete encasement.

2. Install at intervals not greater than that specified in NFPA 70 for support of the type conduit used, but in no case greater than 10 feet.

G. Support conduit so as to prevent bending or displacement during backfilling or concrete placement.

H. Transition from Underground to Exposed: PVC-coated rigid steel conduit per Section 3.3.

I. Installation with Other Piping Systems:

1. Crossings: Maintain minimum 12-inch vertical separation.

2. Parallel Runs: Maintain minimum 12-inch separation.

3. Installation over valves or couplings not permitted.

J. Provide expansion fittings that allow minimum of 4 inches of movement in vertical conduit runs from underground where exposed conduit will be fastened to or will enter building or structure.

K. Provide expansion/deflection fittings in conduit runs that exit building or structure below grade. Conduit from building wall to fitting shall be PVC-coated rigid steel.

L. Concrete Encasement:

1. Service entrance raceways shall be concrete encased, if noted on drawings.

2. High voltage raceway containing wire or cable with an operating voltage of over 600V shall be concrete encased.

3. Concrete Color: Red.

M. Backfill:

1. Backfill material shall be free of rocks and debris and allow for adequate draining of water away from conduit.

2. Controlled low strength fill is an acceptable bedding and pipe zone material. Backfill material to within 12 inches of surface.

3. Backfill shall be tamped and compacted to avoid settling.

4. Do not backfill until inspected by Engineer.

3.12 UNDER SLAB RACEWAYS

A. Make routing changes as necessary to avoid obstructions or conflicts.

B. Support raceways so as to prevent bending or displacement during backfilling or concrete placement.

C. Install raceways with no part embedded within slab and with no interference with slab on grade construction.

D. Raceway spacing, in a single layer or multiple layers:

1. 3 inches clear between adjacent 2-inch or larger raceway.

2. 2 inches clear between adjacent 1-1/2-inch or smaller raceway.

E. Multiple Layers of Raceways: Install under slab on grade in trench below backfill zone, as specified in ISPWC specifications.

F. Individual Raceways and Single Layer Multiple Raceways: Install at lowest elevation of backfill zone with spacing as specified herein. Where conduits cross at perpendicular orientation, installation of conduits shall not interfere with placement of under slab fill that meets compaction and void limitations of earthwork specifications.

G. Under slab raceways that emerge from below slab to top of slab as exposed, shall be located to avoid conflicts with structural slab rebar. Coordinate raceway stub ups with location of structural rebar.

H. Fittings:

1. Union type fittings are not permitted.

2. Provide expansion/deflection fittings in raceway runs that exit building or structure below slab. Locate fittings 18 inches, maximum, beyond exterior wall. Raceway type between building exterior wall to fitting shall be PVC-coated rigid steel. All expansion/deflection fittings shall be inspected and approved by Engineer prior to backfill. Reference detial E17 and E18.

3. Couplings: In multiple raceway runs, stagger so couplings in adjacent runs are not in same traverse line.

3.13 OUTLET AND DEVICE BOXES

A. General:

1. Install plumb and level.

2. Install suitable for conditions encountered at each outlet or device in wiring or raceway system, sized to meet NFPA 70 requirements.

3. Open no more knockouts in sheet steel device boxes than are required; seal unused openings.

4. Install galvanized mounting hardware in industrial areas.

B. Size:

1. Depth: Minimum 2 inches, unless otherwise required by structural conditions. Box extensions not permitted.

2. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.

3. Ceiling Outlet: Minimum 4inch device box, unless otherwise required for installed fixture.

4. Switch and Receptacle: Minimum 2-inch by 4-inch device box.

C. Locations:

1. Drawing locations are approximate.

2. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by Engineer.

3. Light Fixture: Install in symmetrical pattern according to room layout, unless otherwise shown.

D. Mounting Height:

1. General:

a. Dimensions given to centerline of box.

b. Where specified heights do not suit building construction or finish, adjust up or down to avoid interference.

c. Do not straddle CMU block or other construction joints.

2. Light Switch:

a. 48 inches above floor.

b. When located next to door, install on lock side of door.

3. Thermostat: 54 inches above floor.

4. Telephone Outlet:

a. 15 inches above floor.

b. 6 inches above counter tops.

c. Wall Mounted: 52 inches above floor.

5. Convenience Receptacle:

a. General Interior Areas: 18 inches above floor.

b. General Interior Areas (Counter Tops): Install device plate bottom or side 2” above backsplash, or 6 inches above counter tops without backsplash.

c. Industrial Areas, Workshops: 48 inches above floor.

d. Outdoor Areas: 24 inches above finished grade.

6. Special-Purpose Receptacle: 48 inches above floor or as shown.

7. Switch, Motor Starting: 48 inches above floor, unless otherwise indicated on Drawings.

E. Flush Mounted:

1. Install with concealed conduit.

2. Install proper type extension rings or plaster covers to make edges of boxes flush with finished surface.

3. Holes in surrounding surface shall be no larger than required to receive box.

F. Supports:

1. Support boxes independently of conduit by attachment to building structure or structural member.

2. Install bar hangers in frame construction or fasten boxes directly as follows:

a. Wood: Wood screws.

b. Concrete or Brick: Bolts and expansion shields.

c. Hollow Masonry Units: Toggle bolts.

d. Steelwork: Machine screws.

3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.

4. Provide plaster rings where necessary.

5. Boxes embedded in concrete or masonry need not be additionally supported.

G. Install separate junction boxes for flush or recessed lighting fixtures where required by fixture terminal temperature.

H. Boxes Supporting Fixtures: Provide means of attachment with adequate strength to support fixture.

3.14 JUNCTION AND PULL BOXES

A. General:

1. Install plumb and level.

2. Installed boxes shall be accessible.

3. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.

4. Use Form 8 conduit bodies as junction and pull boxes where no splices are required and allowed by applicable codes.

5. Install pull boxes where necessary in raceway system to facilitate conductor installation.

6. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.

7. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.

B. Flush Mounted:

1. Install with concealed conduit.

2. Holes in surrounding surface shall be no larger than required to receive box.

3. Make edges of boxes flush with final surface.

C. Mounting Hardware:

1. Noncorrosive Dry Areas: Galvanized.

2. Noncorrosive Wet Areas: Stainless steel.

3. Corrosive Areas: Stainless steel.

D. Supports:

1. Support boxes independently of conduit by attachment to building structure or structural member.

2. Install bar hangers in frame construction or fasten boxes directly as follows:

a. Wood: Wood screws.

b. Concrete or Brick: Bolts and expansion shields.

c. Hollow Masonry Units: Toggle bolts.

d. Steelwork: Machine screws.

3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.

4. Boxes embedded in concrete or masonry need not be additionally supported.

E. At or Below Grade:

1. Install boxes for below grade conduit 2” above finished grade in locations outside of paved areas, roadways, or walkways.

2. If adjacent structure is available, box may be mounted on structure surface just above finished grade in accessible but unobtrusive location.

3. Obtain Engineer’s written acceptance prior to installation in paved areas, roadways, or walkways.

4. Use boxes and covers suitable to support anticipated weights.

F. Install drain/breather fittings in NEMA 250 Type 4 and Type 4X enclosures.

3.15 MANHOLES AND HANDHOLES

A. Excavate, shore, brace, backfill, and final grade in accordance with ISPWC specifications.

B. Do not install until final raceway grading has been determined. Final grade shall slope away from electrical boxes.

C. Provide concrete curb around in road boxes. Roadway asphalt, surface treatment, etc. to be graded away from box to prevent excess water intrusion.

D. Install such that raceway enters at nearly right angle and as near as possible to end of wall, unless otherwise shown.

E. Grounding: As specified in Section 26 05 26 – Grounding and Bonding for Electrical Systems.

F. Identification: Field stamp covers with handhole number as shown. Stamped numbers to be 1-inch minimum height.

3.16 EMPTY RACEWAYS

A. Provide permanent, removable cap over each end.

B. Provide PVC plug with pull tab for underground raceways with end bells.

C. Provide nylon pull cord.

D. Identify, as specified in Article Identification Devices, with waterproof tags attached to pull cord at each end, and at intermediate pull point.

3.17 IDENTIFICATION DEVICES

A. Raceway Tags:

1. Identify per Raceway Schedule designation.

2. For exposed raceways, install tags at each terminus, near midpoint, and at minimum intervals of every 50 feet, whether in ceiling space or surface mounted.

3. Install tags at each terminus for concealed raceways.

4. Provide noncorrosive wire for attachment.

B. Warning Tape: Install approximately 12 inches above underground or concrete-encased raceways. Align parallel to, and within 12 inches of, centerline of run.

C. Buried Raceway Marker:

1. Install at grade to indicate direction of underground raceway.

2. Install at bends and at intervals not exceeding 100 feet in straight runs.

3. Embed and secure to top of concrete base, sized 14 inches long, 6 inches wide, and 8 inches deep; top set flush with finished grade.

3.18 PROTECTION OF INSTALLED WORK

A. Protect products from effects of moisture, corrosion, and physical damage during construction.

B. Provide and maintain manufactured watertight and dust-tight seals over conduit openings during construction.

C. Touch up painted conduit threads after assembly to cover nicks or scars.

D. Touch up coating damage to PVC-coated conduit with patching compound approved by manufacturer. Compound shall be kept refrigerated according to manufacturers' instructions until time of use.

3.19 ADJUSTING AND CLEANING

A. Upon completion of installation of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt, and construction debris.

END OF SECTION 26 05 33

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SECTION 26 05 33.16 – CABINETS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes cabinets, boxes, and fittings for electrical installations and certain types of electrical fittings not covered in other sections. Types of products specified in this Section include:

1. Cabinets.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers complying with the Quality Assurance requirements are acceptable.

1. Data communication cabinets

a. Hoffman EWMW482425 or comparable

b. Panduit

2. Patch panels

a. Match existing

b. Corning

3. Uninterruptable Power Supplies (UPS)

4. Network Switch RE: 27 21 29

a. Match existing

b. Rockwell Stratix 5700 PN 1783-BMS20CA or comparable

2.2 CABINETS, BOXES, AND FITTINGS, GENERAL

A. Electrical Cabinets, Boxes, and Fittings: Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers and accessories required for the intended use. Provide gaskets for units in damp or wet locations.

2.3 MATERIALS AND FINISHES

A. Sheet Steel: Flat-rolled, code-gage, galvanized steel.

B. Fasteners for General Use: Corrosion resistant screws and hardware including cadmium and zinc plated items.

C. Fasteners for Damp or Wet Locations: Stainless steel screws and hardware.

D. Exterior Finish: Gray baked enamel for items exposed in finished locations except as otherwise indicated.

E. Painted Interior Finish: Where indicated, white baked enamel.

F. Fittings for Boxes, Cabinets, and Enclosures: Conform to UL 514B. Zinc plated steel for conduit hubs, bushings, box connectors and couplers. Set screw type. Use insulated throat connectors.

2.4 CABINETS

A. Comply with UL 50, "Electrical Cabinets and Boxes."

B. Construction: Sheet steel, NEMA 12 class except as otherwise indicated. Cabinet shall consist of a box and a front consisting of a one piece frame and a hinged door. Arrange door to close against a rabbet placed all around the inside edge of the frame, with a uniformly close fit between door and frame. Provide concealed fasteners, not over 24 inches apart, to hold fronts to cabinet boxes and provide for adjustment. Provide flush or concealed door hinges not over 24 inches apart and not over 6 inches from top and bottom of door. For flush cabinets, make the front approximately 3/4-inch larger than the box all around. For surface mounted cabinets make front same height and width as box.

C. Doors: Double doors for cabinets wider than 24 inches. Telephone cabinets wider than 48-inches may have sliding or removable doors.

D. Locks: Combination spring catch and key lock, with all locks for cabinets of the same system keyed alike. Locks may be omitted on signal, power, and lighting cabinets located within wire closets and mechanical/electrical rooms. Locks shall be of a type to permit doors to latch closed without locking.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locations: Install items where indicated and where required to suit code requirements and installation conditions.

B. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.

C. Support and fasten items securely in accordance with Section 26 05 29 – Support Devices.

D. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.

E. Remove sharp edges where they may come in contact with wiring or personnel.

3.2 INSTALLATION OF CABINETS AND HINGED DOOR ENCLOSURES

A. Mount with fronts straight and plumb.

B. Install with tops 78 inches above floor.

C. Set cabinets in finished spaces flush with walls.

3.3 GROUNDING

A. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes a grounding conductor, provide a grounding terminal in the interior of the cabinet, box or enclosure.

3.4 CLEANING AND FINISH REPAIR

A. Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, abrasions and weld marks.

B. Galvanized Finish: Repair damage using a zinc-rich paint recommended by the tray manufacturer.

C. Painted Finish: Repair damage using matching corrosion inhibiting touch-up coating.

END OF SECTION 26 05 33.16

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SECTION 26 05 73 – POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 SCOPE

A. Section includes:

1. Short circuit fault analysis study.

2. Protective device coordination study.

3. Arc-flash hazard study.

B. The Contractor shall furnish short-circuit and protective device coordination studies which shall be prepared by a Registered Professional Engineer. The analysis shall be performed and submitted in two phases for initial and final studies.

C. The Contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.5 and Informative Annex D.

D. It is the Contractor's responsibility for scheduling and coordinating the work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of the Contractor's Work.

E. The Contractor shall coordinate with the Owner to schedule and attend Electrical System Study meetings as defined in Part 3.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems (Red Book).

2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).

3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis (Brown Book).

4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings (Gray Book).

5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems (Blue Book).

6. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures

3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories

5. ANSI C37.5 – Methods for Determining the RMS Value of a Sinusoidal Current Wave and Normal-Frequency Recovery Voltage, and for Simplified Calculation of Fault Currents

C. The National Fire Protection Association (NFPA)

1. NFPA 70 - National Electrical Code, latest edition

2. NFPA 70E – Standard for Electrical Safety in the Workplace

1.3 SUBMITTALS FOR REVIEW/APPROVAL

A. Furnish submittals as specified in Section 01 33 00 – Submittal Procedures and 26 05 00 – Electrical, General.

B. The initial short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.4 SUBMITTALS FOR CONSTRUCTION

A. The final results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. No more than five (5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Additional copies, where required, shall be provided on CD in PDF format.

B. The report shall include the following sections:

1. One-line diagram showing protective device ampere ratings and associated designations, cable size & lengths, transformer kVA & voltage ratings, motor & generator kVA ratings, and switchgear/switchboard/panelboard designations

2. Descriptions, purpose, basis and scope of the study

3. Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings

4. Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings

5. Multi-function relay setting file printouts including all ANSI protective relay functions and associated logic and control. Metering, communication, and control logic settings not associated with ANSI protective functions are not required.

6. Fault study input data, case descriptions, and current calculations including a definition of terms and guide for interpretation of the computer printout

7. Incident energy and flash protection boundary calculations

8. Comments and recommendations for system improvements, where needed

9. Executive Summary including source of information and assumptions made

1.5 QUALIFICATIONS

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies. The Registered Professional Electrical Engineer shall be a full-time employee of the Engineering Services Organization.

PART 2 - PRODUCT

2.1 STUDIES

A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer. By using the equipment manufacturer the study allows coordination of proper breakers, fuses, and current transformers. The coordination study shall begin with the utility company's feeder protective device and include all of the electrical protective devices down to and include the largest feeder circuit breaker and motor starter in the 480 Volt motor control centers and power distribution panelboards. The study shall also include variable frequency drives, harmonic filters, power factor correction equipment, transformers and protective devices associated with variable frequency drives, emergency and standby generators associated paralleling equipment and distribution switchgear.

B. The Contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.5 and Informative Annex D.

C. The short-circuit fault analysis shall be performed and submitted in 2 phases:

1. Initial short-circuit fault analysis:

    a. Based on the Contract Documents and Electric Utility information.

    b. The initial short-circuit fault analysis report shall indicate the estimated available short-circuit current at the line side terminals of each piece of equipment covered by the scope of the study.

    c. Provide a list of assumptions used in the initial study.

2. Final short-circuit analysis:

    a. The final short-circuit fault analysis shall modify the initial analysis as follows:

        1) Utilize the actual equipment provided on the project.

        2) Utilize conductor lengths based on installation.

2.2 DATA COLLECTION

A. Contractor shall furnish all field data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to eliminate unnecessary delays and assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Source combination may include present and future utility supplies, motors, and generators.

C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner or Contractor.

D. Include fault contribution of existing motors in the study, with motors < 50 hp grouped together. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.3 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standards 141, latest edition.

B. Transformer design impedances and standard X/R ratios shall be used when test values are not available.

C. Provide the following:

1. Calculation methods and assumptions

2. Selected base per unit quantities

3. One-line diagram of the system being evaluated with available fault at each bus, and interrupting rating of devices noted

4. Source impedance data, including electric utility system and motor fault contribution characteristics

5. Typical calculations

6. Tabulations of calculated quantities

7. Results, conclusions, and recommendations

D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:

1. Electric utility's supply termination point

2. Incoming switchgear

3. Low voltage switchgear

4. Motor control centers

5. Standby generators and automatic transfer switches

6. Branch circuit panelboards

7. Other significant locations throughout the system

E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

F. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short circuit ratings

2. Adequacy of switchgear, motor control centers, and panelboard bus bracing to withstand short-circuit stresses

3. Adequacy of transformer windings to withstand short-circuit stresses

4. Cable and busway sizes for ability to withstand short-circuit heating

5. Notify Owner in writing, of existing, circuit protective devices improperly rated for the calculated available fault current

2.4 PROTECTIVE DEVICE COORDINATION STUDY

A. Proposed protective device coordination time-current curves shall be graphically displayed on log-log scale paper.

B. Include on each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.

D. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the curve sheets, where applicable:

1. Electric utility's protective device

2. Low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands

3. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands

4. Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters

5. Conductor damage curves

6. Ground fault protective devices, as applicable

7. Pertinent motor starting characteristics and motor damage points

8. Pertinent generator short-circuit decrement curve and generator damage point

9. Other system load protective devices for the largest branch circuit and the largest feeder circuit breaker in each motor control center

F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

G. Select each primary protective device required for a delta-wye connected transformer so that the characteristics or operating band is within the transformer parameters which includes a parameter equivalent to 58% of the ANSI withstand point to afford protection for secondary line-to-ground faults.

H. Separate low voltage power circuit breakers from each other and the associated primary protective device by a 16% current margin for coordination and protection in the event of secondary line-to-line faults.

I. Engineer shall provide settings file printouts for all multifunction relays supplied under this contract including all ANSI protective relay functions and associated logic and control. Metering, communication, and control logic settings not associated with ANSI protective functions are not required.

2.5 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2012, Informative Annex D.

B. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal.

C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where Work could be performed on energized parts.

D. The Arc-Flash Hazard Analysis shall include all 480v locations and significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA.

E. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm^2.

F. The Arc Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

G. Arc flash computation shall include both line and load side of main breaker calculations, where necessary.

H. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.

2.6 REPORT SECTIONS

A. Input Data:

1. Utility three-phase and line-to-ground available contribution with associated X/R ratios
2. Short-circuit reactance of rotating machines with associated X/R ratios
3. Cable type, construction, size, # per phase, length, impedance and conduit type
4. Bus duct type, size, length, and impedance
5. Transformer primary & secondary voltages, winding configurations, kVA rating, impedance, and X/R ratio
6. Reactor inductance and continuous ampere rating
7. Aerial line type, construction, conductor spacing, size, # per phase, and length

B. Short-Circuit Data:

1. Source fault impedance and generator contributions
2. X to R ratios
3. Asymmetry factors

4. Motor contributions
5. Short circuit kVA
6. Symmetrical and asymmetrical fault currents

C. Recommended Protective Device Settings:

1. Phase and Ground Relays:
   a. Current transformer ratio.
   b. Current setting.
   c. Time setting.
   d. Instantaneous setting.
   e. Specialty non-overcurrent device settings.
   f. Recommendations on improved relaying systems, if applicable.
2. Circuit Breakers:
   a. Adjustable pickups and time delays (long time, short time, ground).
   b. Adjustable time-current characteristic.
   c. Adjustable instantaneous pickup.
   d. Recommendations on improved trip systems, if applicable.

D. Incident energy and arc flash boundary calculations.

1. Arcing fault magnitude
2. Device clearing time
3. Duration of arc
4. Arc flash boundary
5. Working distance
6. Incident energy
7. Recommendations for arc flash energy reduction

PART 3 - EXECUTION

3.1 ELECTRICAL SYSTEM STUDY MEETINGS

A. The individual conducting the short circuit analysis, protective device coordination, and the arc-flash hazard studies shall meet with the Owner and Engineer 3 times.

B. The purpose of the 3 meetings is as follows:

1. Initial meeting:

    a. Meet with the Owner and Engineer to discuss the scope of the studies.

    b. Discuss the Owner's operational requirements for both normal operation and maintenance.

2. Preliminary results meeting:

    a. This meeting will be held after the studies have been completed, reviewed, and accepted by the Engineer.

    b. The purpose of this meeting is to inform the Owner of the results of the study and impacts on normal operation and maintenance including:

        1) Protective device coordination problems and recommended solutions.

        2) Explanation of the arc-flash study results and its potential impact on operations.

        3) Recommendations for reduction of arc-flash category levels including reduction of protective device settings or changes in operational practices.

3. Final meeting:

    a. Discuss changes to the reports based on the previous meeting.

    b. Discuss with the Owner how changes to the electrical system may change the arc-flash hazard category.

    c. Deliver the final electrical system studies report.

C. The meetings will be at the Owner's facility:

1. Provide a minimum of 3 weeks notice to the Owner and Engineer in advance of the projected meeting date.

2. Submit a draft of the meeting agenda when each meeting is requested.

D. Meeting materials:

1. Prepare and provide the following materials:

    a. Meeting agenda. Include at a minimum the scope of the meeting, estimated time length for the meeting and meeting goals.

    b. 6 copies of the Project one-line diagrams for the initial meeting.

    c. 6 copies of the studies of the submitted study.

E. By virtue of the fact that this is a professional study the Owner reserves the right to modify the requirements of the study to comply with its operational requirements. The protective device coordination study and the arc-flash study shall be modified based on the results of the meetings with the Owner.

3.2 FIELD ADJUSTMENT

A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. Notify Owner in writing of any required major equipment modifications.

D. Following completion of all studies, acceptance testing and startup by the field engineering service division of the equipment manufacturer, a 2-year warranty shall be provided on all components manufactured by the engineering service parent manufacturing company.

3.3 ARC FLASH WARNING LABELS

A. The vendor shall provide a 4 in. x 4 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

B. The label shall have an orange header with the wording, “WARNING, SHOCK & ARC FLASH HAZARD”, and shall include the following information:

1. Location designation
2. Nominal voltage
3. Arc flash boundary
4. Incident energy
5. Working distance
6. Shock Boundaries
7. Engineering report number, revision number and issue date

C. Labels shall be machine printed, with no field markings

D. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

1. For each 480 and applicable 208 volt panelboards and disconnects, one arc flash label shall be provided
2. For each motor control center, one arc flash label shall be provided

3. For each low voltage switchboard, one arc flash label shall be provided

4. For each switchgear, one flash label shall be provided

E. Labels shall be field installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

3.4 ARC FLASH TRAINING

A. The equipment vendor shall train personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70E, Standard For Electrical Safety Requirements For Employee Workplaces, shall be provided in the equipment manuals. The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET).

END OF SECTION 26 05 73

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SECTION 26 08 00 – FIELD ELECTRICAL ACCEPTANCE TESTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Responsibilities for testing the electrical installation.
2. Routine tests during installation.
3. Adjusting and calibration.
4. Acceptance tests.
5. Demonstration of electrical equipment.
6. Commissioning and plant start-up.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
    a. Section 01 33 00 – Submittal Procedures
    b. Section 26 05 00 – Electrical, General
    c. Section 26 05 26 – Grounding and Bonding for Electrical Systems

C. Copyright information:

1. Some portions of this Section are copyrighted by the InterNational Electrical Testing Association, Inc (NETA). See NETA publication ATS for details.

1.2 REFERENCES

A. As specified in Section 26 05 00 – Electrical, General.

B. American National Standards Institute (ANSI).

C. ASTM International (ASTM):

1. D 877 - Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.

2. D 923 - Standard Practices for Sampling Electrical Insulating Liquids.

3. D 971 - Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method.

4. D 1298 - Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.

5. D 1500 - Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale).

6. D 1524 - Standard Test Method for Visual Examination of Used Electrical Insulating Oils of Petroleum Origin in the Field.

7. D 1816 - Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using VDE Electrodes.

8. D 3612 - Standard Test Method for Analysis of Gases Dissolved in Electrical Insulating Oil by Gas Chromatography.

D. Institute of Electrical and Electronics Engineers (IEEE):

1. 43 - IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery.

2. 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

3. 95 - IEEE Recommended Practice for Insulation Testing of AC Electric Machinery (2300 V and Above) With High Direct Voltage.

4. 450 - IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.

5. C57.13 - IEEE Standard Requirements for Instrument Transformers.

6. C57.13.1 - IEEE Guide for Field Testing of Relaying Current Transformers.

7. C57.13.3 - IEEE Guide for Grounding of Instrument Transformer Secondary Circuits and Cases.

8. C57.104 - IEEE Guide for the Interpretation of Gases Generated in Oil-Immersed Transformers.

E. Insulated Cable Engineer’s Association (ICEA).

F. InterNational Electrical Testing Association (NETA).

1. ATS-2009 Standard for Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems.

G. International Electrotechnical Commission (IEC).

H. Manufacturer's testing recommendations and instruction manuals.

I. National Fire Protection Association (NFPA):

1. 70 - National Electrical Code (NEC).

2. 110 - Standard for Emergency and Standby Power Systems.

J. National Institute of Standards and Technology (NIST).

K. Specification sections for the electrical equipment being tested.

L. Shop drawings.

1.3 DEFINITIONS

A. As specified in Section 26 05 00 – Electrical, General.

B. Specific definitions:

1. Testing laboratory: The organization performing acceptance tests.

1.4 SYSTEM DESCRIPTION

A. Testing of all electrical equipment installed under this Contract in accordance with the manufacturer's requirements and as specified in this Section.

B. Conduct all tests in the presence of the Engineer or the Engineer's representative:

1. The Engineer will witness all visual, mechanical, and electrical tests and inspections.

C. The testing and inspections shall verify that the equipment is operational within the tolerances required and expected by the manufacturer, and these Specifications. The results of the tests shall determine the suitability for continued reliable operation.

D. Responsibilities:

1. Contractor responsibilities:

a. Ensure that all resources are made available for testing, and that all testing requirements are met.

2. Electrical subcontractor responsibilities:

a. Perform routine tests during installation.

b. Demonstrate operation of electrical equipment.

c. Commission the electrical installation.

d. Provide the necessary services during testing, and provide these services to the testing laboratory, Contractor, and other subcontractors, including but not limited to:

1) Providing electrical power as required.

2) Operating of electrical equipment in conjunction with testing of other equipment.

3) Activating and shutting down electrical circuits.

4) Making and recording electrical measurements.

5) Replacing blown fuses.

6) Installing temporary jumpers.

3. Testing laboratory responsibilities:

a. Perform all acceptance tests as defined in this Section.

b. Provide all required equipment, materials, labor, and technical support during acceptance tests.

E. Upon completion of testing or calibration, attach a label to all serviced devices:

1. The label shall indicate the date serviced and the company that performed the service.

1.5 SUBMITTALS

A. Furnish submittals as specified in Sections 01 33 00 – Submittal Procedures and 26 05 00 – Electrical, General.

B. LAN cable test form:

1. LAN cable test reports:

a. Submit 3 copies of test reports showing the results of all tests specified in this Section:

1) Test type.

2) Test location.

3) Test date.

4) Cable number.

5) Cable length.

6) Certification that the cable meets or exceeds the specified standard.

b. Furnish hard copy and electronic copy for all traces.

C. Test report:

1. Include the following:

a. Summary of Project.

b. Description of equipment tested.

c. Description of tests performed.

d. Test results.

e. Conclusions and recommendations.

f. Completed test forms.

g. List of test equipment used and calibration dates.

h. LAN cable test reports.

D. Testing laboratory qualifications:

1. Submit a complete resume and statement of qualifications from the proposed testing laboratory detailing their experiences in performing the tests specified:

a. This statement will be used to determine whether the laboratory is acceptable, and shall include:

1) Corporate history and references.

2) Resume of individual performing test.

3) Equipment list and test calibration data.

E. Division of responsibilities:

1. Submit a list identifying who is responsible for performing each portion of the testing.

F. Manufacturers' testing procedures:

1. Submit manufacturers' recommended testing procedures and acceptable test results for review by the Engineer.

1.6 QUALITY ASSURANCE

A. As specified in Section 26 05 00 – Electrical, General.

B. Testing laboratory qualifications:

1. The testing laboratory may be qualified testing personnel from the electrical subcontractor's staff or an independent testing company.

2. Selection of the testing laboratory and testing personnel is subject to approval by the Engineer based on testing experience and certifications of the individuals and testing capabilities of the organization.

1.7 DELIVERY, STORAGE, AND PROTECTION NOT USED

1.8 PROJECT OR SITE CONDITIONS

A. As specified in Section 26 05 00 – Electrical, General.

1.9 SEQUENCING

A. Perform testing in the following sequence:

1. Perform routine tests as the equipment is installed including:

a. Insulation resistance tests.

b. Continuity tests.

c. Rotational tests.

2. Adjusting and preliminary calibration.

3. Acceptance tests.

4. Demonstration.

5. Commissioning and plant start-up.

1.10 SCHEDULING NOT USED

1.11 WARRANTY

A. As specified in Section 26 05 00 – Electrical, General.

1.12 SYSTEM START-UP NOT USED

1.13 OWNER'S INSTRUCTIONS NOT USED

1.14 COMMISSIONING

A. Commissioning and plant start-up, as described in the Specifications, shall not begin until acceptance testing is complete, and operation has been demonstrated to the satisfaction of the Engineer.

B. Commissioning shall only be attempted as a function of normal plant operation in which plant process flows and levels are routine and equipment operates automatically in response to flow and level parameters or computer command, as applicable:

1. Simulation of process parameters will be considered only upon receipt of a written request by the Contractor.

C. Record all motor currents during normal operation.

D. Record the indications of all power meters every half-hour during commissioning.

1.15 MAINTENANCE NOT USED

PART 2 - PRODUCTS

2.1 MANUFACTURERS NOT USED

2.2 EXISTING PRODUCTS NOT USED

2.3 MATERIALS NOT USED

2.4 MANUFACTURED UNITS NOT USED

2.5 EQUIPMENT NOT USED

2.6 COMPONENTS NOT USED

2.7 ACCESSORIES NOT USED

2.8 MIXES NOT USED

2.9 FABRICATION NOT USED

2.10 FINISHES NOT USED

2.11 SOURCE QUALITY CONTROL

A. General:

1. Test instrument calibration:

a. Utilize a testing laboratory with a calibration program which maintains all applicable test instrumentation within rated accuracy.

b. The accuracy shall be traceable to the NIST in an unbroken chain.

c. Calibrate instruments in accordance with the following frequency schedule:

1) Field instruments: 6 months maximum.

2) Laboratory instruments: 12 months maximum.

3) Leased specialty equipment where the accuracy is guaranteed by the lessor (such as Doble): 12 months maximum.

d. Dated calibration labels shall be visible on all test equipment.

e. Maintain an up-to-date instrument calibration record for each test instrument:

1) The records shall show the date and results of each calibration or test.

f. Maintain an up-to-date instrument calibration instruction and procedure for each test instrument.

PART 3 - EXECUTION

3.1 EXAMINATION NOT USED

3.2 PREPARATION

A. Do not begin testing until the following conditions have been met:

1. All instruments required are available and in proper operating condition.

2. All required dispensable materials such as solvents, rags, and brushes are available.

3. All equipment handling devices such as cranes, vehicles, chain falls and other lifting equipment are available or scheduled.

4. All instruction books, calibration curves, or other printed material to cover the electrical devices are available.

5. Data sheets to record all test results are available.

3.3 INSTALLATION NOT USED

3.4 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION NOT USED

3.5 REPAIR/RESTORATION NOT USED

3.6 RE-INSTALLATION NOT USED

3.7 FIELD QUALITY CONTROL

A. Dry type transformers:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, and grounding.

d. Verify that resilient mounts are free and that any shipping brackets have been removed.

e. Inspect equipment for cleanliness.

f. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

g. Verify that as-left tap connections are as specified.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground:

1) Apply voltage in accordance with manufacturer's published data.

Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Calculate dielectric absorption ration or polarization index.

d. Perform turns ratio tests at all tap positions.

e. Verify correct secondary voltage, phase-to-phase and phase-to-neutral after energization and before loading.

3. Test values:

a. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Tap connections are left as found unless otherwise specified.

e. Minimum insulation resistance values of transformer insulation shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

2) Investigate insulation values less than the allowable minimum.

f. The dielectric absorption ratio or polarization index shall not be less than 1.0.

g. Turns-ratio results should not deviate more than 1/2 percent from either the adjacent coils or calculated ratio.

h. Phase-to-phase and phase-to-neutral secondary voltages shall be in agreement with nameplate data.

B. Cables, 600 volts and less:

1. Visual and mechanical inspection:

a. Compare cable data with that indicated on the Drawings and specified in the Specifications.

b. Inspect exposed sections of cables for physical damage and correct connection as indicated on the Drawings.

c. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

d. Inspect compression-applied connectors for correct cable match and indentation.

e. Inspect for correct identification and arrangements.

f. Inspect jacket insulation and condition.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with low-resistance ohmmeter.

b. Perform insulation-resistance tests on each conductor with respect to ground and adjacent conductors:

1) Applied voltage shall be:

500 VDC for 300-volt rated cable.

1,000 VDC for 600-volt rated cable.

2) Test duration shall be 1 minute.

c. Perform continuity tests to ensure correct cable connection.

d. Verify uniform resistance of parallel conductors.

3. Test values:

a. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Insulation resistance values shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

2) Investigate values of insulation resistance less than the allowable minimum.

e. Cables shall exhibit continuity.

f. Investigate deviations in resistance between parallel conductors.

C. Low voltage molded case and insulated case circuit breakers:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage and alignment.

d. Verify the unit is clean.

e. Operate circuit breaker to ensure smooth operation.

f. Inspect bolted electrical connections for high resistance by one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

g. Inspect operating mechanism, contacts, and arc chutes in unsealed units.

h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low resistance ohmmeter.

b. Perform insulation resistance tests for 1 minute on each pole, phase-to-phase and phase-to-ground with the circuit breaker closed and across each open pole:

1) Apply voltage in accordance with manufacturer's published data.

2) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Perform a contact/pole-resistance test.

d. Determine long-time pickup and delay by primary current injection.

e. Determine short-time pickup and delay by primary current injection.

f. Determine ground-fault pickup and delay by primary current injection.

g. Determine instantaneous pickup value by primary current injection.

h. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data.

i. Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, antipump function and trip unit battery condition:

1) Reset all trip logs and indicators.

j. Verify operation of charging mechanism.

3. Test values:

a. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Insulation resistance values shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

2) Investigate values of insulation resistance less than the allowable minimum.

e. Microhm or dc millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data:

1) If manufacturer's data is not available, investigate any values which deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.

f. Insulation resistance values of control wiring shall not be less than 2 megohms.

g. Long-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current characteristic tolerance band including adjustment factors:

1) If manufacturer's curves are not available, trip times shall not exceed the value shown in NETA ATS tables.

h. Short-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.

i. Ground fault pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.

j. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

k. Pickup values and trip characteristics shall be within manufacturer's published tolerances.

l. Minimum pickup voltage of the shunt trip and close coils shall conform to the manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

m. Breaker open, close, trip, trip-free, antipump, and auxiliary features shall function as designed.

n. The charging mechanism shall operate in accordance with manufacturer's published data.

D. Grounding systems:

1. Visual and mechanical inspection:

a. Inspect ground system for compliance with that indicated on the Drawings, specified in Specifications, and in the National Electrical Code.

b. Inspect physical and mechanical condition.

c. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:

Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

d. Inspect anchorage.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

b. Perform fall of potential test or alternative test in accordance with IEEE 81 on the main grounding electrode or system.

c. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, the system neutral and any derived neutral points.

3. Test values:

a. Grounding system electrical and mechanical connections shall be free of corrosion.

b. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

c. Bolt torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

d. The resistance between the main grounding electrode and ground shall be as specified in Section 26 05 26 – Grounding and Bonding for Electrical Systems. Investigate point-to-point resistance values that exceed 0.5 ohm.

E. Rotating machinery:

1. Visual and mechanical inspection:

a. Compare equipment nameplate information with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, and grounding.

d. Inspect air baffles, filter media, cooling fans, slip rings, brushes, and brush rigging.

e. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:

Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

Thermographic survey.

f. Perform special tests such as gap spacing and machine alignment if applicable.

g. Verify correct application of appropriate lubrication and lubrication systems.

h. Verify that resistance temperature detector (RTD) circuits conform to that indicated on the Drawings.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low resistance ohmmeter.

b. Perform insulation resistance test in accordance with IEEE 43:

1) On motors 200 horsepower and smaller, test duration shall be 1 minute. Calculate dielectric absorption ratio.

2) On motors larger than 200 horsepower, test duration shall be 10 minutes. Calculate polarization index.

c. Perform dc dielectric withstand voltage tests on machines rated at 2,300 volts and greater in accordance with IEEE 95.

d. Perform phase-to-phase stator resistance test on machines rated at 2,300 volts and greater.

e. Perform insulation resistance test on insulated bearings in accordance with manufacturer's published data.

f. Test surge protection devices as specified in this Section.

g. Test motor starter as specified in this Section.

h. Perform resistance tests on resistance temperature detector (RTD) circuits.

i. Verify operation of motor space heater.

j. Perform a rotation test to ensure correct shaft rotation.

k. Measure running current and evaluate relative to load conditions and nameplate full-load amperes.

3. Test values:

a. Inspection:

1) Air baffles shall be clean and installed in accordance with the manufacturer's published data.

2) Filter media shall be clean and installed in accordance with the manufacturer's published data.

3) Cooling fans shall operate.

4) Slip ring alignment shall be within manufacturer's published tolerances.

5) Brush alignment shall be within manufacturer's published tolerances.

6) Brush rigging shall be within manufacturer's published tolerances.

b. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

c. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

d. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

e. Air-gap spacing and machine alignment shall be in accordance with manufacturer's published data.

f. The dielectric absorption ratio or polarization index shall not be less than 1.0. The recommended minimum insulation ($IR_{1\ min}$) test results in megohms shall be corrected to 40 degrees Celsius and read as follows:

1) IR1 min equals 100 megohms for dc armature and ac windings with form-wound coils above 1 kilovolt.

2) IR1 min equals 5 megohms for machines and random-wound stator coils and form-wound coils rated below 1 kilovolt.

Dielectric withstand voltage and surge comparison tests shall not be performed on machines having lower values than those indicated above.

g. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.

h. Investigate phase-to-phase stator resistance values that deviate by more than 10 percent.

i. Power factor or dissipation factor values shall be compared to manufacturer's published data:

1) In the absence of manufacturer's published data compare values of similar machines.

j. Tip-up values shall indicate no significant increase in power factor.

k. If no evidence of distress, insulation failure or waveform nesting is observed by the end of the total time of voltage application during the surge comparison test, the test specimen is considered to have passed the test.

l. Bearing insulation resistance measurements shall be within manufacturer's published tolerances:

1) In the absence of manufacturer's published data compare values of similar machines.

m. Test results of surge protection devices shall be as specified in this Section.

n. Test results of motor starter equipment shall be as specified in this Section.

o. RTD circuits shall conform to the design intent and machine protection device manufacturer's published data.

p. Heaters shall be operational.

q. Vibration amplitudes shall not exceed values in NETA ATS tables:

1) If values exceed those in the NETA ATS tables, perform a complete vibration analysis.

r. Machine rotation should match required rotation of connected load.

s. Running phase-to-phase voltages should be within 1.0 percent. Running currents shall be balanced and proportional to load condition and nameplate data.

F. Motor starters, low voltage:

1. Visual and mechanical inspection:

a. Compare equipment nameplate information with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, and grounding.

d. Verify the unit is clean.

e. Inspect contactors:

1) Verify mechanical operation.

2) Verify contact gap, wipe, alignment, and pressure are in accordance with manufacturer's published data.

f. Motor-running protection:

1) Verify overload element rating is correct for its application.

2) If motor running protection is provided by fuses, verify correct fuse rating.

g. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:

Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

h. Lubrication requirements:

1) Verify appropriate lubrication on moving current-carrying parts.

2) Verify appropriate lubrication on moving and sliding surfaces.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low resistance ohmmeter.

b. Perform insulation resistance tests for 1 minute on each pole, phase-to-phase and phase to ground with the starter closed, and across each open pole for 1 minute:

1) Test voltage shall be in accordance with manufacturer's published data.

2) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 VDC for 300-volt rated cable and 1,000 VDC for 600-volt rated cable. Apply the test voltage for 1 minute:

1) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.

d. Test motor protection devices in accordance with manufacturer's published data.

e. Test circuit breakers as specified in this Section.

f. Perform operational tests by initiating control devices.

3. Test values:

a. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Insulation resistance values shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

2) Investigate values of insulation resistance less than the allowable minimum.

e. Insulation resistance values of control wiring shall not be less than 2 megohms.

f. Motor protection parameters shall be in accordance with manufacturer's published data.

g. Circuit breaker test results shall as specified in this Section.

h. Control devices shall perform in accordance with system design requirements.

G. Motor control centers, low voltage:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding and required clearances.

d. Inspect equipment for cleanliness.

e. Verify that circuit breaker/fuse sizes and types correspond to the approved submittals and coordination study.

f. Verify that current and voltage transformer ratios correspond to that indicated on the Drawings.

g. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

h. Mechanical and electrical interlocks:

1) Attempt closure on locked-open devices.

2) Attempt to open locked-closed devices.

3) Make/attempt key-exchanges in all positions.

i. Lubrication requirements:

1) Verify appropriate lubrication on moving current-carrying parts.

2) Verify appropriate lubrication on moving and sliding surfaces.

j. Inspect insulators for evidence of physical damage or contaminated surfaces.

k. Verify correct barrier and shutter installation and operation.

l. Exercise all active components.

m. Inspect all indicating devices for correct operation.

n. Verify that filters are in place and/or vents are clear.

o. Perform visual and mechanical inspection of instrument transformers as specified in this Section.

p. Inspect control power transformers:

1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.

2) Verify that primary and secondary fuse/circuit breaker ratings match the submittal drawings.

q. Perform visual and mechanical inspection of circuit breakers as specified in this Section.

r. Perform visual and mechanical inspection of starters as specified in this Section.

s. Perform visual and mechanical inspection of dry-type transformers as specified in this Section.

t. Perform visual and mechanical inspection of variable frequency drives as specified in this Section.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter if applicable.

b. Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground for 1 minute:

1) Perform test in accordance with NETA ATS tables.

c. Perform an dielectric withstand test on each bus section, each phase to ground with phases not under test grounded, in accordance with manufacturer's published data or NETA ATS tables. Apply the test voltage for 1 minute.

d. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 VDC for 300-volt rated cable and 1,000 VDC for 600-volt rated cable. Apply the test voltage for 1 minute:

1) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.

e. Perform ground-resistance tests:

1) Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral and derived neutral points.

f. Determine the accuracy of all meters.

g. Control power transformers:

1) Perform insulation resistance tests, winding-to-winding and winding-to-ground:

Test voltages shall be in accordance with NETA ATS tables or as specified by the manufacturer.

2) Perform secondary wiring integrity test:

Disconnect transformer at secondary terminals and connect secondary wiring to a rated secondary voltage source:

(1) Verify correct potential at all devices.

3) Verify correct secondary voltage by energizing primary winding with system voltage:

Measure secondary voltage with the secondary wiring disconnected.

h. Verify operation of space heaters.

i. Perform electrical tests of circuit breakers as specified in this Section.

j. Perform electrical tests of starters as specified in this Section.

k. Perform electrical tests of dry-type transformers as specified in this Section.

l. Perform electrical tests of variable frequency drives as specified in this Section.

3. Test values:

a. Compare bus connection resistances to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer’s published data:

1) Refer to NETA ATS tables in the absence of manufacturer’s published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Compare bus connection resistances to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Insulation-resistance values for bus and control power transformers shall be in accordance with manufacturer's published data:

Refer to NETA ATS tables in the absence of manufacturer's published data.

Investigate insulation values less than the allowable minimum.

Do not proceed with dielectric withstand voltage tests until insulation-resistance values are above minimum values.

e. Bus insulation shall withstand the overpotential test voltage applied.

f. Insulation-resistance values for control wiring shall not be less than 2.0 megohms.

g. Instrument transformer test values shall be as specified in this Section.

h. Investigate grounding system resistance values that exceed 0.5 ohm.

i. Meter accuracy shall be in accordance with manufacturer's published data.

j. Control power transformers:

1) Insulation resistance values of control power transformers shall be in accordance with manufacturer's published data:

Refer to NETA ATS tables in the absence of manufacturer's published data.

Investigate insulation values less than the allowable minimum.

Do not proceed with dielectric withstand voltage tests until insulation-resistance values are above minimum values.

2) Secondary wiring shall be in accordance with that indicated on the Drawings and specified in the Specifications.

3) Secondary voltage shall be in accordance with that indicated on the Drawings.

k. Heaters shall be operational.

l. Test values for circuit breakers shall be as specified in this Section.

m. Test values for starters shall be as specified in this Section.

n. Test values for dry-type transformers shall as specified in this Section.

o. Test values for variable frequency drives shall be as specified in this Section.

H. Variable frequency drive systems:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, and grounding.

d. Verify the unit is clean.

e. Ensure vent path openings are free from debris and that heat transfer surfaces are clean.

f. Verify correct connections of circuit boards, wiring, disconnects, and ribbon cables.

g. Motor running protection:

1) Verify drive overcurrent setpoints are correct for their application.

2) If drive is used to operate multiple motors, verify individual overload element ratings are correct for their application.

3) Apply minimum and maximum speed setpoints. Verify setpoints are within limitations of the load coupled to the motor.

h. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

i. Verify correct fuse sizing in accordance with manufacturer's published data.

j. Perform visual and mechanical inspection of input circuit breaker as specified in this Section.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with low-resistance ohmmeter.

b. Test the motor overload relay elements by injecting primary current through the overload circuit and monitoring trip time of the overload element.

c. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 VDC for 300-volt rated cable and 1,000 VDC for 600-volt rated cable. Apply the test voltage for 1 minute:

1) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.

d. Test for the following parameters in accordance with relay calibration procedures specified in this Section or as recommended by the manufacturer:

1) Input phase loss protection.

2) Input overvoltage protection.

3) Output phase rotation.

4) Overtemperature protection.

5) Direct current overvoltage protection.

6) Overfrequency protection.

7) Drive overload protection.

8) Fault alarm outputs.

e. Perform continuity tests on bonding conductors as specified in this Section.

f. Perform start-up of drive in accordance with manufacturer's published data. Calibrate drive to the system's minimum and maximum speed control signals.

g. Perform operational tests by initiating control devices:

1) Slowly vary drive speed between minimum and maximum. Observe motor and load for unusual noise or vibration.

2) Verify operation of drive from remote start/stop and speed control signals.

h. Perform electrical tests of input circuit breaker as specified in this Section.

3. Test values:

a. Compare bolted connection resistances to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Overload test trip times at 300 percent of overload element rating shall be in accordance with manufacturer's published time-current curve.

e. Test values for input circuit breaker shall be as specified in this Section.

f. Insulation-resistance values for control wiring shall not be less than 2.0 megohms.

g. Relay calibration results shall be as specified in this Section.

h. Continuity of bonding conductors shall be as specified in this Section.

i. Control devices shall perform in accordance with system requirements.

j. Operational tests shall conform to system design requirements.

I. Surge arresters, low-voltage:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding, and clearances.

d. Verify the arresters are clean.

e. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

f. Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

g. Verify that stroke counter is correctly mounted and electrically connected, if applicable.

h. Record stroke counter reading.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

b. Perform an insulation-resistance test on each arrester, phase terminal-to-ground:

1) Apply voltage in accordance with manufacturers published data.

2) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Test grounding connection as specified in this Section.

3. Test values:

a. Compare bolted connection resistances to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Insulation resistance values shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

2) Investigate insulation values less than the allowable minimum.

d. Resistance between the arrester ground terminal and the ground system shall be less than 0.5 ohm.

J. Fiber-optic cables:

1. Visual and mechanical inspection:

a. Compare cable, connector, and splice data with that indicated on the Drawings and specified in the Specifications:

b. Inspect cable and connections for physical and mechanical damage.

c. Verify that all connectors and splices are correctly installed.

2. Electrical tests:

a. Perform cable length measurement, fiber fracture inspection, and construction defect inspection using an optical time domain reflectometer (OTDR):

1) OTDR test performed on fiber cables less than 100 meters shall be performed with the aid of a launch cable.

2) Adjust OTDR pulse width settings to a maximum setting of 1/1000th of the cable length or 10 nanoseconds.

b. Perform connector and splice integrity test using an optical time domain reflectometer.

c. Perform cable attenuation loss measurement with an optical power loss test set:

1) Perform attenuation tests with an Optical Loss Test Set capable and calibrated to show anomalies of 0.1 dB as a minimum.

2) Test multimode fibers at 850 nanometer and 1,300 nanometer.

3) Test single mode fibers at 1,310 nanometer and 1,550 nanometer.

d. Perform connector and splice attenuation loss measurement from both ends of the optical cable with an optical power loss test set:

1) At the conclusion of all outdoor splices at one location, and before they are enclosed and sealed, all splices shall be tested with OTDR at the optimal wavelengths (850 and 1,300 for multimode, 1,310 and 1,550 for single mode), in both directions. The splices shall be tested for integrity as well as attenuation.

e. Perform fiber links integrity and attenuation tests using each link shall be an OTDR and an Optical Loss Test Set:

1) OTDR traces shall be from both directions on each fiber at the 2 optimal wavelengths, 850 nanometer and 1,300 nanometer for multimode fibers.

2) Optical loss testing shall be done with handheld test sets in 1 direction at the 2 optimal wavelengths for the appropriate fiber type. Test equipment shall equal or exceed the accuracy and resolution of Agilent/HP 8147 high performance OTDR.

3. Test values:

a. Cable and connections shall not have been subjected to physical or mechanical damage.

b. Connectors and splices shall be installed in accordance with industry standards.

c. The optical time domain reflectometer signal should be analyzed for excessive connection, splice, or cable backscatter by viewing the reflected power/distance graph.

d. Attenuation loss measurement shall be expressed in dB/km. Losses shall be within the manufacturer's recommendations when no local site specifications are available.

e. Individual fusion splice losses shall not exceed 0.1 dB. Measurement results shall be recorded, validated by trace, and filed with the records of the respective cable runs.

K. LAN cable testing:

1. Visual and mechanical inspections:

a. Compare cable type and connections with that indicated on the Drawings and specified in the Specifications.

b. Inspect cable and connectors for physical and mechanical damage.

c. Verify that all connectors are correctly installed.

2. Pre-testing:

a. Test individual cables before installation:

1) Before physical placement of the cable, test each cable while on the spool with a LAN certification test device.

2) Before the cable is installed, verify that the cable conforms to the manufacturer's attenuation specification and that no damage has been done to the cable during shipping or handling.

3) The test shall be fully documented and the results submitted to the Engineer, including a hard copy of all traces, before placement of the cable.

4) The Engineer shall be notified if a cable fails to meet specification and the cable shall not be installed unless otherwise directed by the Engineer.

3. Electrical tests:

a. Perform cable end-to-end testing on all installed cables after installation of connectors from both ends of the cable.

b. Test shall include cable system performance tests and confirm the absence of wiring errors.

4. Test results:

a. Cables shall meet or exceed TIA standards for a Category 5e or Category 6 installation, as applicable.

5. Test equipment:

a. LAN certification equipment used for the testing shall be capable of testing Category 6 cable installation to TIA proposed Level III accuracy. Tests performed shall include:

1) Near end cross talk.

2) Attenuation.

3) Equal level far end cross talk.

4) Return loss.

5) Ambient noise.

6) Effective cable length.

7) Propagation delay.

8) Continuity/loop resistance.

b. LAN certification test equipment shall be able to store and produce plots of the test results.

c. Acceptable manufacturers: The following or equal:

1) Agilent Technologies, WireScope 350.

L. Capacitors and reactors, capacitors:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding, and clearances.

d. Verify the unit is clean.

e. Verify that capacitors are electrically connected in their specified configuration.

f. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low-resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method:

Refer to manufacturer’s instructions for proper foot-pound levels NETA ATS tables.

3) Perform thermographic survey.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.

b. Perform insulation-resistance tests from phase terminal(s) to case for one minute.

1) Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, refer to NETA ATS tables.

c. Measure the capacitance of all terminal combinations.

d. Measure resistance of the internal discharge resistors.

3. Test values:

a. Test values - visual and mechanical:

1) Compare bolted connection resistance values to values of similar connections.

Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Bolt-torque levels shall be in accordance with manufacturer's published data:

Refer to NETA ATS tables in the absence of manufacturer’s data.

3) Results of the thermographic survey shall be in accordance with NETA ATS requirements.

b. Test values - electrical:

1) Compare bolted connection resistance values to values of similar connections:

Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Insulation-resistance values shall be in accordance with manufacturer's published data:

Refer to NETA ATS tables in the absence of manufacturer's published data.

Values of insulation resistance less than NETA ATS tables or manufacturer's recommendations should be investigated.

3) Investigate capacitance values differing from manufacturer's published data.

4) Investigate discharge resistor values differing from manufacturer's published data. In accordance with NFPA 70 NEC, Article 460, residual voltage of a capacitor shall be reduced to 50 volts in the following time intervals after being disconnected from the source of supply:

Rated Voltage	Discharge Time
Less than or equal to 600 volts	1 minute
Greater than 600 volts	5 minutes

3.8 ADJUSTING

A. Adjust limit switches and level switches to their operating points before testing.

B. Set pressure switches, flow switches, and timing relays to anticipated values before testing:

1. Final settings shall be as dictated by operating results during testing.

3.9 CLEANING

A. As specified in Section 26 05 00 –Electrical, General.

B. After the acceptance tests have been completed, dispose of all testing expendables, vacuum all cabinets, and sweep clean all surrounding areas.

3.10 DEMONSTRATION AND TRAINING

A. As specified in Section 26 05 00 – Electrical, General.

B. Subsystem demonstration:

1. Subsystem, as used in this Section, means individual and groups of pumps, conveyor systems, chemical feeders, air conditioning units, ventilation fans, air compressors, blowers, lighting control systems and other electrically operated or controlled equipment.

2. Before demonstrating any subsystem:

a. Demonstrate proper operation of all alarm and status contacts.

b. Adjust and calibrate all process and control devices as accurately as possible.

3. Operate each subsystem in its manual mode:

a. Demonstrate compliance with all Contract requirements.

4. After each subsystem has operated successfully in its manual mode, perform automatic and remote operation demonstrations:

a. Verify that all features are fully operational and meet all Contract requirements.

b. Demonstrate all operating modes and sequences, including proper start and stop sequence of pumps, proper operation of valves and proper speed control.

3.11 PROTECTION

A. As specified in Section 26 05 00 – Electrical, General.

3.12 SCHEDULES

A. At least 30 days before commencement of the acceptance tests, submit the manufacturer's complete field testing procedures to the Engineer and to the testing laboratory, complete with expected test results and tolerances for all equipment to be tested.

END OF SECTION 26 08 00

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SECTION 26 21 00 - SERVICE ENTRANCE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Coordinate new modifications to the existing incoming power service with Idaho Power Company. Idaho Power Company contact number is 1(800) 488-6151.

B. Coordinate service connections and modifications to the existing service to accommodate service upgrades as indicated on the plans.

C. Verify exact location of service feeds and transformers with Idaho Power Company. Electrical power service to be maintained. Any and all power shut downs shall be scheduled and coordinated with the owner and related trades.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Install, modify or demolish service-entrance equipment as indicated on the plans. New equipment to be installed, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that service-entrance equipment fulfills requirements. Comply with applicable installation requirements of NEC, UL, ANSI, IEEE, and NEMA standards.

B. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B, and the NEC.

END OF SECTION 26 21 00

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SECTION 26 22 00 – LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

2. Control and signal transformers.

1.3 SUBMITTALS

A. Product Data Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Wiring and connection diagrams.

C. Source quality-control test reports.

D. Output Settings Reports: Record of tap adjustments specified in Part 3.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with IEEE C 57.12.91.

C. Energy-Efficient Transformers Rated 15 kVA and Larger: Certified as meeting NEMA TP 1, Class 1 efficiency levels when tested according to NEMA TP 2.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified Section 26 05 00 – Electrical, General.

B. Coordinate installation of wall-mounting and structure-hanging supports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Siemens.

2. GE Electrical Distribution & Control.

3. Square D/Group Schneider NA.

4. Eaton

2.2 MATERIALS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices, except for taps.

1. Internal Coil Connections: Brazed or pressure type. Coil Material: Copper.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Indoor Transformer Enclosure: Comply with NEMA 250 for "Indoor Corrosion Protection."

1. Finish Color: Gray.

2. Enclosure: Ventilated, NEMA 250, Type 2.

D. Outdoor Transformer Enclosure: Comply with NEMA 250 for "Outdoor Corrosion Protection."

1. Finish Color: Gray.

2. Enclosure: Ventilated, raintight, NEMA 250, Type 3R required.

E. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

F. Taps for Transformers Smaller Than 3 kVA: None.

G. Taps for Transformers 7.5 to 24 kVA: Two 5 percent taps below rated voltage.

H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

I. Wall Brackets: Manufacturer's standard brackets.

2.4 CONTROL AND SIGNAL TRANSFORMERS

A. Description: Self-cooled, two-winding dry type, rated for continuous duty, complying with NEMA ST 1, and listed and labeled as complying with UL 506.

B. Ratings: Continuous duty. If rating is not indicated, provide at least 50 percent spare capacity above connected peak load.

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls and floors for suitable mounting conditions where transformers will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as specified in Section 26 05 00 – Electrical, General

B. Install floor-mounting transformers level on concrete bases. Construct concrete bases of dimensions not less than 4 inches larger in both directions than supported unit and 4 inches high.

1. Anchor transformers to concrete bases according to manufacturer's written instructions, seismic codes at Project, and requirements in Section 26 05 00 – Electrical, General.

3.3 CONNECTIONS

A. Ground equipment according to Section 26 05 26 – Grounding and Bonding for Electrical Systems.

B. Connect wiring according to Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 5 percent. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

END OF SECTION 26 22 00

SECTION 26 24 13.21 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SCOPE

1. Furnish and install, where indicated, a free-standing, dead-front type low-voltage distribution switchboard, utilizing group mounted circuit protective devices, integrated panelboards, and other equipment as specified herein, and as shown on the contract drawings.

1.2 RELATED SECTIONS

A. Section 26 22 13 – Dry-Type Distribution Transformers – General Purpose (1500 kVA and below)

1. Section 26 24 16 – Panelboards

2. Section 26 28 00 – Overcurrent Protective Devices

3. Section 26 43 13.A – Surge Protective Devices

1.3 REFERENCES

A. The low-voltage distribution switchboards and all components shall be designed, manufactured, and tested in accordance with the latest applicable following standards:

1. NEMA PB-2

2. UL Standard 891

1.4 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:

1. Master drawing index

2. Front view elevation

3. Floor plan

4. Top view

5. Single line

6. Schematic diagram

7. Nameplate schedule

8. Component list

9. Conduit entry/exit locations

10. Assembly ratings including:

11. Short-circuit rating.

12. Voltage

13. Continuous current

14. Major component ratings including:

15. Voltage

16. Continuous current

17. Interrupting ratings

18. Cable terminal sizes

19. Product data sheets

B. Where applicable, the following additional information shall be submitted to the Engineer:

1. Busway connection

2. Connection details between close-coupled assemblies

3. Composite floor plan of close-coupled assemblies

1.5 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Paragraph 1.4 and shall incorporate all changes made during the manufacturing process.

2. Wiring diagrams

3. Certified production test reports

4. Installation information

5. Seismic certification and equipment anchorage details as specified.

1.6 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.7 REGULATORY REQUIREMENTS

A. The low-voltage switchboard shall be UL labeled.

1.8 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.9 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

1.10 PRODUCTS

1.11 MANUFACTURERS

A. Eaton

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

1.12 RATINGS

A. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current as shown on the drawings. Main Switchboard Section shall be fully rated for 65,000 amperes symmetrical at rated voltage. Sub-panels shall be rated to meet requirements shown on drawings. Copies of series combinations shall be submitted with approval drawings. These series combinations are required to be tested by UL and values predicted by the use of let-through curves are not acceptable.

B. Voltage rating to be as indicated on the drawings.

1.13 CONSTRUCTION

A. All sections of the switchboard shall be front and rear aligned with depth as shown on the drawings. All protective devices shall be group mounted. Devices shall be front removable and load connections front accessible enabling switchboard to be mounted against a wall.

B. The assembly shall be provided with adequate lifting means.

C. The switchboard shall be equal to Eaton type Pow-R-Line C utilizing the components herein specified and as shown on the drawings.

D. The switchboard shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.

1.14 BUS

A. All bus bars shall be silver-plated copper. Main horizontal bus bars, if applicable, shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).

B. Provide a full capacity neutral bus where a neutral bus is indicated on the drawings.

C. A copper ground bus (minimum 1/4 x 2 inch) shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard.

D. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

1.15 WIRING/TERMINATIONS

A. Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer’s wiring diagrams.

B. Mechanical-type terminals shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of the size as indicated on the drawings.

C. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.

D. All control wire shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

E. Where there is a main switchboard section in the lineup, the switchboard manufacturer shall wire from the associated feeder breaker to the respective panelboard, dry type distribution transformer, automatic transfer switch, UPS, etc… as noted on drawings. Feeders shall be copper, and conductor sized as noted on the drawings. This wiring shall be installed in the factory and shall not be installed in the field. All factory installed power wiring shall be provided with phase color tape as follows:

1. 480/277-Volt WYE Systems

    a. Phase-A = Brown

    b. Phase-B = Orange

    c. Phase-C = Yellow

    d. Neutral = Gray

2. 208/120-Volt WYE Systems

    a. Phase-A = Black

    b. Phase-B = Red

    c. Phase-C = Blue

    d. Neutral = White

1.16 MAIN SWITCHBOARD SECTION

A. Main protective devices

B. Trip units – Main and Tie devices

C. Feeder protective devices

D. Trip units – Feeder devices

E. Accessories

1. Provide shunt trips, bell alarms and auxiliary switches as shown on the contract drawings.

1.17 OWNER METERING

A. Where indicated on the drawings, provide a separate owner metering compartment with front hinged door, and include the following:

B. Current transformers for each meter. Current transformers shall be wired to shorting-type terminal blocks.

C. Microprocessor-Based Metering System to comply with section 26 27 13.11.

1.18 ENCLOSURES

A. NEMA 3R Enclosure

1.19 NAMEPLATES

A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background. Characters shall be 3/16-inch high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating. Furnish master nameplate giving switchboard designation, voltage ampere rating, short-circuit rating, manufacturer's name, general order number, and item number.

B. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

1.20 FINISH

A. All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 light gray.

1.21 SURGE PROTECTIVE DEVICES

A. Provide surge protective devices as specified in Section 26 43.13A.

PART 2 - - EXECUTION

2.1 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

1. The switchboard shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchboard will be tested for operation under simulated service conditions to assure the accuracy of the wiring and the functioning of all equipment. The main circuits shall be given a dielectric test of 2200 volts for one (1) minute between live parts and ground, and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1500 volts for one (1) minute between live parts and ground.

B. The manufacturer shall provide three (3) certified copies of factory test reports.

2.2 TRAINING

A. The Contractor shall provide a training session for up to five (5) owner's representatives for 1 normal workdays at a jobsite location determined by the owner.

B. A manufacturer's qualified representative shall conduct the training session. The training program shall consist of instruction on operation of the assembly, circuit breakers, fused switches, and major components within the assembly.

2.3 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer's instructions, contract drawings and National Electrical Code.

B. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to the floor without the use of floor sills provided the floor is level to 1/8 inch per 3-foot distance in any direction. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

2.4 FIELD ADJUSTMENTS

1. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study and protective device coordination study.

2. Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with an approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the owner.

END OF SECTION 26 24 13.21

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SECTION 26 24 16 – PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this Section.

1.2 SUMMARY

A. This Section includes load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:

1. Branch-circuit panelboards.

2. Distribution panelboards.

1.3 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, TVSS device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.

b. Bus configuration, current, and voltage ratings.

c. Short-circuit current rating of panelboards and overcurrent protective devices.

d. UL listing.

e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

C. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing. Scheduling shall be typewritten indicating loads served by each breaker.

D. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Section 01 78 23 – Operation and Maintenance Data, include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.6 EXTRA MATERIALS

A. Keys: Six spares of each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:

a. Eaton

b. General Electric Co.; Electrical Distribution & Control Div.

c. Siemens Energy & Automation, Inc.

d. Square D by Schneide Electric

2.2 FABRICATION AND FEATURES

A. Enclosures: Flush or Surface mounted cabinets as indicated. NEMA PB 1, Type 1, to meet environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.

2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

3. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

B. Front: Secured to box with piano hinged door in door trim. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

C. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.

D. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.

E. Bus: Copper.

F. Main and Neutral Lugs: Compression type suitable for use with conductor material.

G. Equipment Ground Bus: Copper only Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

H. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

I. Feed-through Lugs: Compression type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals, unless otherwise stated. Series rating not allowed.

2.4 LOAD CENTERS - NOT ALLOWED.

2.5 BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.6 DISTRIBUTION PANELBOARDS

A. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.

B. Main Overcurrent Protective Devices: Circuit breaker.

C. Branch overcurrent protective devices shall be one of the following:

1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Mounting Heights: Top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.

C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

D. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

E. Install filler plates in unused spaces.

F. Provision for Future Circuits at Flush Panelboards: Stub three 3/4-inch (19 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 3/4-inch (19 mm) empty conduits into raised floor space or below slab not on grade.

G. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 26 05 00 – Electrical, General.

B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, section 7.5 for switches and section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

B. Balancing loads between phases such that difference is below 20 percent.

3.5 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.6 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 24 16

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SECTION 26 27 13.11 – MICROPROCESSOR-BASED METERING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes power monitoring equipment

1.3 SUBMITTALS

A. Furnish in accordance with Section 01 33 00 – Submittal Procedures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Eaton products.

1. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

B. The Power Xpert Meter 2000 series, PXM2270:

1. Where indicated on the drawings, provide a microprocessor based line of multifunction, power meter(s), designated (PM), equal to Eaton PXM2270 series meters. The meter device shall be UL listed. All meters shall have the following ratings, features, and functions, unless a specific meter type is designated.

2. The meter shall be designed for Multifunction Electrical Measurement on 3 phase power systems. The Meter shall support 3-Element Wye, 2.5 Element Wye, 2 Element Delta, 4 wire Delta systems.

3. The meter surge withstand shall conform to IEEE C37.90.1 and ANSI C62.41 (6KV)

4. The meter shall be user programmable for voltage range to any PT ratio.

5. The meter shall have a burden of up to .36VA per phase, Max at 600V, 0.014VA at 120 Volts.

6. The meter shall accept a direct voltage input range of up to 576 Volts Line to Neutral, and a range of up to 721 Volts Line to Line.

7. The meter shall accept a current input of up to 10 amps continuous. Start up current for a 5 Amp input shall be no greater than .005 Amps.

8. The meter shall be capable of a dual input method for current inputs. As standard the meter shall be designed to allow the CT circuit to pass directly through the meter without any physical termination on the meter, ensuring the meter cannot be a point of failure on the CT circuit. As an option where indicated on the drawing or required for the application, provide additional termination pass-through bars, allowing the CT leads to be terminated on the meter. The meter must be capable of supporting both termination methods.

9. The meter shall have the following additional ratings and features:

10. Fault Current Withstand shall be 100 Amps for 10 seconds, 300 Amps for 3 seconds, and 500 Amps for 1 second.

11. Meter shall be programmable for current to any CT ratio. The use of DIP switches for selecting fixed ratios shall not be acceptable.

12. Meter shall have a maximum burden of 0.005VA per phase, at the maximum at 11 Amperes.

13. Meter to accept a pass through wire gauge dimension of 0.177” / 4.5 mm.

14. All inputs and outputs shall be galvanically isolated to 2500 Volts AC.

15. The meter shall accept current inputs of class 10: (0 to 10A), 5 Amp Nominal, and class 2 (0 to 2A), 1A Nominal Secondary.

16. The meter shall have an accuracy of +/- 0.1% or better for volts and amps, and 0.2% for power and energy functions. The meter shall meet the accuracy requirements of IEC687 (class 0.2%) and ANSI C12.20 (Class 0.2%).

17. The meter shall provide true RMS measurements of voltage, phase to neutral and phase to phase; current, per phase and neutral.

18. The meter shall provide sampling at 400+ samples per cycle on all channels measured readings simultaneously.

19. The meter shall utilize 24 bit Analog to Digital conversion.

20. Type PXM2270 meters shall provide per phase % THD (Total Harmonic Distortion) and individual harmonic monitoring to the 40^{th} order for voltage (reference to neutral only) and current, and shall provide Volts, Amps, kW, kVAR, PF, kVA, Frequency, kWh, kVAh, kVARh, 1 KYZ pulse output, on board meter limit exceeded alarms, provide a waveform view of real time harmonic distortion on a PC from the embedded WEB server and 768 Megabytes for data logging.

21. The meter shall provide pre- and post-event recording capability.

22. The meter shall have a programmable sampling rate for the waveform recorder.

23. The meter shall have an advanced DSP design that allows power quality triggers to be based on a 1 cycle updated RMS.

24. The meter shall allow up to 1500 events to be recorded.

25. The meter shall store waveform data on the meter ftp server in COMTRADE format and be accessible via a web browser.

26. The meter shall be able to be configured and viewed from the on-board web server without the need for external software.

27. The meter shall include a three-line, bright red, .56" LED display.

28. The meter shall fit in both DIN 92mm and ANSI C39.1 Round cut-outs.

29. The meter must display a % of Load Bar on the front panel to provide an analog feel. The % Load Bar shall have not less than 10 segments.

30. The meter shall be available in transducer only version, which shall not include a display. The transducer version shall mount directly to a DIN rail.

31. Meter shall be a traceable revenue meter, which shall contain a utility grade test pulse allowing power providers to verify and confirm that the meter is performing to its rated accuracy.

32. The meter shall include 2 independent communication ports on the back with multiple protocols, including the following minimum capability:

    a. Network Communication Format

        1) Connection Type: RJ-45 10/100 Base-T Ethernet Network port

        2) Ethernet card shall allow auto transmit/receive detection for straight or null RJ45 cables.

        3) Protocols: Ethernet TCP/IP, Modbus TCP, BACnet/IP, SNMP v1 & v3 (Network), SMTP (email), HTTP, HTTPS, Atom Feed

33. The meter shall provide user configured fixed window or sliding window demand. This shall allow the user to set up the particular utility demand profile.

34. Readings for kW, kVAR, kVA and PF shall be calculated using utility demand features.

35. All other parameters shall offer max and min capability over the user selectable averaging period.

36. Voltage shall provide an instantaneous max and min reading displaying the highest surge and lowest sag seen by the meter.

37. The meter shall be capable of operating on a power supply of 90 to 265 Volts AC and 100 to 370 Volts DC. Universal Power AC/DC Supply shall be available and shall have a burden of less than 11VA. An option shall also be available to operate on a power supply from 18-60 VDC.

38. Meter shall provide update rate of 100msec for Watts, Var and VA. All other parameters shall be 1 second.

39. The meter shall provide on board meter Limits Alarms and Control Capability as follows:

    a. Limit ranges can be set for any measured parameter.

    b. Up to 16 limit ranges can be set.

    c. Limit ranges shall be based on % of Full-Scale settings.

    d. Manual relay control shall be available using Modbus RTU command when used with optional relay card.

    e. Relay set delays and reset delays shall be available.

40. The PXM 2000 series shall provide the following advanced analysis features:

    a. Calculation of harmonic magnitudes and phase angle for each phase voltage and current through the 40th harmonic.

    b. Waveform view of real time harmonic distortion and individual harmonic monitoring on a PC from the embedded WEB server

    c. Historical Trending: Historical trend logging for graphical viewing from an embedded WEB server. The graphical views of historical data shall support both pan and zoom functions. All standard metering parameters (42 real-time measures) shall be logged as part of the standard meter functionality including minimum, maximum and average for each metered parameter. The averages shall be calculated over the time interval period. Minimum storage capacity for standard trend plots shall be as follows for PXM2270 respectively:

        1) Five-minute intervals for 90, 180, 365 days.

        2) Fifteen-minute intervals for 1, 2, 3 years

        3) Sixty-minute intervals for 5, 10, 15 years

        4) Data storage up to 256, 512, 768 MB.

41. Event Triggers: The meter shall have a quantity of two (2) types of configurable event triggers consisting of:

a. On board meter out of limits, the on-board meter out of limits can be set for any measured parameter, for up to 16 limits. If any of the 16 limits are exceeded, an alarm condition will be present and illuminate one of the LEDs on the meter faceplate. The on board meter out of limits can also be used to energize a relay output, if so equipped. These triggers shall permit pickup, reset and pickup delay to be user configurable.

b. On board gateway card out of limits. The on-board gateway limits can trigger an alarm off any measured parameter on any of the PXM 2000 model series. Upper and lower cautionary and critical limits shall be available for each of the measured parameters. On board Gateway card Out of limits – Up to One Hundred and Sixty-Eight (168) triggers

42. Event Logging: The embedded WEB Server shall allow the user to view a list of triggered events along with event details. In addition, a separate system log shall store logging of activities including acknowledged triggers, and systems operations, such as resets. Storage shall be reserved for 100,000 events.

43. Minimum and Maximum values for the following parameters:

a. Voltage L-L and L-N

b. Current per phase

c. Apparent Power Factor

d. Real, Reactive, and Apparent total Power

e. %THD voltage L-N

f. %THD Current per phase

g. Frequency

44. The WEB server shall provide the user with remote WEB access to all the metered and trend information. The WEB server shall include real time monitored information in both numeric and graphical visual formats.

45. The meter shall have a real-time clock with the added capability to synchronize with a network time server to maintain time accuracy.

46. The meter shall have I/O expandability through one Option card slot on the back.

47. The card shall be capable of being installed in the field, without removing the meter from installation.

48. The meter shall auto-detect the presence of any I/O Option card.

49. The Option card slot shall accept I/O card in all of the following formats: Four channel bi-directional 0-1mA Output Card; Four Channel 4-20mA Output Card; Two Relay Outputs/2 Status Inputs Card; and Four KYZ Pulses/4 Status Inputs Card.

50. The 0-1mA Output Option Card shall provide the following features:

    a. Bi-directional from 0-1mA Outputs.

    b. Assignable to any measured parameter.

    c. 0.1% of full scale.

    d. Maximum load impedance to 10k Ohms, with no accuracy losses.

51. The 4-20mA Output Option Card shall provide the following features:

    a. Assignable to any measured parameter.

    b. 0.1% of full scale.

    c. Maximum load impedance to 500 Ohms, with no accuracy losses.

    d. Loop powered using up to 24 Volts DC.

52. The Two Relay Outputs/2 Status Inputs Option Card shall provide the following features:

    a. Status Inputs – Wet/Dry Auto Detect up to 300 VDC.

    b. Trigger on User Set Limits/Alarms.

    c. Set delays and reset delays.

53. The Four KYZ Pulses/4 Status Inputs Option Card shall provide the following features:

    a. Programmable to any Energy parameter and pulse value.

    b. Programmable to End of Interval Pulse.

    c. Can function for manual relay control and limit-based control.

    d. 120mA continuous load current.

54. Power meter shall be able to be stored in (-20 to +70) degrees C.

55. Operating temperature shall be (-20 to +70) degrees C.

56. A NEMA 12 faceplate rating shall be available for the meter.

PART 3 - EXECUTION

3.1 WIRING

A. Provide and install all wiring per manufacturer’s instructions.

3.2 INSTALLATION

A. General: Install electrical cables, wires, and connectors in compliance with NEC.

B. Install CTs compatible with unit and with adequate ratings for the system to be monitored.

C. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values.

D. Mount level and square with adequate clearance for ease of access at normal standing height.

3.3 FIELD QUALITY CONTROL

A. Prior to energizing, test wires and cables for electrical continuity and for short-circuits.

B. Verify unit is functioning properly. Replace any faulty or malfunctioning parts as needed and re-test.

END OF SECTION 26 27 13.11

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SECTION 26 27 26 – WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes receptacles, connectors, switches, and finish plates.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

A. Product Data: For each product specified.

B. Shop Drawings: Legends for receptacles and switch plates.

C. Maintenance Data: For materials and products to include in maintenance manuals specified in Division 1.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

B. Comply with NEMA WD 1.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for provided by others Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Wiring Devices:

    a. Cooper Wiring Devices

    b. Hubbell, Inc.; Wiring Devices Div.

    c. Leviton Manufacturing Co., Inc.

    d. Pass & Seymour/Legrand; Wiring Devices Div.

2. Wiring Devices for Hazardous (Classified) Locations:

    a. Crouse-Hinds Electrical Co.; Distribution Equipment Div.

    b. Killark Electric Manufacturing Co.

    c. Pyle-National, Inc.; an Amphenol Co.

3. Multioutlet Assemblies:

    a. Hubbell, Inc.: Wiring Devices Div.

    b. Wiremold.

2.2 RECEPTACLES

A. Straight-Blade and Locking Receptacles: Industrial grade Leviton 5362 or equal.

B. GFCI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle. Do not connect downstream receptacles to load side of GFCI. Design units for installation in a 2-3/4-inch-deep outlet box without an adapter.

C. Isolated-Ground Receptacles: Equipment grounding contacts connected only to the green grounding screw terminal of the device with inherent electrical isolation from mounting strap.

1. Devices: Listed and labeled as isolated-ground receptacles.

2. Isolation Method: Integral to receptacle construction and not dependent on removable parts.

D. TVSS Receptacles: Duplex type, NEMA WD 6, Configuration 5-20R, with integral TVSS in line to ground, line to neutral, and neutral to ground.

1. TVSS Components: Multiple metal-oxide varistors; rated a nominal clamp level of 500 transient-suppression voltage and minimum single transient pulse energy dissipation of 140 J line to neutral, and 70 J line to ground and neutral to ground.

2. Active TVSS Indication: Light visible in face of device to indicate device as "active" or "no longer active."

3. Identification: Distinctive marking on face of device denotes TVSS-type unit.

E. Hazardous (Classified) Location Receptacles: Comply with NEMA FB 11.

2.3 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

2.4 SWITCHES

A. Toggle Switches: Commercial-duty, quiet type.

1. Single Pole Switch: 20 A, 120/277-V AC. Leviton CSB 120 or approved equal.

2. 3-Way Switch: 20A 120/277-V AC: Leviton CSB 320 or approved equal.

2.5 WALL PLATES

A. Single and combination types match corresponding wiring devices. Provide the following wall plate types:

1. Finished Spaces: Nylon/Lexan – White (Emergency receptacle and switch plates shall be red in color and be engraved with the label “Emergency” and be labeled with the panel circuit number).

2. Unfinished spaces: Galvanized steel (Emergency receptacle and switch plates shall be red in color and be engraved with the label “Emergency” and be labeled with the panel circuit number).

3. Exterior non-continuous use: Die cast aluminum or impact resistant thermoplastic with spring loaded flip cover and weather-resistant gasket.

4. Exterior continuous use: Die cast aluminum or impact resistant thermoplastic with 3-1/2” deep “in-use” flip cover and weather-resistant gasket.

2.6 MULTIOUTLET ASSEMBLIES

A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

B. Raceway Material: Metal, with manufacturer's standard finish.

C. Wire: No. 12 AWG.

2.7 FINISHES

A. Color: White, unless otherwise indicated or required by Code.

2.8 RAISED COVERS, SURFACE MOUNTED

A. Single and double cover types to match the corresponding wiring device.

1. Interior spaces only.

2. Cover to be mounted to a 4 square device box.

3. Finish to be galvanized steel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies plumb and secure.

B. Install wall plates when painting is complete.

C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.

D. Do not share neutral conductor on load side of dimmers.

E. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

F. Protect devices and assemblies during painting.

G. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Section 26 05 00 – Electrical, General.

3.3 CONNECTIONS

A. Connect wiring device grounding terminal to outlet box with bonding jumper.

B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.

C. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.

D. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Check TVSS receptacle indicating lights for normal indication.

B. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

C. Replace damaged or defective components.

END OF SECTION 26 27 26

SECTION 26 28 00 – OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes overcurrent protective devices (OCPDs) rated 600 V and below and switching devices commonly used with them.

1.2 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 specification sections.

B. Product data for fuses, fusible switches, circuit breakers, and OCPD accessories specified in this Section, including descriptive data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Cartridge Fuses:
    a. Bussmann Div., Cooper Industries, Inc.
    b. Gould Inc.
    c. Littelfuse Inc.
2. Fusible Switches:
    a. General Electric Co.
    b. Square D Co.
    c. Siemens
    d. Eaton
3. Molded-Case Circuit Breakers:
    a. General Electric Co.
    b. Square D Co.
    c. Siemens

d. Eaton

4. Combination Circuit Breaker and Ground Fault Circuit Interrupters:

a. General Electric Co.

b. Square D Co.

c. Siemens

d. Eaton

5. Molded-Case Circuit Breakers With Solid-State Trip Devices:

a. General Electric Co.

b. Square D Co.

c. Siemens

d. Eaton

2.2 OVERCURRENT PROTECTIVE DEVICES (OCPD'S), GENERAL

A. General: Provide OCPD's in indicated types, as integral components of panelboards, switchboards, and also as individually enclosed and mounted single units.

B. Enclosures: NEMA 250 "Enclosures for Electrical Equipment (1,000 Volts Maximum)."

2.3 CARTRIDGE FUSES

A. General: NEMA Standard FU1, "Low-Voltage Cartridge Fuses." Unless indicated otherwise, provide nonrenewable cartridge fuses of indicated types, classes, and current ratings that have voltage ratings consistent with the circuits on which used.

B. Class RK1 and RK5 Dual Element Time-Delay Fuses: UL 198E, "Class R Fuses."

2.4 FUSIBLE SWITCHES

A. General: UL 98 "Enclosed and Dead Front Switches" and NEMA KS 1 "Enclosed Switches," quick-make, quick-break heavy-duty units.

B. Rating: Load-breaking capacity in excess of the normal horsepower rating for the switch.

C. Withstand Capability: In excess of the let-through current permitted by its fuse when subject to faults up to 100,000 RMS symmetrical amperes.

D. Operation: By means of external handle.

E. Interlock: Prevents access to switch interior except when in "off" position.

F. Fuse Clips: Rejection type.

G. Padlocking Provisions: For 2 padlocks, whether open or closed.

H. Enclosure for Independent Mounting: NEMA Type 1 enclosure except as otherwise indicated or required to suit environment where located.

2.5 MOLDED-CASE CIRCUIT BREAKERS

A. General: UL 489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures," and NEMA AB 1, "Molded Case Circuit Breakers."

B. Construction: Bolt-in type, except breakers 225-ampere frame size and larger may be plug-in type if held in place by positive locking device requiring mechanical release for removal.

C. Characteristics: Indicated frame size, trip rating, number of poles, and a short-circuit interrupting capacity rating of 10,000 amperes symmetrical, unless a greater rating as indicated.

D. Tripping Device: Quick-make, quick-break toggle mechanism with inverse-time delay and instantaneous overcurrent trip protection for each pole.

E. Adjustable Instantaneous Trip Devices: Factory adjusted to low-trip-setting current values.

F. Enclosure for Independent Mounting: NEMA Type 1 enclosure, except as otherwise indicated or required to suit environment where located.

G. Combination Circuit Breakers and Ground Fault Circuit Interrupters: UL 943 "Ground Fault Circuit Interrupters," arranged for sensing and tripping for ground fault current in addition to overcurrent and short-circuit current. Provide features as follows:

1. Match features and module size of panelboard breakers and provide clear identification of ground fault trip function.

2. Trip Setting for Ground Fault: 30 milliamperes.

2.6 OCPD ACCESSORIES

A. Shunt-Trip Devices for Circuit Breakers: Where indicated, arrange to trip breaker from an external source of power through a control switch or relay contacts.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Independently Mounted OCPD's: Locate as indicated and install in accordance with manufacturer's written installation instructions.

B. OCPD's in distribution equipment shall be factory installed.

3.2 CONNECTIONS

A. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.3 GROUNDING

A. Provide equipment grounding connections for individually mounted OCPD units as indicated and as required by NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.4 FIELD QUALITY CONTROL

A. Visual and mechanical inspection: Include the following inspections and related work.

1. Overcurrent-Protective-Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system arrangement and parameters. Where discrepancies are found, test organization shall recommend final protective device ratings and settings. Use accepted revised ratings or settings to make the final system adjustments.

2. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.

3. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.

4. Check tightness of electrical connections of OCPD's with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

5. Clean OCPD's using manufacturer's approved methods and materials.

B. Retest: Correct deficiencies identified by tests and observations and provide retesting of OCPD's. Verify by the system tests that specified requirements are met.

3.5 CLEANING

A. Upon completion of installation, inspect OCPD's. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

END OF SECTION 26 28 00

SECTION 26 29 13.13 - ACROSS-THE-LINE-MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes A.C. motor control devices rated 600 V and below that are not supplied as an integral part of a motor control center.

B. Related Sections include the following:

1. Section 26 05 00 – Electrical, General for general materials, installation methods, and labeling.

1.3 SUBMITTALS

A. Product data for products specified in this Section. Include dimensions, ratings, and data on features and components.

B. Maintenance Data: For products to include in the maintenance manuals specified in Division 1.

C. Load Current and Overload Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain similar motor-control devices through one source from a single manufacturer.

B. Comply with NFPA 70, UL, and NEMA.

C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms “Listed and Labeled”: As defined in the National Electrical Code, Article 100.

1.5 COORDINATION

A. Coordinate features of controllers and control devices with pilot devices and control circuits provided under Divisions 23, 40 – 46 Sections covering control systems.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Spare Fuses and Incandescent Indicating Lamps: Furnish 1 spare for every 5 installed units, but not less than 1 set of 3 of each kind.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Eaton

2. Allen-Bradley Co.; Industrial Control Group.

3. General Electric Co.; Electrical Distribution & Control Div.

4. Square D Co.

2.2 MANUAL MOTOR CONTROLLERS

A. Description: NEMA ICS 2, general purpose, Class A with toggle action and overload element.

2.3 MAGNETIC MOTOR CONTROLLERS

A. Description: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.

B. Control Circuit: 120 V. Provide control power transformer integral with controller where no other supply of 120 V control power to controller is indicated. Provide control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.

C. Combination Controller: Factory assembled with controller and arranged to disconnect switch with or without overcurrent protection as indicated.

1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by a nationally recognized testing laboratory.

D. Electronic Overload Relay: Assembly designed to meet the following minimum requirements:

1. NEMA ICS 2, Class 10 tripping characteristics selected to protect motor against voltage unbalance and single phasing.

2. Control Module shall be provided with a minimum of four (4) Inputs and three (3) Relay Outputs.

3. Sensing Module shall be capable of voltage protection, power protection and voltage, power, and energy monitoring.

4. Communication Module providing Ethernet/IP with (2) RJ45 ports that can support a star, linear and ring topologies. Additional functionality shall include:

5. Two (2) concurrent Class 1 connections. (One (1) exclusive owner and one (1) listen only)

6. Six (6) simultaneous Class 3 connections. (Explicit messaging)

7. Embedded EDS file.

8. Studio 5000 Add-on Profile

9. Autotransformer Reduced-Voltage Controller: NEMA ICS 2, closed transition.

E. Overload Relay: NEMA ICS 2, Class 10 tripping characteristics selected to protect motor against voltage unbalance and single phasing.

2.4 ENCLOSURES

A. Description: Flush or surface mounted cabinets as indicated. NEMA 250, Type 12, unless otherwise indicated to comply with environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.

2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

3. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

2.5 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.

F. Current-Sensing, Phase-Failure Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

PART 3 - EXECUTION

3.1 APPLICATION

A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

C. Use fractional-horsepower manual controllers for single-phase motors, unless otherwise indicated.

D. Use manual controllers for 3-phase motors up to 5 hp not requiring automatic or remote control.

E. Pushbutton Stations: In covers of magnetic controllers for manually started motors where indicated, start contact connected in parallel with sealing auxiliary contact for low-voltage protection.

F. Hand-Off-Automatic Selector Switches: In covers of manual and magnetic controllers of motors started and stopped by automatic controls or interlocks with other equipment.

3.2 INSTALLATION

A. Install independently mounted motor-control devices according to manufacturer’s written instructions.

B. Location: Locate controllers within sight of motors controlled, unless otherwise indicated.

C. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks .

D. Install freestanding equipment on concrete housekeeping bases conforming to Section 26 05 00 – Electrical, General.

E. Motor-Controller Fuses: Install indicated fuses in each fusible switch.

3.3 IDENTIFICATION

A. Identify motor control components and control wiring in accordance with Section 26 05 00 – Electrical, General.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between motor control devices in accordance to Division 26 Section "Wires and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic control devices where available.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5, 7.6, and 7.16. Certify compliance with test parameters.

2. Remove and replace malfunctioning units with new units, and retest.

3.5 CONNECTIONS

A. Tighten connectors, terminals, bus joints, and mountings. Tighten field connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, comply with tightening torques specified in UL 486A and UL 486B.

3.6 FIELD QUALITY CONTROL

A. Testing: After installing motor controllers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.

2. Remove and replace malfunctioning units with new units, and retest.

3.7 CLEANING

A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally using methods and materials as recommended by manufacturer.

END OF SECTION 26 29 13.13

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SECTION 26 29 23 – VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes solid-state, PWM and VFD, VFCs for speed control of three-phase, induction motors. These VFCs are to be enclosed in freestanding NEMA 250, Type 12, unless otherwise indicated to comply with environmental conditions at installed location, see Electrical Drawings and Divisions 40-46 and 46 specifications.

B. VFC vendor to provide VFC that will operate at installed altitude. Vendor shall verify altitude.

C. VFC vendor to provide dv/dt filter which is integral to the VFC enclosure for applications with output conductor lengths over 100 feet.

1.2 SUBMITTALS

A. Product Data: For each type of VFC, provide dimensions; mounting arrangements; location for conduit entries; shipping and operating weights; and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.

B. The following shall be included in the bid package:

1. Description of equipment and tests included in bid to meet the indicated power quality requirements.

2. Nearest factory authorized service center meeting all points of 1.03A.

3. Qualification and name of engineering and technical persons responsible for support and warranty of this project.

C. The following shall be included in the submittal package and be approved by the engineer prior to any construction of the VFC system:

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.

b. Nameplate legends.

c. Short-circuit current ratings of integrated unit.

d. UL listing for series rating of overcurrent protective devices in combination controllers.

e. Features, characteristics, ratings, and factory settings of each motor-control center unit.

2. Wiring Diagrams: Power, signal, and control wiring for VFC. Provide schematic wiring diagram for each type of VFC.

3. Detailed description of the filter equipment and sample graphs and data to meet IEEE 519-1992.

4. Carrier frequency information.

5. Detailed description of the dv/dt filter and product data, as applicable, to ensure protection for the pump motors against high frequency voltage spikes for the full operational range of switching frequencies with applied cable length to motor.

D. Qualification Data: For testing agency and manufacturer.

E. Field Test Reports: Written reports specified in Part 3.04D below.

F. Manufacturer's field service report.

G. Operation and Maintenance Data: For VFCs, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 26 05 00 – Electrical, General, include the following:

1. Routine maintenance requirements for VFCs and all installed components.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and 24 hour emergency maintenance and repairs.

B. Source Limitations: Obtain VFCs of a single type through one source from a single manufacturer.

C. The system shall be pre-integrated with the necessary harmonic mitigation equipment.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70, IEEE 519-1992, ANSI C37, and ANSI C57.

1.4 COORDINATION

A. Match features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.

B. Match features, accessories, and functions of each VFC and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load. See Division 40 sections for information on motor control sequence.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide products by the following:

1. Allen Bradley; Rockwell Automation.

2. Eaton

3. Or pre-approved Equal

B. Contractor job site integration of reactors, harmonic filters, power components, etc. may be required. Start-up, harmonic testing and warranty support services must be supplied by the above or other qualified company approved by engineer. Allowable harmonic limits to be coordinated with Avista Utilities.

2.2 VARIABLE FREQUENCY CONTROLLERS

A. Description: NEMA ICS 2, IGBT, PWM, VFD, VFC; listed and labeled as a complete unit and arranged to provide variable speed of a NEMA MG 1, Design B, 3-phase, induction motor by adjusting output voltage and frequency. Refer to Divisions 40 – 43 and 46 for additional information on motors controlled by VFCs.

B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

C. Output Rating: 3-phase; 6 to 120 Hz, with horsepower constant throughout speed range.

D. Unit Operating Requirements:

1. Input ac voltage tolerance of 480 V, plus or minus 10 percent.

2. Input frequency tolerance of 60 Hz, plus or minus 6 percent.

3. Output Rating: 3-phase; 6 to 66 Hz, with amperage equal or greater to motor nameplate amperage including altitude derating.

4. Minimum Inverter Efficiency: 96 percent at 60 Hz, full load.

5. Minimum Displacement Primary-Side Power Factor: 96 percent lagging.

6. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.

7. Starting Torque: Default to be 50% with adjustment to 120%.

8. Speed Regulation: Plus or minus 1 percent.

9. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.

E. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.

2. Maximum Speed: 80 to 100 percent of maximum rpm.

3. Acceleration: Adjustable from .01 to 3600 seconds.

4. Deceleration: Adjustable from .01 to 3600 seconds.

5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

F. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors.

2. Snubber networks to protect against malfunction due to system voltage transients.

3. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.

4. Filtering to prevent noise interference with other electronic equipment.

5. Motor Overload Relay: Adjustable.

6. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.

7. Instantaneous line-to-line and line-to-ground overcurrent trips.

8. Loss-of-phase protection.

9. Reverse-phase protection.

10. Short-circuit protection.

11. Motor overtemperature fault.

G. Automatic Reset and Restart: To attempt three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bi-directional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

H. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped. VFC to automatically re-start motor after outage.

I. Carrier Frequency Adjustment: Provide ability to manually adjust drive carrier frequency. VFCs 100HP and less shall provide carrier frequency adjustment capability from 1 to 10kHz. VFCs over 100HP shall include carrier frequency adjustment information recommended by the manufacturer.

J. Torque Boost: Automatically vary starting and continuous torque to at least 1.5 times the minimum torque to insure high-starting torque and increased torque at slow speeds.

K. Motor Temperature Compensation at Slow Speeds: Adjustable current fallback based on output frequency for temperature protection of self-cooled fan-ventilated motors at slow speeds.

L. Provide line and load side filtering to minimize total harmonic distortion.

M. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

N. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

O. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, and fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).

10. Motor output voltage (V).

P. Control Signal Interface: Provide VFC with the following:

1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.

2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:

a. 0 to 10-V dc.

b. 0-20 or 4-20 mA.

c. Potentiometer using up/down digital inputs.

d. Fixed frequencies using digital inputs.

e. RS485.

f. Ethernet connectivity using Ethernet/IP protocol

g. Keypad display for local hand operation.

h. Remote start/stop input

3. Output Signal Interface:

a. Provide two analog output signals (0/4-20 mA), which can be programmed for the following:

b. Output frequency (Hz).

c. Output current (load).

d. DC-link voltage (VDC).

e. Motor torque (percent).

f. Motor speed (rpm).

g. Set-point frequency (Hz).

4. Remote Indication Interface: Provide dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

a. Motor running.

b. Set-point speed reached.

c. Fault and warning indication (overtemperature or overcurrent).

d. PID high or low speed limits reached.

e. Drive system is in remote.

Q. Integral Disconnecting Means: Provide HACR rated breaker as indicated on drawings.

2.3 ACCESSORIES

A. Devices shall be factory installed in motor control enclosure.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Standard Displays:

1. Output frequency (Hz).

2. Set-point frequency (Hz).

3. Motor current (amperes).

4. DC-link voltage (VDC).

5. Motor torque (percent).

6. Motor speed (rpm).

7. Motor output voltage (V).

F. Current-Sensing, Phase-Failure Relays for Bypass Controller: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

G. Harmonic Mitigation: Complying with IEEE Standard 519-1992 shall be a requirement of this project. Harmonic filters, 18 pulse converter configurations, phase multiplication devices, or any other components required to mitigate harmonic voltage and current to IEEE Std. 519-1992 shall be an integral part of the VFC system. Designs which are not pre-integrated and factory wired as part of the UL label will not be acceptable.

1. Designs which cause voltage rise at the VFC terminals must document coordination with the total system variation to prevent nuisance tripping.

2. Designs which do not provide both true and displacement, measured at the VFC terminals, of at least 95% or better at full load are not acceptable. Designs that allow leading power factor at minimum loads are not acceptable.

H. Relevant data for VFC vendor calculations to meet IEEE Std. 519-1992 requirements are as follows:

1. The point of common coupling (PCC) shall be defined per 3.01.C below.

2. The calculated load current (I_L) shall be the total combined full load current of each ASD system supplied as part of this project or the total combined amperage of loads designated as “non-linear”.

3. The VFC vendor is responsible for determining the short circuit current (I_{SC}) available at the PCC.

I. Output dv/dt filter: Passive device, designed to protect AC motors from the destructive effects of peak voltages. Guaranteed to meet maximum peak motor voltage specification (150% of bus voltage) with up to 1,000 ft of cable between the filter and the motor.

1. Voltage range to meet system requirements and size to meet applied motor.

2. Continuous current rating of 100% RMS.

3. Intermittent current ratings of 150% for 1 minute.

4. Intermittent current ratings of 200% for 10 seconds.

5. Rated for designed altitude.

6. Rated for maximum ambient temperature: 50°C.

7. Insertion Loss: 3% of rated voltage maximum.

8. Audible Noise at two meters: 76dB-A maximum.

2.4 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Select features of each VFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, drive, and load.

B. Select rating of controllers to suit motor controlled. The VFC vender shall certify that the supplied equipment is properly matched to the loads being fed.

C. The drive shall be capable of operating in compliance with IEEE 519-1992, with point of common coupling (PCC) defined as the point at which each individual device is connected to the electrical distribution system. Drive manufacturer shall provide harmonic calculations and on-site post installation harmonic testing with certified reports prior to final acceptance of installation. See 3.04D.

3.2 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

3. All tests necessary to prove compliance with IEEE Standard 519-1992.

B. Testing: Perform the following field quality-control testing:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.4 STARTUP SERVICE

A. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 sections.

B. Complete installation and startup checks according to manufacturer's written instructions.

3.5 ADJUSTING

A. Set field-adjustable switches.

3.6 CLEANING

A. Clean VFCs internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain VFCs.

END OF SECTION 26 29 23

SECTION 26 32 13 – ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of engine generator set Work is indicated by drawings and is hereby defined to include, but not by way of limitation, engines, electrical generators, engine starting systems including batteries, instrument control panel, transfer switches, annunciator panel, exhaust silencer, and accessories required for a complete generator installation.

B. Generator set required for the project is a 1000kW, 480V, 3Ø, 4 wire diesel engine-driven unit.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on engine-driven generator sets and components. Submit wiring diagrams for engine-driven generator units showing connections to electrical power panels, feeders, automatic transfer switches, and ancillary equipment. Differentiate between portions of wiring that are manufacturer-installed and portions that are field-installed.

B. Maintenance data for materials and products, for inclusion in Operating and Maintenance Manual specified in Section 26 05 00 – Electrical, General. Include complete Operations and Maintenance Manual, Illustrated Parts List and Maintenance Schedule.

C. Certifications: Provide engine-driven generator sets certified test record of the following final production testing:

1. Single-step load pickup.

2. Transient and steady state governing. The generator will serve loads controlled by VFD’s. Manufacturer shall take appropriate measures. Refer to drawings for loads served.

3. Safety shutdown device testing.

4. Voltage regulation.

5. Rated power.

6. Maximum power.

D. Provide certified test record prior to engine-driven generator set being shipped from factory to project location.

E. Unit Responsibility: The complete standby emergency generator systems are to be tested under full load conditions, as a unit, before being shipped to the job site from factory. Installation and hook-up to be under direct supervision of factory trained personnel.

F. The automatic transfer control shall be supplied per specification Section 26 36 00 – Transfer Switches and integrated with the engine-generator.

G. Generator support shall be a factory authorized service center located within a 200 mile radius of the project site.

1.3 DELIVERY, STORAGE AND HANDLING

A. Deliver engine-driven generator properly packaged and mounted on pallets, or skids to facilitate handling of heavy items. Utilize factory-fabricated type containers or wrappings for engine-generator and components that protect equipment from damage.

B. Store engine-driven generator equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle engine-driven generator equipment carefully to prevent physical damage to equipment and components. Do not install damaged equipment; remove from site and replace damaged equipment with new.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering diesel generator sets which may be incorporated in the Work include the following:

1. Caterpillar Tractor Co.

2. Cummins Corp.

3. Kohler

4. Generac

5. MTU

B. Generator Sets

1. General: Except as otherwise indicated, provide manufacturer's standard engine-driven generator sets and auxiliary equipment as indicated by published product information, and as required for a complete installation.

2. Engine-Driven Generator: Provide packaged electrical power engine-driven generator assembly unit rated as indicated on drawings, at a governed speed of 1800 RPM, and rated 80 percent power factor for continuous operation, 480/277 volt, 3-phase, 4-wire, 60 Hz, at installed altitude (verify altitude), at 110 deg. F. Equip generator with a turbo-charged, 1800 RPM, engine, and fueled as noted; liquid cooled. Engine shall meet all EPA Tier level requirements at time engine is manufactured. Provide unit-mounted radiator, blower fan, water pump, and thermostat. Connect engine drive directly to 4-pole revolving-field type single, maintenance-free, bearing generator through semi-flexible steel disk coupling; equip set with associated control equipment to automatically start engine, transfer load to standby power upon failure of normal power source, transfer load back to normal power upon its restoration, and stop engine. Actual temperature rise measured by resistance method at full load shall not exceed 125 degrees Centigrade. Cushion-mount engine-generator on heavy steel base with spring type vibration isolators to reduce possibility of torsional vibration. Provide water-cooled type engine with unit-mounted radiator. Equip engine with low-oil pressure, high-water temperature, and automatic overspeed safety shutdown devices. Equip generator with exciter and voltage regulator to maintain voltage within 2 percent of rated value. Direct-connect generator to fly wheel by semi-flexible steel disk coupling. Provide unit capable of voltage recovery, within regulated range, of 7 seconds following sudden load increase from 0 to 100 percent of rated load, and with voltage dip not to exceed 35 percent upon application of rated load at rated power factor. Construct unit in compliance with applicable standards; and with additional construction features as indicated:

   a. Motor Starting Accessories: The generator will be used to feed motor loads that are controlled via variable frequency drives. Provide items for improved motor starting and generator regulation such as permanent magnet generator end, electronic governor, voltage regulators, etc..

   b. Starting System: Provide engine-generator units with 24-volt, 3-wire, negative ground, starting systems including 24-volt positive engagement solenoid shift-starting motors, batteries and 35-ampere, or greater, automatic battery charging alternators with solid-state voltage regulation.

   c. Instrument Control Panel: Provide engine-generator units with engine oil-pressure and water-temperature indicators, battery charge-rate ammeter, START - STOP switch for manual operation of unit, reset circuit breaker, static voltage regulator, voltage-adjusting rheostat, voltmeter, ammeter with phase selector switch with an OFF position, and with running time indicator and frequency meters. Select type circuitry of plug-in design capable of quick replacement, and of accepting a plug-in device that allows maintenance to test control panel performance without operating the engine.

   d. Controller: Provide a set mounted controller that complies with applicable NFPA standards. Controller shall provide all indicators, alarms, and monitoring functions that a Cummins Power Command Control 2100 provides per NFPA 110 level one requirement. Controller shall be accessible without the use of ladders, steps, etc.

e. Connection to Data Link: Provide an Ethernet IP connection to SCADA. The controls shall have the ability to communicate in a common protocol with the programmable logic controller for the following:

1) Engine high-temperature shutdown.

2) Lube-oil low-pressure shutdown.

3) Overspeed shutdown.

4) Remote emergency-stop shutdown.

5) Engine high-temperature pre-alarm.

6) Lube-oil low-pressure pre-alarm.

7) Fuel tank, low-fuel level.

8) Low coolant level.

9) Over crank shutdown.

10) Coolant low-temperature alarm.

11) Control switch not in auto position.

12) Battery-charger malfunction alarm.

13) Battery low-voltage alarm.

f. Provide hardwired dry contact connection to SCADA for the following signals:

1) Generator Running

2) Generator Fault

3) Generator not in Auto.

2.2 ENGINE-GENERATOR SET ACCESSORIES

A. Provide factory-fabricated automatic load-transfer switch control, mated to generator to automatically start generator unit when line voltage drops to 70 percent normal value, transfer load to generator, and transfer load back to normal source when voltage is restored to 90 percent normal, and when line voltage reaches 115% rated voltage, restoring at 100% rated voltage. Equip electrically operated, mechanically held, and electrically and mechanically interlocked, transfer switch with limiter that opens starting circuit after 45 seconds when engine fails to start. Also provide time-delay features to prevent excessive transfer and retransfer operation during momentary line voltage dips, load retransfer, and engine shutdown. Equip unit with indicator for starting, test switch for manual simulation of power outages including standby unit operation and load transfer, and time-clock exerciser circuit for automatic periodic exercise under load of engine-generator unit. Provide 120V control circuit for control of louvers. Provide service rated main circuit breaker mated to generator. Breaker shall be accessible without the use of ladders, steps, etc.

B. Provide battery rack, battery warmers, battery cables, 12-volt battery(ies) capable of delivering the minimum cold-cranking amps required at zero degrees Fahrenheit per SAE Standard J-537.

C. Provide gas proof, seamless, stainless steel, flexible exhaust connector.

D. Provide flexible fuel line(s) rated 300 degrees F and 100 PSI ending in pipe thread.

E. Provide engine exhaust silencer, coated to be temperature and rust resistant, rated for critical applications 35dB reduction. Exhaust silencer to be housed inside of weatherproof enclosure.

F. Provide block heater of proper wattage and voltage, thermostatically controlled to maintain engine coolant at 90 degrees Fahrenheit (32 degrees Celsius). The block heater shall be installed with shut-off valves for maintenance. Valves to be field installed.

G. Provide 10-ampere automatic float and equalize battery charger with +/- 1% constant voltage regulation from no load to full load over +/- 10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambients from -40 degrees C to +60 degrees C, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected.

H. Provide a U.L. 142 label double wall sub base fuel tank of adequate capacity to operate generator 24 hours at full load. Tank shall be of steel construction and installed under the generator. Provide Sub Base Tank to include C Channel or I beam welded beneath the tank spaced 40 inches apart to accept neoprene pads between support beams and concrete floor. Tank shall be equipped with normal and emergency venting. Provide all necessary piping for a complete venting system. Venting shall comply with applicable requirements of IFC. Tank openings and overflow protection shall comply with IFC. Tank to be equipped with supply/return lines installed to engine, low fuel level switch, leak detection, and tank heater. Install tank and accessories per applicable codes, standards, and manufacturers requirements.

I. Provide U.L listed weatherproof sound attenuated (79dB at 23 feet) housing. Housing to be finished inside and out with a rust-inhibiting primer, and then a top coat paint. Side panels to be removable for maintenance and lockable. Provide necessary louvers and exhaust silencer connections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which diesel engine-driven generator units are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.2 INSTALLATION OF DIESEL ENGINE-DRIVEN GENERATOR SETS

A. Install engine-driven generator unit as indicated, in accordance with the equipment manufacturer's written instructions, and with recognized industry practices, to ensure that engine-generator unit fulfills requirements. Comply with NFPA and NEMA standards pertaining to installation of engine-generator sets and accessories.

B. Coordinate with other work, including raceways, electrical boxes and fittings, fuel tanks, piping and accessories, as necessary to interface installation of engine-generator equipment work with other work.

C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A, B and the National Electrical Code.

D. Align shafts of engine and generator within tolerances recommended by engine-generator unit manufacturer.

E. Contractor or Owner to fill tank prior to testing.

3.3 GROUNDING

A. Provide equipment grounding connections for diesel engine-driven generator units as indicated. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounding.

3.4 FIELD QUALITY CONTROL

A. Start-up Testing

1. Engage local equipment manufacturer's representative to perform start-up and load tests upon completion of installation, with the Engineer in attendance; provide certified test record. Tests are to include the following:

a. Check fuel, lubricating oil, and antifreeze in liquid cooled models for conformity to the manufacturer's recommendations under environmental conditions present.

b. Test, prior to cranking engine for proper operation, accessories that normally function while the set is in a standby mode.

c. Check, during start-up test mode, for normal and emergency line-to-line voltage and phase rotation.

d. Test, by means of simulated power outage, automatic start-up by remote-automatic starting, transfer of load, and automatic shutdown. Prior to this test adjust, for proper system coordination, transfer switch timers. Monitor throughout the test, engine temperature, oil pressure, battery charge level, generator voltage, amperes, and frequency. All tests shall be conducted with generator under full (100%) load. Full load test shall be minimum 4 hours under full load.

2. Upon completion of installation demonstrate capability and compliance of system with requirements. Where possible, correct malfunctioning unit at site, then retest to demonstrate compliance; otherwise, remove and replace with new unit, and proceed with retesting. Initial testing and retesting to be at no cost to Owner.

3. Upon completion of all tests and Owner acceptance, Contractor to top off fuel tank.

3.5 PERSONNEL TRAINING

A. Building Operating Personnel Training: Train Owner's building personnel in procedures for starting-up, testing and operating diesel engine-driven generator sets. In addition, train Owner's personnel in periodic maintenance of batteries.

END OF SECTION 26 32 13

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SECTION 26 35 25 – PASSIVE HARMONIC FILTERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope

1. Provide all labor, materials, equipment and incidentals as shown on the DRAWINGS, specified and required to furnish and install the harmonic filter to limit harmonic voltage and current to acceptable levels as defined by IEEE Std 519-2014.

2. The harmonic filter shall be designed to filter all characteristic low frequency harmonics (5^{th}, 7^{th}, 11^{th}, 13^{th}, etc.), generated from three phase diode rectifier loads such as variable frequency drives (VFD), while improving the system power factor.

3. The harmonic filter shall be installed on the front end of the VFD as indicated on the Submittal Drawings.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown and specified.

1. Voltage and current harmonic mitigation per IEEE-519-2014. The Point of Common Coupling (PCC) for all voltage and current harmonic calculations and measurements shall be at the input terminals of the harmonic filter in combination with the VFD. The filter supplier shall not be responsible for pre-existing voltage distortion caused by other harmonic sources.

2. The harmonic filter shall be UL 508 listed and labeled.

3. The harmonic filter shall be warranted free from defects both in materials and in workmanship for a period of three years from the date of shipment, when applied in accordance with the manufacturer’s recommended procedures.

4. The filter shall not adversely react with or resonate with the power system or attract harmonics from other sources.

1.3 SUBMITTALS

A. Submittal Drawings shall include the following information:

1. Outline dimensions and weight.

2. Customer connection and power wiring diagrams.

3. Complete technical product description.

1.4 ENVIRONMENTAL CONDITIONS

A. The harmonic filter shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics or life.

1. Operating Ambient Temperature: -40°C to 40°C.

2. Storage Temperature: -40°C to 60°C.

3. Relative Humidity: 0 to 95%, non-condensing.

4. Altitude: Operating at 1342 meters (4,403 ft).

1.5 WARRANTY

A. The harmonic filter shall be warranted to be free of defects both in materials and in workmanship for a period of 3 years from the date of shipment.

1.6 PERFORMANCE REQUIREMENTS

A. Input Power

1. Voltage: 480 Volt, 3Ø, 3W

2. Frequency: 60 Hz

3. The filter HP rating(s) shall be determined in accordance with the drawings.

B. Output Performance

1. Harmonic Correction:

a. The Total Demand Distortion (TDD) of the current at the input terminals of the filter, in combination with the variable frequency drive, shall not exceed 5% THID at full rated load and given the filter is correctly applied.

b. The Total Harmonic Voltage Distortion (THVD) at the input terminals of the filter in combination with the variable frequency drive shall not exceed the limits defined in Table 2 of IEEE-519 (2014). The filter supplier shall not be responsible for pre-existing voltage distortion caused by other harmonic sources.

2. When the VFD is in bypass, the motor is connected across the line. In this line connected arrangement, the filter will improve the power factor by at least 0.05 for motors with poor power factor (<0.85).

3. The full load efficiency of the filter shall not be less than 97% for filters larger than 5 HP or less than 98.5% for filters larger than 25 HP.

4. The filter may produce a capacitive reactive power (KVAR) less than or equal to 40% of its HP rating over the full load range.

5. Voltage Regulation: The voltage regulation at the VFD terminals and attributable to the filter shall not exceed 5%. Filters with greater than 10% voltage drop, and/or filters that have capacitors in series with the VFD, are not acceptable.

PART 2 - PRODUCT

2.1 GENERAL

A. Voltage: 480 Volts, 60 Hz, 3 phase, 3 wire plus ground.

B. Current Rating: Provide the rated current as indicated on the Submittal Drawings.

C. Manufacturer:

1. TCI

2. Products offered from the manufacturer of the VFD.

3. Or engineer approved equal.

2.2 HIGH PERFORMANCE CAPACITOR CELLS

A. Capacitor cells shall have a voltage rating capable of handling nominal system voltage plus 10% continuously. Capacitor windings shall be metalized film construction consisting of aluminum-coated electrodes that are vacuum-deposited on polypropylene dielectric film. Dielectric material shall be low-loss (no more than 0.25 watts per kVAR). Capacitor cells themselves shall be rated to operate at a temperature of at least 65°C on the capacitor case. The capacitance tolerance shall be not more than ±10%. Capacitors shall be UL recognized.

B. Liquid-filled capacitor cells shall be contained in hermetically sealed metal cans. Impregnate, if used, shall be biodegradable and not contain PCBs. Capacitor cells shall have a pressure-sensitive circuit interrupter which, in case of a hazardous internal pressure increase, will disconnect all three phases simultaneously.

C. Individual capacitor cells, or groups of cells, shall be provided with a 3-phase discharge resistor network or individual resistors in the case of single-phase capacitors. The resistors shall be sized to reduce residual voltage to less than 50V within one minute of de-energization (NEC article 460-6).

2.3 INDUCTORS

A. Both shunt circuit inductors and series line reactors shall be designed for harmonic filtering service and for slowing the rate of rapid current changes. The inductors shall be UL component-recognized or listed and shall be built to comply to UL 508. Construction shall be of copper wire-wound on magnetic steel cores. Inductors shall be three-phase. Series line reactors shall be sized appropriately for the total connected load. Design maximum temperature rise for inductors shall be 135°C on bobbin wound and 155°C on form wound devices at rated current.

B. Windings shall consist of copper wire. Terminations shall be copper alloy ring lugs, UL-recognized terminal blocks, or solid copper bus. Sheet insulation shall be DuPont Nomex 410, IPT Cequin, or 3M ThermaVolt AR of the thickness as required for UL insulation systems.

C. Completed inductors shall be impregnated, using 100% solids epoxy resin. All insulation varnish systems shall be UL recognized and rated 180°C Class H, 200°C Class N, or 220°C Class R, 600V. Inductors shall be Hi-Pot tested (2,640V, 60 Hz, 1 second) line-to-line and line-to-ground.

2.4 WIRE

A. Capacitor current-carrying wire shall consist of copper with thermoplastic insulation that is rated at 600V and for a minimum of 105°C. Wire shall be: NEC-rated, MTW, and UL style AWM. Control wire shall be copper wire that is rated at 600V for 90°C. Signal wire shall be multi-conductor jacketed wire that is rated for 300V at 80°C.

2.5 ENCLOSURE

A. The harmonic filter shall be offered in a stand-alone UL Type 1 or UL Type 3R enclosure based on installed location as indicated on the plans.

B. The paint shall be the manufacturer’s standard type and color.

2.6 COMMUNICATIONS/CONTROLS

A. The harmonic filter shall be equipped with communication capability and shall provide access, via serial communications, to real-time system performance data. This data shall be accessible via SCADA system interface and shall include:

1. Filter input and output RMS Voltage

2. Filter input and output RMS Current

3. Filter Input Current THD

4. Filter Input Voltage THD

5. Input Displacement Power Factor

6. Filter Contactor Status

7. Non-Critical Faults including:

a. Over/Under input/output current

b. Over/under input/output voltage

c. Current and Voltage THD irregularities

d. Current imbalance

8. Critical Faults including:

   a. Filter over/under current

   b. Filter over/under voltage

   c. Capacitor Failure

   d. Contactor failure

   e. Phase loss

   f. Blown Fuse indication

B. The harmonic filter shall have the ability to communicate over a standard industrial Ethernet or Modbus RTU communications network.

C. The filter shall monitor system performance parameters without the use of current transformers.

D. The harmonic filter shall provide local control to the filter contactor based on RMS load current, current THD/TDD, or displacement power factor, as measured at the filter input terminals.

E. The filter control shall have the ability, via active control, to ensure that the filter does not contribute leadings VARs on to the power system.

F. The harmonic filter shall be able to provide trend history data for RMS voltage, RMS current, current THD, voltage THD, and power factor as measured by the filter input and output terminals.

G. Adjustable operational parameters shall be password protected.

2.7 DESIGN

A. The harmonic filter shall suppress characteristic harmonics without the requirement to phase shift against other harmonic sources or without the need for individual tuning.

B. The harmonic filter shall consist of inductive element(s) in series with the load and an inductive-capacitive network in shunt with the load. The shunt circuit shall be tuned to 4.7 times the fundamental frequency.

C. To control leading VARs on the power system or to enhance compatibility, the PQconnect connectivity option shall provide the disconnect means for the filter capacitors via active data monitoring and contactor control. 120V power shall be provided internal to the filter to power the contactor and PQconnect board.

PART 3 - EXECUTION

3.1 TESTING

A. All reactors shall be functionally tested to verify inductance and the filter assembly shall be functionally tested for proper connections and wiring configuration.

B. Every filter shall be tested at no load current at the manufacturing facility.

C. Manufacturing facility shall have harmonic performance testing capability with VFD loads.

3.2 EXAMINATION

A. Verify that location is ready to receive equipment.

B. Verify that the building environment can be maintained within the service conditions required by the manufacturer of the harmonic filter.

3.3 INSTALLATION

A. Installation shall be in compliance with all applicable local codes and all manufacturer requirements, instructions and drawings.

END OF SECTION 26 35 25

SECTION 26 35 26 – ACTIVE HARMONIC FILTERS (AHF)

PART 1 - GENERAL

1.1 SUMMARY

A. This specification defines the requirements for active harmonic filter systems in order to meet IEEE-519-2014 electrical system requirements for harmonic current limits. The active harmonic filter shall have the capability to maintain power factor between 0.95 and 0.999 lagging when operated within limits. These filters are to be enclosed in freestanding NEMA 250, Type 12, unless otherwise indicated to comply with environmental conditions at installed location.

B. The active harmonic filter shall electronically supply the non-fundamental current demanded by the non-linear load that results in a near sinusoidal current being drawn from the supply.

1.2 STANDARDS

A. The active harmonic filter system shall be designed in accordance with the applicable sections of the following documents.

1. IEEE std 519-2014
2. UL 508
3. ARRA – American Recovery Investment Act
4. Manufactured in the USA
5. The products shall include third party approvals by cULus.

1.3 SUBMITTALS

A. Product Data: For each filter, provide dimensions; mounting arrangements; location for conduit entries; shipping and operating weights; and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.

B. The following shall be included in the bid package:

1. Detailed description of equipment and tests included in bid to meet the indicated power quality requirements. Include sample graphs and data to meet IEEE 519-1992.
2. Nearest factory authorized service center meeting all points of 1.03A.
3. Qualification and name of engineering and technical persons responsible for support and warranty of this project.

C. The following shall be included in the submittal package and be approved by the engineer prior to any construction of the active harmonic filter system:

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.

b. Nameplate legends.

c. Short-circuit current ratings of integrated unit.

2. Wiring Diagrams: Power, signal, and control wiring. Provide schematic wiring diagram for each type of harmonic filter.

D. Field Test Reports: Written reports specified in Part 3.05D below.

E. Manufacturer's field service report.

F. Operation and Maintenance Data: For harmonic filters, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 26 05 00 – Electrical, General, include the following:

1. Routine maintenance requirements for active harmonic filter and all installed components.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain AHFs of a single type through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

A. Match features of AHFs, installed units, and accessory devices with communication devices and control circuits to which they connect.

B. Coordinate placement for installation of AHFs and CTs with related equipment to ensure adaquate space is available for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide products by the following:

1. Mesta

2. TCI

3. Eaton

4. Or equal as approved by the engineer.

2.2 ACTIVE HARMONIC FILTERS

A. System Description

1. Voltage: 480/600 Volts, 60 Hz, 3 phase, 3 wire plus ground.

2. Current Rating: Provide the rated current as indicated on the drawings

3. Current Transformers:

a. Two current transformers are required and mounted on phases A & C.

b. Current transformers are an integral part of the active harmonic filter. When current transformers are installed external to the active harmonic filter equipment, the contractor shall be responsible for the installation of manufacturer provided current transformers.

c. Current ratings of the current transformers shall be according to full load current of the circuit on which installed. Primary rating or 500A, 1000A, 3000A, or 5000A with a secondary rating of 5A are acceptable.

d. Current transformers rated for 400 hertz shall be used.

e. The current transformers shall be placed as close as possible to the non-linear load to be conditioned, within manufacturer guidelines.

B. Performance Requirements

1. Response Time:

a. In a steady state condition, the active harmonic filter shall have a response time of less than one (1) line cycle.

b. In the event of a load change or transient condition, the response time shall be within three (3) line cycles.

2. Input Power:

a. Voltage: 480 Volt, 3 phase, 3 wire plus ground

b. Voltage Tolerance: +/- 10% of nominal

c. Frequency: automatically adapted to 60Hz, +/- 3%

d. Input Circuit Breaker: 65 kAIC (min), or 100 kAIC Rated (if specified elsewhere)

3. Output Performance

a. Performance of the active harmonic filter shall be independent of the impedance of the power source. All performance levels shall be attained whether on the AC lines, backup generator, or output of UPS.

b. Harmonic Correction:

1) Limit the 2nd through 50th order harmonic current to <5% TDD (or, if specified elsewhere, to the calculated level per IEEE std 519) at each installed location indicated herein. Levels for individual harmonic orders shall comply with respective levels established in ANSI/IEEE std 519-2014, Table 2.

2) Limit the THD (V) added to the electrical system immediately upstream of the active line conditioner location(s) to less than or equal to 5%. The active harmonic filter shall not correct for utility supplied voltage distortion levels.

c. When sized properly, reactive Current Compensation shall be capable of improving power factor to be to between 0.90 and 0.999 lagging. All linear and non-linear load must be documented.

2.3 ENCLOSURE

A. Each filter shall be provided in a UL Type 1, 12, or 3R rated enclosure.

B. All enclosed units shall have means to prevent the door from being opened when the unit is energized. This can be achieved by either:

C. A door-interlocked circuit breaker that provides power interruption when the door is opened. The circuit breaker shall be lockable in the power-off position. Units shall be disconnected from the power source by a disconnect device or circuit breaker contained in the power distribution center as defined by local and national codes for branch circuit protection. OR

D. A mechanism that locks the door when the unit is energized. The unit may be fed using an external disconnect or breaker.

E. Freestanding units shall include lifting provisions by forklift truck and lifting lugs. Wall mount units weighing more than 80 pounds shall be equipped with a means of lifting, such as lifting lugs.

F. Door Mounted Digital HMI Operator Interface option.

G. All units shall be provided with a grounding lug. Grounding by the contractor is to be performed according to local and national standards.

2.4 OPERATOR CONTROLS AND INTERFACE

A. The active harmonic filter shall require minimal field programming.

B. The active harmonic filter shall contain a color touch screen display with the following features:

1. Easily navigable screens, including Home, Status, Fault and Setup screens.

2. Display voltage and current waveform data along with RMS metering data.

3. A gauge-based indicator of active filter current usage, from 0 to 100% of capacity. Dual state indications of nominal operation and “at capacity” operation.

4. An alarm history buffer saved in non-volatile. Buffer information shall persist between power outages, with a minimum of 128 event entries.

5. Ability to set the end user Line/Load CT ratio of the active harmonic filter system.

6. The Operator Interface shall show THD, Power Factor, RMS Current, RMS Voltage, and Fault History.

C. The active harmonic filter shall have the ability to operate in three (3) modes: i) harmonic correction only mode, ii) power factor correction only mode, or iii) combination harmonic and power factor mode. All three control modes shall be configurable from the local operator color touch screen display.

D. The active harmonic filter shall have a configurable relay-based run/stop command input in addition to the manual and auto run/stop commands. The active filter shall have a configurable relay-based fault output. Each contact shall be rated for 2.0 Amperes at 250 volts.

E. The filter shall have a configurable network-based run/stop command input in addition to the manual and auto run/stop commands.

F. The filter shall have the ability to load and save operational parameters in non-volatile persistent memory and the ability to revert to factory default parameter settings.

G. The filter shall have the ability to communicate over standard industrial Ethernet communications network, Ethernet/IP.

H. The unit shall automatically begin to correct harmonic currents after power up without the need for operator intervention.

I. The unit shall have the ability to display trend history data for line voltage, line current, filter current, current THD, filter bus voltage, and filter heatsink temperature.

2.5 DESIGN

A. All active harmonic filters shall be defined as power electronic devices which consist of power semiconductors and a DC bus that acts to inject current into the AC line that will cancel undesirable harmonic currents drawn by the load. A DC bus shall store power for power semiconductor switching. A digital microcontroller shall control the operation of the power converter.

B. The active harmonic filter shall feature fully digital synchronous frame controls for selected harmonics to enhance drive load compatibility.

C. The active harmonic filter shall feature a fully digital, broadband current regulator with progressive gains to eliminate system resonance tuning issues and simplify startup and commissioning.

D. The active harmonic filter shall feature single processor control of all power electronic devices per a single active filter to reduce fault response latency and harmonic correction loop times

E. Each unit shall be designed with over-current and current limiting self-protection. Operation shall continue indefinitely at manufacturer defined safe operating levels without trip off or destruction of the active harmonic filter.

F. Large units (capacity>350A) shall have built in redundancy so at least one half of the corrective current capacity is available after a normal single point fault.

G. All inductive elements in the power circuit of active harmonic filter shall be coreless, in order to maintain constant inductance and avoid saturation at high current levels

H. Units shall detect heatsink temperature and have the ability to fold back the current limit based on the temperature measurement.

I. Two distinct levels of faults shall be employed: Critical and Non-critical levels Non-critical level faults will provide automatic restart and a return to normal operation upon automatic fault clearance. Critical level faults stop the function of the unit and await operator action to restart.

1. Faults such as AC line power loss shall be automatically restarted upon power restoration. Upon removal of these fault conditions, the active line conditioner shall restart without user action.

2. All other faults shall be considered critical faults and stop the active harmonic filter. The run relay shall be disabled and the fault relay enabled. User shall be required to initiate a power reset (cycle power off and on) to restart the active harmonic filter.

J. The logic of the active harmonic filter shall monitor the load current by utilizing two (2) current transformers (CTs) mounted on phases A and C to direct the function of the power electronic converter.

K. Multiple active harmonic filters may be installed in parallel to inject current. The units will function independently. If one unit is stopped or faulted, the remaining units will continue to operate normally.

L. Individual unit characteristics, including sample drawings, weight, and watts loss, can be found in the Installation, Operation, and Maintenance Manual.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive AHFs for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Verify that the jobsite environment can be maintained during and after installation within the service conditions required by the manufacturer.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Installation shall be in compliance with all manufacturer requirements, instructions, and contract drawings, including:

1. Space surrounding the active harmonic filter to maintain adequate cooling.

2. Conditioning of space surrounding the active harmonic filter enclosure to maintain the manufacturer’s ambient temperature and humidity ranges.

3. Accessibility of the active harmonic filter diagnostic lights and communication ports – these components shall be free from obstructions at all times.

B. Coordinate placement and installation of CTs with related equipment. Provide conduit and cable as required for complete installation.

C. Interface

1. Provide all required cables and connectors to interface with other equipment.

2. Ensure that communication connections and wiring are properly protected in accordance with manufacturer recommendations.

3.3 IDENTIFICATION

A. Operating Instructions: Provide printed operating instructions for AHFs, including control sequences. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of AHF units.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each AHF element, bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

3. All tests necessary to prove compliance with IEEE Standard 519-1992.

B. Testing: Perform the following field quality-control testing:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.

2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.6 STARTUP SERVICE

A. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 sections.

B. Complete installation and startup checks according to manufacturer's written instructions.

C. At a minimum, the start-up service shall include:

1. Pre-power check:

a. Verify proper active filter installation and clearances

b. Inspection of the filter for damage and debris

c. Verify critical electrical and mechanical connections are tight

d. Tug test internal connections and verify wiring

e. Update hardware if appropriate

f. Verification of proper power connection at filter input terminals

g. Verification of proper CT installations and electrical connections

2. Active harmonic filter power-up and commissioning:

a. Power the active harmonic filter and perform operational checks

b. Update software if appropriate

c. If applicable run the filter with VFD load and tune filter to system attributes

D. Performance measurements shall be recorded

E. Active harmonic filter parameter listing shall be provided

3.7 ADJUSTING

A. Set field-adjustable switches.

3.8 CLEANING

A. Clean AHFs internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain AHFs.

END OF SECTION 26 29 23

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SECTION 26 36 00 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this Section.

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

C. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, Section 01 78 23 - Operation and Maintenance Data, include the following:

1. Features and operating sequences, both automatic and manual.

2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a 100 mile radius of project location.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

C. Source Limitations: Obtain automatic transfer switches through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NEMA ICS 1 – Industrial Control and Systems: General Requirements.

F. Comply with NFPA 70 – National Electric Code.

G. Comply with NFPA 110 – Standard for Emergency and Standby Power Systems.

H. Comply with UL 1008 unless requirements of these Specifications are stricter.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Contactor Transfer Switches:

a. Caterpillar; Engine Div.

b. Schneider; ASCO Power Technologies, LP.

c. Onan/Cummins Power Generation; Industrial Business Group.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: (Closed Transition) Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Switch Action: Double throw; mechanically held in both directions.

2. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

H. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.

I. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

J. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 05 00 "Electrical Identification."

K. Enclosures: General-purpose NEMA 3R, complying with NEMA ICS 6 and UL 508, unless otherwise indicated/required.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

B. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

C. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

D. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

E. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

F. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.

G. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.

2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.

3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.

4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.

5. Test Switch: Simulate normal-source failure.

6. Switch-Position Pilot Lights: Indicate source to which load is connected.

7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

   a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."

   b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.

9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.

10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.

11. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.

    b. Push-button programming control with digital display of settings.

    c. Integral battery operation of time switch when normal control power is not available.

2.4 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details.

B. Identify components according to Section 26 05 00 – Electrical, General.

C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Section 26 05 26 – Grounding and Bonding for Electrical Systems.

C. Connect wiring according to Section 26 05 19 – Low-Voltage Power Conductors and Cables.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.

2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

    a. Check for electrical continuity of circuits and for short circuits.

    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.

    c. Verify that manual transfer warnings are properly placed.

    d. Perform manual transfer operation.

5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.

    b. Simulate loss of phase-to-ground voltage for each phase of normal source.

    c. Verify time-delay settings.

    d. Verify pickup and dropout voltages by data readout or inspection of control settings.

    e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.

    f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

B. Coordinate tests with tests of generator and run them concurrently.

C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

D. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below.

B. Coordinate this training with that for generator equipment.

END OF SECTION 26 36 00

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SECTION 26 43 13.A - SURGE PROTECTIVE DEVICES (SPD) FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SCOPE

A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers (MCC). Refer to related sections for surge requirements in:

1.2 RELATED SECTIONS

A. Section 26 24 13.21 – Switchboards

B. Section 26 24.16 – Panelboards

1.3 REFERENCES

A. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable standards.

1. ANSI/UL 1449 4th Edition or later
2. ANSI/UL 1283 5th Edition or later (Type 2 applications)
3. IEEE C62.41.1
4. IEEE C62.41.2
5. IEEE C62.43-2005
6. IEEE C62.45-2002
7. IEEE C62.48-2005
8. IEEE C62.62-2010
9. UL 96A
10. NFPA 780
11. FCC Part 15, Subpart B and ICES-003 – Radiated Emissions (for surge protection devices with communication capabilities)

12. FCC Part 15, Subpart B and ICES-003 – Conducted Emissions (for surge protection devices with communication capabilities)

1.4 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:

1. Provide verification that the SPD complies with the required ANSI/UL 1449 4th Edition or later listing by Underwriters Laboratories (UL). Compliance may be in the form of a file number that can be verified on UL's website www.ul.org, the website should contain the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current In.

B. Where applicable the following additional information shall be submitted to the engineer:

1. Descriptive bulletins

2. Product sheets

1.5 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Section 1.04 and shall incorporate all changes made during the manufacturing process.

1.6 QUALIFICATIONS

A. The manufacturer of the electrical distribution equipment shall be the manufacturer of the SPD within the listed electrical distribution equipment.

B. For the equipment specified herein, the manufacturer shall be ISO 14001 and ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of twenty-five (25) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU and have a visible label showing compliance.

E. The SPD shall be UL 1449 current edition listed, 20 kA I_n Type 1 or Type 2 for use in UL 96A systems.

1.7 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

1.8 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals shall be provided with each SPD shipped.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Eaton

1. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.2 VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.

2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.

3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards. End of life mode to be open circuit. Unit with end of life short-circuit mode are not acceptable.

4. Unit shall operate without the need for an external overcurrent protection device (OCPD) and be listed by UL as such. Unit must not require external OCPD or replaceable internal OCPD for the UL Listing.

5. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

Protection Modes				
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

6. Nominal Discharge Current (In) – All SPDs applied to the distribution system shall have a 20kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an In less than 20kA shall be rejected.

7. ANSI/UL 1449 4th Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 4th Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable single-mode modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.

3. Electrical Noise Filter – Each Type 2 unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.

4. Type 2 units with filtering shall conform to UL 1283 5th Edition.

5. Type 1 units shall not contain filtering or have a UL 1283 5th Edition Listing.

6. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

7. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:

   a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

      1) For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.

2) For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes

3) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

b. Remote Status Monitor (optional) – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

c. Audible Alarm and Silence Button (optional) – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

d. Surge Counter (optional) – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.

1) The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.

e. Advanced Monitoring Display (AMD) (optional) - The SPD shall be equipped with an LCD display that indicates to the user the quantity and magnitude of surges that have occurred on each phase.

1) AMD shall display remaining surge protection levels as a percentage with 0% = unprotected, 1-99% = partially protected, 100% = fully protected.

2) In addition to the green/red monitoring solid-state indicator LED (reference 2.E.a) the LED shall include a yellow status to indicate the unit as partially protected

3) AMD shall provide a surge counter for each phase with three categories as defined by IEEE standards (C62.41) as follows:

4) Low Level surge (IEEE Category A)

5) Medium Level surge (IEEE Category B)

6) High Level surge (IEEE Category C)

7) AMD shall provide local access to the following information and data: Surge counts for each phase and per category, total surge counts, event logs with time & date stamps (last 20 events of each category per phase), SPD Protection Level percentage, alarm status, device catalog number, style number, serial number, date code, firmware version, PCB serial number, device name, IP address, ethernet MAC address, and customer support contact information.

8) User shall be capable of inputting the following info into the AMD: set date and time, set device name, change password, clear surge counts & event logs, edit MODBUS status, Edit IP Address, Edit Subnet Mask, and Edit Gateway.

9) User shall be capable of testing the display.

10) The AMD option shall provide a RJ45 ethernet connection port on the surge device, which shall provide a means for secure firmware updates to the SPD.

11) Time and date stamped events to be capable of being downloaded through a RJ45 ethernet connection port.

f. Remote Monitoring (optional with AMD) – The SPD shall be capable of Ethernet communications via Modbus/TCP and BACnet protocols and contain an onboard webpage which complies with UL 2900 standards.

g. BACnet and Modbus/TCP shall be user configurable with access to the following registers:

h. Remaining surge protection levels as a percentage with 0% = unprotected, 1-99% = partially protected, 100% = fully protected

i. LED status for each indicator color (red/yellow/green)

j. Surge counter for each phase with three categories defined using the resultant current from IEEE waveforms (C62.41.2) as follows: Low Level surge (IEEE Category A), Medium Level surge (IEEE Category B), High Level surge (IEEE Category C)

k. Access to the following information and data: Surge counts for each phase and per category, total surge counts, event logs with time & date stamps (last 2000 low, 1500 medium, and 1000 high events on each phase), SPD Protection Level percentage, alarm status, device catalog number, style number, serial number, date code, firmware version, PCB serial number, device name, IP address, ethernet MAC address, and customer support contact information.

l. User shall be capable of remotely inputting the following information: set date and time, set device name, change password, clear surge counts & event logs, change sensitivity settings, edit MODBUS status, edit IP Address, edit Subnet Mask, and edit Gateway.

m. The onboard webpage shall provide a pre-configured user interface with access to the following information:

n. Remaining surge protection levels as a percentage with 0% = unprotected, 1-99% = partially protected, 100% = fully protected

o. LED status for each indicator color (red/yellow/green)

p. Surge counter for each phase with three categories defined using the resultant current from IEEE waveforms (C62.41.2) as follows: Low Level surge (IEEE Category A), Medium Level surge (IEEE Category B), High Level surge (IEEE Category C)

q. Access to the following information and data: Surge counts for each phase and per category, total surge counts, event logs with time & date stamps (last 2000 low, 1500 medium, and 1000 high events on each phase), SPD Protection Level percentage, alarm status, device catalog number, style number, serial number, date code, firmware version, PCB serial number, device name, IP address, ethernet MAC address, and customer support contact information.

r. User shall be capable of remotely inputting the following information: set date and time, set device name, change password, clear surge counts & event logs, edit MODBUS status, edit IP Address, edit Subnet Mask, and edit Gateway.

C. Thermal MOV Protection

1. The unit shall contain thermally protected MOVs. These self-protected MOVs shall have a thermal protection element integrated with the MOV and a mechanical disconnect with arc quenching capabilities in order to achieve overcurrent protection of the MOV. The thermal protection assembly shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur, that would cause them to enter a thermal runaway condition.

2. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. The use of plug in single-mode modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

D. Safety Requirements

1. The SPD shall minimize potential arc flash hazards by containing no single-mode plug in user serviceable / replaceable parts and shall not require periodic maintenance. SPDs containing items such as replaceable single-mode plug in modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

2. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

2.3 SYSTEM APPLICATION

A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

2.4 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.

2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.

3. The panelboard shall be capable of re-energizing upon removal of the SPD.

4. The SPD shall be integral to the panelboard and connected directly to the bus. Alternately, an integral SPD can be connected to a circuit breaker for disconnecting purposes, in the case a disconnect is required.

5. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.

6. The SPD shall be of the same manufacturer as the panelboard.

7. The complete panelboard including the SPD shall be UL67 listed.

2.5 SWITCHGEAR, SWITCHBOARD, MCC AND BUSWAY REQUIREMENTS

A. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.

B. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, or busway.

C. The SPD shall be factory installed integral to the switchgear, switchboard, MCC, and/or bus plug at the assembly plant by the original equipment manufacturer.

D. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.

E. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.

F. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.

G. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.6 SERVICE ENTRANCE REQUIREMENTS

A. Service entrance located SPDs shall be tested and designed for applications within ANSI/IEEE C62.41 Category C environments.

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA, IEEE, and UL standards.

3.2 INSTALLATION

A. The installation of the SPD shall be factory installed integral to the distribution equipment. The Contractor shall install all distribution equipment per the manufacturer's recommendations, applicable electrical codes, and the contract drawings.

3.3 WARRANTY

A. The manufacturer shall provide a ten (10) year warranty (15 year warranty with registration) that covers replacement of the complete unit, including lightning, from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local electrical code.

END OF SECTION 26 43 13.A

SECTION 26 51 19 – LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section includes interior lighting fixtures, lighting fixtures mounted on exterior building surfaces, LED light engines, LED drives, lamps, emergency lighting units, and accessories.

1.3 SUBMITTALS

A. Product Data: For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:

1. Dimensions of fixtures.
2. LED drivers.
3. LED light engine.
4. Types of lamps.

B. Product Certificates: Signed by manufacturers of lighting fixtures certifying that products comply with requirements.

C. Maintenance Data: For lighting fixtures to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

B. Comply with NFPA 70.

C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.5 COORDINATION

A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

B. Exterior Building Lights: Coordinate exterior conduit penetrations for connections to the back of building mounted fixtures. Coordinate locations and install back boxes as required during construction of walls, framing and other related construction.

1.6 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty for Batteries: Written warranty, executed by manufacturer agreeing to replace rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Special Warranty Period for Batteries: Manufacturer's standard, but not less than 5 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for last nine years.

C. Special Warranties for LED Drivers: Written warranty, executed by manufacturer agreeing to replace LED drivers that fail in materials or workmanship within specified warranty period.

1. Special Warranty Period for LED Drivers: Five years form date of manufacture, but not less than four years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated for each designation:

1. Light Fixtures: As indicated on Drawing fixture schedule.

2. LED Drivers: Compatible with LED light engine.

3. LED Light Engine: Per manufacturer on Drawing fixture schedule.

4. Lamps: GE, Philips, Sylvania, Venture, Lithonia and Eye.

2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

A. Metal Parts: Free from burrs, sharp corners, and edges.

B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit maintenance without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during maintenance and when secured in operating position.

D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.

2. Specular Surfaces: 83 percent.

3. Diffusing Specular Surfaces: 75 percent.

4. Laminated Silver Metallized Film: 90 percent.

E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.

1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.

2. Lens Thickness: 0.125-inch minimum, unless greater thickness is indicated.

2.3 LED DRIVERS

A. General Requirements: Unless otherwise indicated, features include the following:

1. Shall be electronic-type, labeled as compliant with radio frequency interference (RFI) requirements of FCC Title 47, Part 15.

2. Total Harmonic Distortion Rating: Less than 20 percent at all input voltages.

3. Sound Rating: A.

4. Minimum efficiency of 85%.

B. LED Drivers: Unless otherwise indicated, features include the following, besides those in "General Requirements" Paragraph above:

1. Dimmable drivers shall be 0-10V type.

2. Dimmable drivers shall be capable of dimming without LED flicker or strobing across their full dimming range.

2.4 EXIT SIGNS

A. General Requirements: Comply with UL 924 and the following:

1. Sign Colors and Lettering Size: Comply with authorities having jurisdiction.

B. Internally Lighted Signs: As follows:

1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum rated lamp life.

2.5 EMERGENCY LED POWER SUPPLY UNITS

A. Internal Type: Self-contained, modular, battery-inverter unit factory mounted within fixture body. Comply with UL 924.

1. Test Switch and Light-Emitting Diode Indicator Light: Visible and accessible without opening fixture or entering ceiling space. Test switch shall illuminate LEDs or lamps for minimum of 3 minutes when pushed momentarily.

2. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum 5-year nominal life.

3. Charger: Fully automatic, solid-state, constant-current type.

4. Operation: Relay automatically energizes LEDs or lamp from unit when normal supply circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects LEDs or lamp, and battery is automatically recharged and floated on charger.

5. Lumen output: Minimum 700 lumens (LED)

2.6 LED LIGHT ENGINES

A. LED Color Temperature: 4000 K, unless otherwise indicated.

B. CCT tolerances are to be kept within a 3-step MacAdam ellipse and are to maintain a Min CRI of 80.

2.7 FIXTURE SUPPORT COMPONENTS

A. Comply with Section 26 05 00 – Electrical, General for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

F. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.8 FINISHES

A. Fixtures: Manufacturer's standard, unless otherwise indicated.

1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.

2. Metallic Finish: Corrosion resistant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set units plumb, square, and level with ceiling and walls, and secure according to manufacturer’s written instructions and approved Shop Drawings.

B. Support for Recessed and Semi-recessed Grid-type Fixtures:

1. Pendant-hung lighting fixtures shall be supported directly from the structure above using No. 9-gauge wire or an approved alternate support without using the ceiling suspension system for direct support.

2. Lighting fixtures weighing less than 56 pound shall have, in addition to the requirements outlined above, two No. 12 gauge hangers connected from the fixture housing to the structure above. These wires may be slack.

3. Lighting fixtures weighing 56 pound or more shall be supported directly from the structure above by approved hangers.

C. Support for Suspended Fixtures: Brace pendants and rods over 48 inches long to limit swinging. Support stem-mounted, single-unit, suspended fixtures with twin-stem hangers. For continuous rows, use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of chassis, including one at each end.

D. Surface-mounted lighting fixtures shall be attached to the ceiling system with positive clamping devices that completely surround the supporting members. Safety wires shall be attached between the clamping device and the adjacent ceiling hanger or to the structure above. In no case shall the fixture exceed the design carrying capacity of the supporting members.

E. Exterior-mounted lighting fixtures shall be mounted according to the manufacturer’s instructions. Conduit shall be concealed within walls or installed within the building and then penetrate to exterior fixture. Surface mounted conduit on exterior of the building is not acceptable. All penetrations are to be sealed.

3.2 CONNECTIONS

A. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 467, UL 486A, and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Tests: As follows:

1. Verify normal operation of each fixture after installation.

2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.

3. Verify normal transfer to battery source and retransfer to normal.

C. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

D. Corrosive Fixtures: Replace during warranty period.

3.4 CLEANING AND ADJUSTING

A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.

B. Adjust amiable fixtures to provide required light intensities.

END OF SECTION 26 51 19

SECTION 26 56 19 – LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section includes exterior lighting fixtures, LED light engines, LED drivers, emergency lighting units, lamps, poles standards, and accessories.

1.3 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

B. Product data describing fixtures, LED light engines, LED drivers, lamps, poles, and accessories. Arrange product data for fixtures in order of fixture designation. Include data on features, poles, accessories, and the following:

1. Outline Drawings of fixtures and poles indicating dimensions and principal features.

2. Electrical ratings and photometric data with certified results of laboratory tests.

C. Maintenance data for materials and products, for inclusion in Operating and Maintenance Manual specified in Division 1 and in Section 16050 Include service bulletin(s).

1. Submit maintenance data and parts list for each roadway and parking area lighting fixture and accessory; including "trouble-shooting" maintenance guide. Include that data, product data, service bulletin(s), and illustrated parts list in a maintenance manual; in accordance with requirements of Division 1.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of exterior lighting units, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms with at least 3 years of successful installation experience on projects with exterior lighting installation work similar to that required for this Project.

PART 2 - PRODUCTS

2.1 FIXTURE COMPONENTS, GENERAL

A. Metal Parts: Free from burrs and sharp edges and corners.

B. Sheet Metal Components: Corrosion-resistant aluminum, except as indicated. Form and support to prevent warping and sagging.

C. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed fixtures.

D. Doors, Frames, and Other Internal Access Provisions: Smooth operating, free from light leakage under operating conditions, and arranged to permit maintenance without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during maintenance and when secured in the operating position. Provide for door removal for cleaning or replacing lens. Arrange for door opening to disconnect driver.

E. Exposed Hardware Material: Stainless steel.

F. Reflecting Surfaces: Minimum reflectances as follows, except as otherwise indicated:

1. White Surfaces: 85 percent.

2. Specular Surfaces: 83 percent.

3. Diffusing Specular Surfaces: 75 percent.

G. Plastic Parts: Resistant to yellowing and other changes due to aging and exposure to heat and UV radiation.

H. Lenses and Refractors: Materials as indicated. Use heat-and aging-resistant, resilient gaskets to seal and cushion lens and refractor mounting in fixture doors.

I. Photoelectric Relay: UL 773.

1. Contact Relays: Single-throw, arranged to fail in the "on" position and factory set to turn light unit on at 1.5 to 3 footcandles and off at 4.5 to 10 footcandles with 15 seconds minimum time delay.

2. Relay Mounting: In fixture housing.

2.2 FIXTURE SUPPORT COMPONENTS

A. Mountings, Fastenings, and Appurtenances: Provide mountings that will correctly position the luminaire to provide the indicated light distribution.

2.3 LED LIGHT ENGINES

A. LED Color Temperature: 3500K, unless otherwise indicated.

B. CCT tolerances are to be kept within a 3-step MacAdam ellipse and are to maintain a Min CRI of 80.

2.4 LAMPS

A. Conform to ANSI Standards, C78 series, applicable to each type of lamp. Provide fixtures with indicated lamps. Where lamps are not indicated, provide lamps recommended by manufacturer.

2.5 FINISH

A. Metal Parts: Manufacturer's standard finish except as otherwise indicated. Finish applied over corrosion-resistant primer after fabrication, free of streaks, runs, holidays, stains, blisters, and similar defects. Remove poles, fixtures, and accessories showing evidence of corrosion or finish failure during Project warranty period and replace with new items.

B. Other Parts: Manufacturer's standard finish except as otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set units plumb, square, level, and secure according to manufacturer's written instructions and shop drawings.

B. Fixture Attachment: Fasten to indicated structural supports.

C. Fixture Attachment with Adjustable Features or Aiming: Attach fixtures and supports to allow aiming for indicated light distribution.

D. Lamp fixtures with indicated lamps according to manufacturer's instructions. Replace malfunctioning lamps.

3.2 FIELD QUALITY CONTROL

A. Inspect installed units for damage.

B. Provide advance notice of dates and times for field tests.

C. Provide instruments to make and record test results.

D. Tests: Verify normal operation of lighting units after installing fixtures and energizing circuits with normal power source. Include the following:

1. Check for flickering or strobing LED drivers.

2. Check for uniformity of illuminations.

E. Replace or repair damaged and malfunctioning units and retest.

3.3 ADJUSTING AND CLEANING

A. Clean components on completion of installation. Use methods and materials recommended by manufacturer.

B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION 26 56 19

Contract Documents & Specifications

CITY OF ABERDEEN WWTP IMPROVEMENTS

Division 31 – Division 46

Volume 3

JUNE 2024

PROJECT NO. 222032

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SECTION 31 00 00 - EARTHWORK

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, materials, and equipment as required for all excavation, grading, providing borrow materials, hauling, placing, and compacting earthwork materials to construct the site to the grades shown on the plans.

B. Prior to commencement of any earthwork, the Contractor shall review the geotechnical reports. The geotechnical report is included in the Appendices for information only and the Contractor is responsible for making any interpretations there from.

C. Submit to the Engineer's Field Representative load tickets on all materials delivered to the site.

1.2 REFERENCE STANDARDS

A.	ASTM D 136	Sieve Analysis of Fine and Coarse Aggregates
B.	ASTM D 422	Method for Particle - Size Analysis of Soils
C.	ASTM D 698	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregated Mixtures, Using 5.5-lb Rammer and 12-inch Drop
D.	ASTM D 1556	Density of Soil by the Sand-Cone Method
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G.	ASTM D 2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate
H.	ASTM D 2487	Classification of Soils for Engineering Purposes
I.	ASTM D 2901	Test Method for Cement Control of Freshly-Mixed Soil Cement
J.	ASTM D 2922	Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).
K.	ASTM D 4254	Test Methods for Minimum Index Density of Soils and Calculative of Relative Density

L. OSHA - 1926.650-651 and other applicable sections.

1.3 SUBMITTALS

A. The Contractor shall submit test results of all materials proposed to be used in the work in accordance with the requirements of Section 01 33 00 - Submittal Procedures.

B. Submit sieve analysis, moisture density relationship test for both ASTM D698 and D1557, and sand equivalency. The sieve analysis and moisture density relationship tests must have been completed within 12 calendar months from the date of submittal.

1.4 DEFINITIONS

A. Backfill or Fill: (a) Material used to replace material removed during construction or (b) The act of replacing or placing material during construction.

B. Backfill Operation or Fill Operation: The method and the activity required to fill surface depressions and excavations, or to construct fills to required grades.

C. Common Fill: Fill or borrow materials which are naturally occurring and not meeting a specific gradation or classification.

D. Structural Fill: The act of placing common or imported fill material under controlled operation to a certain density.

PART 2 - PRODUCTS

2.1 SUITABLE FILL AND BACKFILL MATERIAL REQUIREMENTS

A. The following types of suitable materials are defined (see Execution for the location where the materials are approved for use or where identified in other specifications and drawings):

1. Common Fill: Fill or borrow materials which are naturally occurring, not meeting a specific gradation or classification, are not Unsuitable Materials, and can be placed in a controlled operation to a certain density.

2. Sand Backfill (Bedding Sand): Sand with 100 percent passing a 3/8-inch sieve, at least 90 percent passing a Number 4 sieve and less than 3% passing the No. 200 sieve.

3. Crushed Stone Backfill (Bedding Chips): Manufactured angular, crushed stone, crushed rock, or crushed slag with the following gradation requirements:

Sieve Size	Percent Passing By Weight
1”	100
3/4"	80 - 100
3/8”	20 - 70
No. 4	5 - 20
No. 200	0 - 3

4. Foundation Stabilization Backfill: Uncrushed gravel, and sand with the gradation requirements below. The material shall have a minimum sand equivalent value of 28, sand equivalent not required if less than 5% passing the No. 200 sieve.

Sieve Size	Percent Passing By Weight
3”	100
No. 4	25 - 60
No. 200	0 - 12

5. Coarse Gravel (Drain Rock): Crushed rock or gravel which is free of shale, clay, friable materials, and or debris that conforms to the gradation below. Drain Rock shall have a minimum of 35% Air Voids as determined by ASTM C 29 Standard Test Method for Unit Weight and Voids in aggregate, Jigging Procedure.

Sieve Size	Percent Passing By Weight
3”	100
1”	25 - 60
3/8”	0 - 4
200	0 - 2

6. Aggregate Base (3/4” Road Mix): Crushed aggregate base material of such nature that it can be compacted readily by watering and rolling to form a firm, stable base. The material shall meet the following gradation requirements:

Sieve Size	Percent Passing By Weight
1”	100
3/4"	90 - 100
No. 4	40 - 65
No. 8	30 - 50
No. 200	3 - 9

   a. The sand equivalent value shall be not less than 30, sand equivalent not required if less than 5% passing the No. 200 sieve.

   b. The material shall have a Los Angeles Abrasion of 35% or less.

7. Aggregate Subbase (Pit Run): Uncrushed rock aggregate subbase material that can be compacted readily by watering and rolling to form a firm stable subbase. The material shall meet the following requirements:

Sieve Size	Percent Passing By Weight
4”	100
3”	90-100
No. 4	30-75
No. 200	0 – 15.0

   a. The sand equivalent value shall be not less than 30, sand equivalent not required if less than 5% passing the No. 200 sieve.

   b. The material shall have a Los Angeles Abrasion of 40% or less.

8. Imported Trench Backfill (8” Pit Run):Uncrushed rock aggregate material that can be compacted readily by watering and rolling to form a firm stable trench. The sand equivalent value shall be not less than 25, sand equivalent not required if less than 5% passing the No. 200 sieve, and the material shall meet the following requirements:

Sieve Size	Percent Passing By Weight
8”	100
No. 4	15 - 60
No. 200	0 - 12

9. Trench Plug Material: Low permeable fill material, a non-dispersible clay material having a minimum plasticity index of 10.

10. Top Soil: Excavated material, up to 18 inches below stripped surface, free of rocks larger than 3 inches, organics, roots, refuse, brush or other debris.

11. Rip Rap: Riprap material shall be hard, durable, angular in shape and free from overburden and organic material. The breadth or thickness of any stone shall not be less than one-third of its length. The minimum unit weight of the stone shall be 165 pounds per cubic foot. Riprap material shall have less than 10 percent loss after five cycles in the sulfate soundness tests and shall conform to the following gradation:

Weight of Stones	Percent of Total Weight Less than the Stone Weight
200 lbs	100
130 lbs	80
90 lbs	50
25 lbs	10 max.

12. Filter Sand: Aggregate of natural sand or other approved inert materials composed of hard, strong, and durable particles conforming to the requirements of ASTM C-33 except as modified herein.

    a. Use only aggregates that include deleterious substances not exceeding the following:

Type	Percent Passing By Weight
Clay Lumps	0.50
Coal and Lignite	0.30
Other Deleterious Substances	2.00
Deleterious Material passing No. 200	1.75

    b. Moisture content of fine aggregate shall not exceed 8 percent.

c. Aggregate that is uniformly graded from coarse to fine within the following gradation as follows:

Sieve Size	Percent Passing By Weight
3/8”	100
No. 4	95 - 100
No. 16	45 - 80
No. 50	10 - 30
No. 100	2 - 10
No. 200	0 - 4

2.2 UNSUITABLE MATERIALS

A. Unsuitable material include the materials listed below:

1. Soils which, when classified under ASTM D 2487 – Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System), fall in the classification of Pt, OH, CH, MH, or OL.

2. Soils which cannot be compacted sufficiently to achieve the density specified for the intended use.

3. Materials that contain hazardous or designated waste materials including petroleum hydrocarbons, pesticides, heavy metals, and any material which may be classified as hazardous or toxic according to applicable regulations.

4. Soils that contain greater concentrations of chloride or sulfate irons, or have a soil resistively or pH less than the existing on-site soils.

PART 3 - EXECUTION

3.1 PREPARATION

A. Notify Engineer prior to starting any grading operations.

B. Identify required lines, levels, contours, and datum.

C. Identify and flag surface and aerial utilities, known underground utilities locations.

D. Maintain and protect existing utilities which pass through the work area.

3.2 SITE CONTROL

A. Unfavorable Weather: Do not place, spread, or roll any fill material during unfavorable weather conditions. Do not resume operations until moisture content of material is satisfactory.

B. Flooding: Provide berms or channels to prevent flooding or saturation of subgrade. Promptly remove all water collecting in depressions.

C. Softened Subgrade: Where soil has been softened or eroded by flooding or placement during unfavorable weather, remove all damaged areas and recompact as specified for fill.

D. Dust Control: Use all means necessary to control dust on and near the work and on and near all off-site borrow areas as specified in Section 01 50 00 – Temporary Facilities and Controls. Thoroughly moisten all surfaces as required to prevent dust from being a nuisance to the public, neighbors, residents, properties, and concurrent performance of other work on the site.

E. Noise Control: Use equipment that is equipped with adequate noise attenuation devices.

3.3 OFF-SITE IMPACTS

A. Comply with all traffic and hauling requirements of the State and County.

B. Provide all signing, flagmen, or other special traffic control required to provide for the safety of the public.

C. Use only vehicles approved for highway use and comply with all load requirements.

D. Provide wheel cleaning as required to minimize the tracking of materials onto public roadways.

3.4 PROTECTION

A. Protect trees and other features to remain as a portion of the final landscaping or project.

B. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from equipment and vehicular traffic.

C. Protect above and below grade utilities which are to remain.

D. Notify Engineer of unexpected subsurface conditions and discontinue affected work in the area until notified to resume work.

E. Protect bottom of excavations and soil adjacent to and beneath foundation from frost.

F. Grade excavation top perimeter to prevent surface water runoff into excavation.

3.5 EXCAVATION

A. Excavate all cut areas to the grades shown on the plans.

B. Excavate all areas that have excessive moisture content and cannot be compacted to the required densities.

C. Correct unauthorized excavation at no cost to the Owner.

D. Excavate or scarify and aerate soils with excessive moisture content and allow to dry.

3.6 ROCK EXCAVATION

A. Refer to Section 31 23 16.26 – Rock Removal.

3.7 SUBGRADE PREPARATION

A. Excavate to subgrade elevation.

B. In the presence of a materials testing company, thoroughly proof roll with a loaded tandem-axle dump truck with a minimum weight of 20 tons, or 40-ton static roller.

C. Areas where soft or disturbed conditions are identified, excavate, remove, and dispose of unsuitable soft spot material. If the material is suitable except for excessive moisture content, scarify and dry the material to the acceptable moisture content, or replace it with Engineer approved materials, and recompact to the density of the material to place over the area. Soft sport repair shall be incidental to the Work. No special payment will be made for soft spot repair.

D. The Contractor's materials testing company to submit a subgrade inspection report noting the means and methods used to proof roll the subgrade and any corrections or repairs made.

3.8 PREPARATION OF FOUNDATIONS

A. Building Subgrade:

1. Per Geotechnical Report.

B. All other areas:

1. Per Geotechnical Report.

3.9 CONSTRUCTION OF EMBANKMENTS

A. Fill areas to contours and elevations as shown on the plans. Do not use frozen materials.

B. Place and compact fill materials in continuous lifts not exceeding six (6) inches in depth, unless specifically allowed.

C. Employ a placement method so as not to disturb or damage utilities in trenches.

D. Maintain optimum moisture content of materials to attain required compaction density.

E. Make smooth changes in grade. Blend slopes into level areas.

3.10 IMPORTED STRUCTURAL FILL

A. Aggregate Subbase and Base, granular borrow, and common fill material under parking areas, drive lanes, and vehicle traffic areas, shall be compacted to at least 95% of the maximum dry density as determined in accordance with ASTM D698. Maximum loose lift thickness for aggregate base shall not exceed 8 inches. Maximum loose lift thickness for aggregate subbase, granular borrow, and common fill shall not exceed 10 inches.

B. Aggregate Subbase and Base material under buildings, including 4 feet outside the building area, and under equipment pads shall be compacted to at least 95% of the maximum dry density as determined in accordance with ASTM D1557. Maximum loose lift thickness for aggregate base shall not exceed 8 inches and aggregate subbase shall not exceed 10 inches.

C. Granular material with more than 30% by weight retained on the 3/4-inch sieve shall be compacted to a minimum 75 percent of maximum index density as determined by ASTM D4253 and D4254. Drain rock and crushed stone backfill material does not require compaction.

3.11 DISPOSAL OF WASTE SOIL

A. Contractor shall dispose of waste material at an off-site location determined by the Contractor.

3.12 QUALITY CONTROL

A. Material & Compaction Testing: All soils testing of samples submitted by the Contractor will be done by an independent testing laboratory mutually agreed upon by Contractor and Owner and at the Contractor's expense. If tests indicate work does not meet specific compaction requirements, remove work, replace, and retest at the Contractor's expense.

1. Qualifications of testing company

    a. Basic requirements of ASTM E 329, "Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials as Used in Construction" and ASTM D 3666, "Standard Specification for Minimum Requirements for Agency Testing and Inspecting Bituminous Paving Materials", as applicable.

    b. Calibrate testing equipment at reasonable intervals by devices of accuracy traceable to either the National Bureau of Standards or accepted values of natural physical constants.

2. Frequency of Compaction Tests

    a. Curbs and sidewalks: In horizontal plane, test at start with subsequent tests a maximum of every 250 feet. At landscape islands test each island at one location. At every horizontal location, obtain one test at subgrade. Perform subsequent tests every 12 inches of compacted depth and at top of backfill or when materials or procedures change. Perform a minimum of two (2) tests at finished grade.

b. Parking and vehicle areas, roadways: In horizontal plane, test each backfill area with subsequent test for every 2,500 square feet of backfill surface area. At every horizontal location, obtain one test at subgrade. Perform subsequent tests every 12 inches of compacted depth and at top of backfill or when materials or procedures change.

c. Concrete slabs for buildings, patios, concrete plaza, and entry slabs: In horizontal plane, test each backfill area with subsequent test for every 1,000 square feet of backfill surface area. At every horizontal location, obtain one test at subgrade. Perform subsequent tests every 12 inches of compacted depth and at top of backfill or when materials or procedures change.

d. Linear foundations and footings: In horizontal plane, test at start with subsequent tests a maximum of every 100 feet, and where elevation changes between adjacent footings. At every horizontal location, obtain one test at subgrade. Perform subsequent tests every 12 inches of compacted depth and at top of backfill or when materials or procedures change. Perform a minimum of two (2) tests at finished grade.

e. Along exterior basement walls and retaining walls: In horizontal plane, test each backfill area with subsequent test for every 100 lineal feet of wall, a minimum of two test per exterior wall side, At every horizontal location, obtain one test at subgrade. Perform subsequent tests every 12 inches of compacted depth and at top of backfill or when materials or procedures change.

3.13 TOLERANCES

A. Finished grade of graded areas shall meet the following requirements:

1. In paved areas including roadways, sidewalks, parking lots, etc., plus or minus 0.10 feet from the grade shown on the plans.

2. Building pads, plus or minus 0.05 feet from the grade shown on the plans.

3. In landscaped areas or similar areas, plus or minus two (2) inches.

4. Differential grades between walking surfaces shall not exceed 1/4-inch.

5. Landscape finish grade adjacent to concrete walks shall be minus 1-inch from walking surface elevation.

END OF SECTION 31 00 00

SECTION 31 05 19.13 - GEOTEXTILES FOR EARTHWORK

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install geotextiles as specified herein and as indicated on the drawings.

1.2 SUBMITTALS

A. Certificates: Submit geotextile manufacturer's certified test results showing that the geotextiles meet the requirements of these specifications.

B. Submit manufacturer's installation instructions and maintain copy at the jobsite.

PART 2 - PRODUCTS

2.1 GENERAL

A. Geotextiles shall be composed only of long chain polymeric (at least 85% polyolephins, polyesters or polyamides) filaments or yarns oriented into a stable network that retains its relative structure (including selvages) during handling, placement, and design service life.

2.2 SUBGRADE SEPARATION GEOTEXTILE

A. Verify geotextile delivered to the site meets the requirements of this specification.

B. Subgrade Separation Geotextile fabric shall be woven or non-woven, with the following minimum properties:

Geotextile Property (Roll Values)	Test Method	Requirement
*Grab Tensile Strength – lb (in either principal direction)	ASTM D 4632	270 / 180
*Grab Elongation (%)	ASTM D 4632	<50% / ≥50%
*Puncture Strength – lb	ASTM D 6241	600 / 450
*Trapezoidal Tear Strength – lb	ASTM D 4533	100 / 75
Apparent Opening Size (AOS) (Standard Sieve)	ASTM D 4751 COE CW-002215	#30 or finer
Permittivity (sec-1)	ASTM D 4491	0.02

*For geotextiles with elongation which is less than 50%, the first strength value is applied. For geotextiles with elongation which is equal to or greater than 50%, the second strength value is applied. Higher strength is required for geotextiles with lower elongations.

2.3 DRAINAGE GEOTEXTILE

A. Drainage Geotextile fabric shall be non-woven, with the following minimum properties:

Geotextile Property (Roll Values)	Test Method	Requirement
Grab Tensile Strength – lb (in either principal direction)	ASTM D 4632	≥80
Puncture Strength – lb	ASTM D 6241	≥300
Apparent Opening Size (AOS) (Standard Sieve)	ASTM D 4751	#70 or finer
Permittivity (sec-1)	ASTM D 4491	0.7

2.4 WEED BARRIER

A. Woven geotextile shall be used as weed barrier. Woven geotextile fabric made from polypropylene, shall contain UV inhibitors.

B. Woven fabric shall meet the minimum properties:

Geotextile Property (Roll Values)	Requirement
Unit Weight (oz/yds2)	3.0
Tensile Strength (lbs)	135
Elongation at Break (%)	70
Puncture Strength (lbs)	35
Apparent Opening Size (AOS) (Standard Sieve)	60/70
Trap Tear (lbs)	50
Air Permeability (cm/sec)	3x10-2
Flux (gal/ft2/min)	70
Permitivity (sec-1)	1.2
Thickness	15.0

PART 3 - EXECUTION

3.1 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect geotextiles against damage and excessive sunlight during shipment and storage.

3.2 EXAMINATIONS

Verify that surfaces upon which the geotextile is to be installed are graded to a smooth, uniform condition free of obstructions, depressions, and debris.

3.3 GENERAL PLACEMENT REQUIREMENTS

A. Spread geotextile immediately ahead of the covering operation. Do not drag the geotextile on the ground or mishandle it in any way. Place the geotextile loosely and without wrinkles so that placement of the overlying material will not tear the geotextile.

B. Place the cover material on the geotextile in such a manner that a minimum of 12 inches of material will be between the equipment tires or tracks and the geotextile at all times.

C. Cover the geotextile with the specified cover material as soon as possible. Geotextiles which have not been ultraviolet stabilized shall not remain uncovered for longer than 7 days. Ultraviolet stabilized materials shall not remain exposed longer than 30 days.

3.4 PLACEMENT IN SOFT GROUND

A. Where geotextiles will be placed over soft ground, construction vehicles shall not drive directly on the geotextile material. End-dumping the cover material directly on the geotextile will not be permitted. Under no circumstances shall cover material be dropped on unprotected geotextile from a height greater than 3 ft. above the surface of the geotextile.

B. Limit compaction of the first lift above the geotextile over soft ground to operation of placing and spreading equipment only. No sheep foot type equipment will be allowed on the first lift. Subsequent lifts will be closely observed during compaction. If any foundation failures occur during compaction operations, lightweight compaction equipment shall be used. Use pegs, pins, or the manufacturer’s recommended methods as needed to hold the geotextile in place until the specified cover material is placed. Seams that have separated will require the removal of fill and the required overlap reestablished. Repair at no cost to the Owner.

3.5 REPAIRS

A. Should the geotextile be torn, punctured or the overlaps joints disturbed, as evidenced by visible geotextile damage, subgrade pumping, intrusion, or pad or roadbed distortion, remove the backfill around the damaged or displaced area and repair or replace the damaged geotextile at no cost to the Owner.

B. The repair shall consist of a patch of the same type of geotextile placed over the ruptured area. The patch shall overlap the existing geotextiles a minimum of 2 feet from the edge of the rupture.

3.6 JOINT OVERLAP

A. Subgrade Separation: Overlap the geotextile a minimum of 2 feet at all joints.

B. Drainage Application: Overlap the geotextile a minimum of 12 inches at all joints. In trenches less than 12 in. wide, overlap shall be the width of the trench.

C. Weed Barrier: Overlap the geotextile a minimum of 6 inches at all joints.

END OF SECTION 31 05 19.13

SECTION 31 11 00 - CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide removal of trees, stumps, shrubs, grass and other vegetation within the construction limits to permit construction of the new facilities.

B. Protect the adjoining properties from damage during clearing and grubbing operations.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 CLEARING AND GRUBBING

A. Clearing and grubbing shall extend to no more than 3 feet outside of the construction limits. The clearing and grubbing operation shall be conducted in a manner which will not damage any vegetation outside of the clearing and grubbing limits. All brush, roots, and other debris within the grubbing limits shall be removed to a depth of 6". Completely remove stumps and other debris protruding through the subgrade surface. The Contractor shall chop all brush and debris resulting from the Clearing and Grubbing operation and haul to a disposal site located by the Contractor off-site. Burning of debris on-site will not be allowed.

3.2 STRIPPING

A. Areas within the limits of the project shall be stripped to remove topsoil containing organic material before construction begins over such areas. The topsoil shall not be used in construction of onsite fills or trench backfills. The topsoil shall be distributed on areas that have been disturbed that will be reseeded.

END OF SECTION 31 11 00

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SECTION 31 23 16.26 - ROCK REMOVAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Perform rock excavation as necessary for installation of structures, pipelines, utilities and other services. Provide all labor, materials, and equipment as required for rock excavation including drilling, blasting, and related work specified herein.

B. Blasting rock may be used to construct the excavations where the rock outside the excavation will be undisturbed and provide an adequate size and safe work area for the construction of structures in the future.

C. Rock excavation is permitted where standard excavation equipment cannot effectively remove rock, and where the rock can be blasted within the area provided for excavation.

D. Rock excavation is incidental to the work. No additional payment will be made regardless of quantity. Contractor is responsible for disposal of all excess rock off-site at no additional cost to Owner.

E. A Geotechnical report is provided in Appendix A for the Contractor’s information. Rock levels are only known in the location of the test holes. Contractor is responsible for including the cost of rock removal, disposal, and additional fill materials as may be required to complete the Work in their Bid Price. No additional payment shall be approved during construction.

1.2 REFERENCE STANDARDS

A. NFPA 495 Code for Explosive Materials

1.3 DEFINITIONS

A. Controlled Blasting: Drilling and shooting a series of line holes for controlling the neat line of the back slope along the excavation line of the construction.

B. Flyrock: Rock that is propelled into the air by the force of the explosion. Flyrock usually comes from prebroken material on the surface or upper open face and is an indicator of wasted energy.

C. Presplitting: Drilling a single row of line holes along the neat excavation line of the slope, properly loading to minimize overbreak, and firing simultaneously in advance of the production round blasting.

D. Cushion Blasting: Providing an undisturbed buffer section approximately 10 feet thick between the neat excavation line of the slope and the production round blasting or ripping. After removal of the materials composing the production zone, the undisturbed section of the slope is trimmed off by simultaneously firing a single row of line holes drilled on the neat excavation line.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 00 – Submittal Procedures.

B. Copy of blasting permit.

C. Site condition survey, seismic survey, and blasting plan and schedule.

D. Qualifications of seismic survey and blasting companies.

E. Storage plans along with the type of magazine or explosive storage facility to be used on the job site.

F. Daily blasting logs.

1.5 FIELD MEASUREMENTS

A. Mark excavation limits on the ground prior to performing work.

B. Verify that survey benchmark and intended elevations for the work are as shown in the drawings.

1.6 QUALIFICATIONS

A. Seismic Survey Firm: Company specializing in seismic surveys with a minimum of 5 years documented experience.

B. Licensed Explosives Firm: Company specializing in explosives for disintegration of rock, with a minimum of 5 years documented experience.

PART 2 - PRODUCTS

2.1 ROCK SLOPE PROTECTION

A. Netting Mesh: Netting shall be double twisted hexagonal steel wire 8x10 mesh. Wire shall be hot dipped galvanized wire 0.12 inch in diameter carbon steel wire with a tensile strength of 60,000 psi conforming top ASTM A641.

B. Lacing Wire: Lacing wire shall be hot dipped galvanized wire 0.148 inch in diameter carbon steel wire with a tensile strength of 60,000 psi conforming top ASTM A641.

C. Wire Rope: Wire rope shall be ¾ inch 6x19 IWRC wire rope. Wire rope shall have a break strength of 50,000 pounds. Follow manufacturer’s recommendations for size, number, spacing and installation torque for wire rope clips.

D. Weldless Steel Rings: Weldless steel rings shall be 1 inch by 4 inch inside diameter hot dip galvanized forged alloy steel ring with a minimum working load of 10,000 pounds conforming to Federal Specification RR C271D, Type VI.

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor shall assume all liability and responsibility connected with or accruing from blasting or the use of explosives, including but not limited to, damage to Work or adjacent property and structures, injuries, lawsuits, complaints, and all other adverse results, actual, alleged, inferred, or implied.

B. Do not leave explosives unprotected in areas where persons or property could be endangered. Safely and securely store explosives in compliance with local laws and ordinances, clearly marking such storage places “Dangerous Explosives”.

C. Secure all required permits and written approval of the Engineer prior to blasting.

D. Provide 24 hours advance notice via newspapers, radio announcements, etc. prior to blasting.

E. Do not blast during weekends, holidays, or outside normal working hours, unless otherwise approved by the Engineer.

3.2 BLASTING EXAMINATIONS

A. Conduct a site condition survey documenting conditions of buildings in proximity to blasting site which could be affected by blasting, photograph existing conditions, and identify irregularities.

B. Conduct a seismic survey to determine maximum charges that can be used at different locations without damaging adjacent properties or other work.

C. Provide seismographic monitoring during the progress of blasting operations.

3.3 BLASTING PLAN

A. Conduct a site condition survey documenting exposed exterior above grade conditions of buildings and water retaining structures in proximity to blasting site which could be affected by blasting, photograph existing conditions, and identify irregularities.

B. Prior to commencing drilling and blasting operations, the Contractor shall submit a "Blasting Plan" to the Engineer for review. The blasting plan shall contain the full details of the drilling and blasting patterns and controls that the Contractor proposes to use of the production blasting. The blasting plan shall contain the following minimum information:

1. Limits of the proposed shot(s).

2. Plan and section views of the proposed drill pattern including free face, burden, blast hole angles, lift height and subdrill depth.

3. The plan shall describe how the contractor plans on preventing flyrock or blast debris from entering adjacent areas.

4. Proposed methods for mitigating impacts to surrounding structures, utilities, private residences, and traffic.

C. The amount and type of explosives, methods of loading, delay patterns, and other features of the controlled blasting shall be selected to produce a cut face sheared along the staked slope line with a minimum of overbreak and little or no material shattered or loosened back of the finished slope.

D. The blasting plan submittal is for quality control and record keeping purposes. Review of the blast plan by the Engineer shall not relieve the contractor of his responsibility for the accuracy and adequacy of the plan when implemented in the field.

3.4 BLASTING OPERATIONS

A. All blasting operations, including the transportation, storage and handling of explosives and blasting agents, shall be performed in accordance with NFPA 495 and the applicable provisions of pertinent Federal, State, and local regulations.

B. When it is required to store explosives, blasting agents or detonators the Contractor shall conform to all applicable state and federal laws governing explosives storage.

C. Production blast holes shall be drilled on the patterns submitted by the Contractor. The production blast holes shall be drilled within two (2) blast hole diameters of the planned collar location. The location and staking of the blast holes shall be the responsibility of the Contractor. If more than 5 percent of the holes are drilled outside of this tolerance, the Contractor shall be required to refill these holes with crushed stone and redrill them at the proper location.

D. Blast holes shall be covered to keep overburden from falling into the holes after drilling.

E. The Contractor shall demonstrate the adequacy of the proposed blast plan by drilling, blasting and excavating short test sections. Satisfactory results must be achieved and approved prior to commencing full-scale blasting operations. Unsatisfactory test shot results include an excessive amount of fragmentation beyond the indicated lines and grade, excessive flyrock, or blasting below the bottom grade of the excavation. All costs incurred by the Contractor in adopting revised blasting methods necessary to produce an acceptable test shot shall be considered incidental and will not be paid for separately.

F. The Contractor shall control the blast energy by using the necessary delays to prevent movement of existing adjacent areas.

G. When line holes for presplitting are simultaneously detonated with the production round, use suitable millisecond delays in the production round blasting.

H. Do not use lifters or springing of line holes in controlled blasting operations.

I. If at any time during the progress of the work, the methods of drilling and blasting do not produce the desired result of a uniform slope, shear face or bottom grade, the Contractor shall be required to drill, blast, and excavate in short sections until satisfactory results are achieved. Extra costs shall be borne by the Contractor.

3.5 SAFETY PROCEDURES

A. Traffic Control. Furnish and erect special signs and provide traffic and pedestrian control to warn the public of the blasting operations. Place signs at appropriate points within and near the project limits, and maintain them to be clearly evident to the public during all critical period of the blasting operation. If blasting is by means of electric detonators, include a warning statement to have radio transmitters off. Prior to blasting, station workers, and provide signals and traffic control to alert people of dangerous conditions. Notify the local public agency responsible for fire protection in the area of the blasting, and comply with all regulations pertaining to blasting.

B. Warnings and Signals. The Contractor shall establish a method of warning all employees on the job site of an impending blast. The signal shall consist of a five-minute warning signal to notify all in the area that a blast will be fired within a five-minute period. A second warning signal shall be sounded one minute before the blast. After the blast is over, there shall be an all clear signal sounded so all in the area understand that all blasting operations are finished.

C. Flyrock Control. Flyrock shall be limited to the excavation limit.

1. Before the firing of any blast in areas where flying rock may result in personal injury or unacceptable damage to property or the work, the rock to be blasted shall be covered with approved blasting mats, soil, or other equally serviceable material to prevent flyrock.

2. If flyrock leaves the excavation limit boundaries, all blasting operations shall cease until the Contractor reviews the blast and determines the cause and solution to eliminate flyrock from leaving the excavation limit. Before blasting proceeds, a written report shall be submitted to the Engineer for his approval. The written report shall include the determined cause and remedial steps to ensure correction.

D. Scaling. All rock on the cut face that is loose, hanging, or otherwise creates a potentially dangerous situation shall be removed during or upon completion of the excavation for each lift. The slopes shall be scaled throughout the duration of the contract and at such frequency as required to remove all hazardous loose rock or overhangs. Scaling is incidental to excavation.

E. Daily Blasting Logs. The Contractor shall provide to Engineer, on a weekly basis, a daily log of blasting operations. The log shall be updated at the close of each business day. The log shall include the dates of blasts, number of blasts, times, blasting locations and patterns. The blasting logs are for quality control and record keeping purposes.

F. Daily Explosive Material Consumption. The Contractor shall keep a daily record of transactions to be maintained at each storage magazine. Inventory records shall be updated at the close of every business day. The records shall show the class and quantities received and issued and total remaining on hand at the end of each day.

G. Report of Loss. Should a loss or theft of explosives occur, all circumstances and details of the loss or theft shall be immediately reported to the nearest office of Alcohol, Tobacco & Firearms as well as to the local law enforcement authorities.

3.6 ROCK SLOPE PROTECTION

A. Complete scaling of the rock face prior to installing the rockfall netting. Install the anchors at the top of the rock face before installing the netting material.

B. The Contractor shall determine the method of installation of the netting material. The netting may be either rolled down over the rock face from the top of the face and assembled in place or the netting mat be assembled in panels on the ground and lifted into place against the rock face. Seam the individual sections of netting together to form a continuous mat of netting along the rock face.

C. Secure the netting material to the anchors with wire rope ties as shown on the drawings. After the netting is secured in place, the netting shall be pushed into the slope so the netting conforms to the rock face irregularities.

3.7 DISPOSAL OF EXCAVATED ROCK

A. Dispose legally offsite all excavated rock that is unsuitable for backfill material. For processing of the rock for structural fill material, reference Section 31 00 00 - Earthwork.

END OF SECTION 31 23 16.26

SECTION 31 23 19 - DEWATERING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide, install, and remove material and equipment necessary for removing water during excavation, backfill, and compaction for earthwork, structures, and piping. Dewater all utility trenches and structural excavations such that Work is performed in dry conditions. Maintain removal of water until backfilling is complete. Dewatering of trenches and other excavations is considered incidental to the construction of the Work.

B. Maintain groundwater levels at a minimum of 2 feet below the proposed construction excavations.

1.2 SUBMITTALS

A. Submit for approval a site-specific dewatering plan, sealed by a professional engineer licensed in the State in which the work will take place, based on the location and configuration of site improvements. Evaluate the site conditions, potential dewatering options, and considerations relative to the dewatering design and equipment, and construction approach. Discharge into the wastewater treatment system is not permitted. Include the following minimum components in the plan:

1. Detailed shop drawings showing the locations of all excavations, shoring, and temporary dewatering equipment.

2. Detailed shop drawings showing the installation of temporary dewatering equipment.

3. Pumping and piping capacity.

4. Location of discharge and permit to discharge to any offsite facilities or irrigation system.

5. Sediment control devices.

6. Redundant pumps.

7. Power source and routing.

1.3 PERMITTING

A. The dewatering plan shall be in accordance with all industry standard best management practices and Idaho DEQ requirements, and shall be developed using sound engineering techniques. After Engineer approval, the Contractor shall submit the approved dewatering plan to DEQ with the Short Term Activity Exemption permit and dewatering plan of the dewatering system proposed. Submit approved Short Term Activity Exemption permit to the Engineer prior to implementation of the dewater plan.

B. Include dewatering in the stormwater pollution prevention plan for the Construction General Permit (CGP).

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor is responsible for all necessary equipment to implement and maintain the dewatering operations throughout the construction process. This includes but is not limited to:

1. Providing temporary power as necessary
2. Pumping equipment
3. Competent workmen for the operation of the pumping equipment
4. Temporary piping
5. Sedimentation basins
6. Standby/redundant equipment

END OF SECTION 31 23 19

SECTION 31 23 33 - TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all excavation of trenches, bedding, and backfilling work for construction of piping.

B. Excavation of trenches shall include all material excavated or removed regardless of type, character, composition, or condition of the material.

1.2 SUBMITTALS

A. The Contractor shall submit samples of all materials proposed to be used in work. Sample sizes shall be determined by the testing laboratory.

1.3 DEFINITIONS

A. Pipe Zone: That portion of the vertical trench cross-section lying between a plane below the bottom surface of the pipe and a plane 6 inches above the top of the pipe.

B. Trench Zone: The portion of the vertical trench cross-section lying between the Pipe Zone and a point 18 inches below the finished grade.

C. Final Backfill: The portion of the vertical trench cross-section within 18 inches of finished grade.

D. Pipe Bedding: Material placed below the pipe and in the Pipe Zone.

E. Springline: The center axis of the pipe.

F. Trench Backfill: Material placed from the top of the Pipe Zone to finished grade.

G. Trench Foundation Material: Material placed below the Pipe Bedding.

PART 2 - PRODUCTS

2.1 PIPE BEDDING MATERIAL

A. Pipe bedding shall consist of crushed stone backfill (bedding chips) or sand bedding material per Section 31 00 00 - Earthwork.

B. All pipes smaller than 4 inches shall be bedded with sand.

2.2 TRENCH BACKFILL MATERIAL

A. Excavated trench material may be used as follows:

1. Excavated trench material shall be free from cinders, ashes, refuse, organic and frozen material, boulders with any dimension exceeding 8 inches, or other unsuitable material per Section 31 00 00 - Earthwork.

2. Material with excessive or deficient moisture content will not be considered as unsuitable if the moisture content can be adjusted to a level that allows obtaining compaction.

3. Imported backfill material shall conform to imported trench backfill (8" Pit Run) per Section 31 00 00 - Earthwork.

2.3 FOUNDATION STABILIZATION

A. Trench foundation material shall consist of foundation stabilization backfill material per Section 31 00 00 - Earthwork.

2.4 IDENTIFICATION TAPE AND LOCATING WIRE

A. Locating wire shall be No. 12 AWG insulated cooper locating wire with 1/64" PVC insulation.

B. Identification tape shall be 3-inches wide, 4 mil polyethylene vinyl. Tape text and color shall meet the following requirements

Pipe Contents	Text	Color
Potable Water	"CAUTION – WATER LINE BURIED BELOW"	Blue
Pressure Sewer	"CAUTION – SEWER LINE BURIED BELOW"	Green
Reclaimed Water	"CAUTION – RECLAIMED WATER LINE BURIED BELOW"	Purple
Pressure Irrigation	"CAUTION – IRRIGATION LINE BURIED BELOW"	Purple
Gas	"CAUTION – GAS LINE BURIED BELOW"	Yellow
Telephone	"CAUTION – PIPE LINE BURIED BELOW"	Yellow
Cable TV	"CAUTION – PIPE LINE BURIED BELOW"	Yellow
Electric	"CAUTION – ELECTRICAL LINE BURIED BELOW"	Red

PART 3 - EXECUTION

3.1 EXISTING UTILITIES:

A. The Contractor shall be fully responsible for any and all damage to existing or constructed utilities, and shall repair damages in accordance with utility owner's requirements at no additional cost to the Owner. It shall be the Contractor's responsibility to coordinate and notify all affected utility owners. Call 811 Dig-Line before commencing construction.

1. Parallel Utility Support: Work associated with parallel utility support and utility crossings shall be incidental to the work unless a specific bid item is provided for parallel utility support.

2. Utility Crossing Support: All utilities that interfere with the construction of the trenching and pipe installation shall be temporarily supported in accordance with the utility owner's requirements. Work associated with utility crossings support shall be incidental to the work unless a specific bid item is provided for utility crossing support.

3. All crossing utilities shown on the plans and marked by Dig-Line shall be vertical and horizontally located, in a non-destructive manner, prior to construction to verify pipe elevation, materials, and diameter. This information shall be provided to the Engineer for evaluation of conflicts prior to construction. All potholes shall be backfilled immediately after obtaining information.

3.2 TRENCH EXCAVATION

A. Trenches shall be excavated to lines and grades shown on the drawings, with a minimum width at the top or crown of the pipe not to exceed the outside diameter of the pipe plus 2'. In the event the Contractor should over excavate in width or depth without the Engineer's approval, he shall provide pipe bedding for the full length of the over excavation. No special payment will be made for work caused by over excavation.

B. Trench shall be kept free from water at all times to facilitate fine grading, proper laying and joining of pipe, and prevention of damage to completed joints.

C. If the trench bottom is disturbed during excavation, compact trench bottom to 95% maximum density of the standard proctor, ASTM D698.

D. The Contractor shall conduct trench operations in such a manner as to provide adequate safety precautions for workmen, adjacent property, or the public at all times by use of adequate sheeting, shoring, or bracing to sustain stability of the trench floor and walls. The Contractor shall furnish, place, and maintain such shoring as may be required to support sides of the trench. Costs of shoring and bracing shall be considered incidental to trench excavation and backfill.

E. The Contractor shall conduct trench operations in such a manner as to provide adequate safety precautions for workmen, adjacent property, or the public at all times by use of adequate sheeting, shoring, or bracing to sustain stability of the trench floor and walls. The Contractor shall furnish, place, and maintain such shoring as may be required to support sides of the trench.

3.3 PIPE BEDDING

A. Place bedding in layers no thicker than 6 inches. Allow for bedding depth around pipe bells. Place bedding at least 4 inches below the pipe and 6 inches above the pipe.

B. Shovel slice and tamp to ensure that the bedding material is firmly placed.

C. Following placement of pipe, place additional bedding material up to the springline of the pipe. Shovel slice and tamp to ensure that the bedding material fills in and supports the pipe haunch area.

D. In 6 inch lifts, place additional bedding layers from the pipe springline to 6 inches above the pipe.

3.4 TRENCH BACKFILL

A. All backfill material shall be placed in layers not to exceed 8-inch maximum loose lift thickness for native material and 12-inch maximum loose lift thickness for imported aggregate backfill.

B. The entire trench shall be compacted to a minimum of 95% of standard maximum density of the standard proctor as determined by ASTM D-698.

C. Trenches under buildings and structures shall be compacted, the entire depth, to 95% of the maximum density of the modified proctor determined by ASTM D1557.

3.5 IDENTIFICATION TAPE AND LOCATING WIRE PLACEMENT

A. Unless indicated otherwise, attach locating wire to the crown of all buried pipelines using electrical tape, except gravity irrigation, sanitary sewer, or storm sewer mains having visible manholes or clean-out structures at all angle points. Provide 12” of slack wire above ground at each location of valve or wire box.

B. Unless indicated otherwise, identification tape shall be placed above all buried pipelines, 18” - 24” above the crown of the pipe, except gravity irrigation, sanitary sewer, or storm sewer mains having visible manholes or clean-out structures at all angle points.

C. Unless indicated otherwise, identification tape shall be placed above all buried pipelines that are installed with locating wire. Identification tape shall be placed 18” - 24” above the crown of the pipe.

3.6 QUALITY CONTROL

A. Material & Compaction Testing: All soils testing of samples submitted by the Contractor will be done by a testing laboratory mutually agreed upon by Contractor and Owner and at the Contractor’s expense. If tests indicate work does not meet specific compaction requirements, remove work, replace, and retest at the Contractor’s expense.

1. Qualifications of testing company

a. Basic requirements of ASTM E 329, “Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials as Used in Construction” and ASTM D 3666, “Standard Specification for Minimum Requirements for Agency Testing and Inspecting Bituminous Paving Materials”, as applicable.

b. Calibrate testing equipment at reasonable intervals by devices of accuracy traceable to either the National Bureau of Standards or accepted values of natural physical constants.

2. Frequency of Compaction Tests

a. Test section shall be a tested at 2-feet above top of pipe and every 1-foot lift thereafter and at the top of the trench backfill.

b. Two (2) test sections, at different locations for every trench less than 300 feet in length, but not less than once per day.

c. One (1) test section per every 300 feet of additional trench and at locations where materials or construction procedures change, but not less than once per day.

3.7 CLEANUP

A. Surplus excavated material or stripped material not salvaged as topsoil and excavated material not meeting the requirements for backfill shall become waste. All waste material shall be disposed of by the Contractor.

END OF SECTION 31 23 33

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SECTION 31 40 00 – SHORING

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents:

1. Drawings and general provisions of the Contract apply to this Section.

2. Review these documents for coordination with additional requirements and information that apply to Work under this Section.

B. Section Includes:

1. Design of bracing and shoring.

2. Selection of construction sequence.

3. Temporary bracing and/ or shoring of the structure or portions of the structure as required to prevent the structure from becoming unsafe during construction.

4. Temporary shoring of excavations.

5. Construction and removal of posts, timbers, lagging, braces, etc. at the end of construction.

C. Related Sections:

1. Division 01 Section "General Requirements."

2. Division 01 Section "Special Procedures."

3. Division 31 Section "Excavation".

1.2 REFERENCES

A. General:

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.

2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.

3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.

1.3 DESIGN REQUIREMENTS

A. General: The stability and integrity of the structure during construction shall be maintained at levels generally acceptable within the construction industry by the use of bracing and shoring. In no case shall the structure be allowed to become unsafe during construction. Design stresses in bracing and shoring shall not exceed the allowable stresses permitted in IBC.

B. Bracing and Shoring for Structures:

1. The bracing and shoring systems required to provide temporary support of a structure or portions of a structure during construction shall be designed to support the dead, live, soil, earthquake and wind loads that may be imposed on the structure during construction in accordance with industry standards and generally accepted engineering principles.

2. The proposed bracing and shoring systems shall have foundations designed for allowable soil bearing pressures in accordance with the geotechnical investigation prepared for the Project.

C. Shoring of Excavations: The proposed shoring systems shall be designed for earth pressures and allowable soil bearing values as applicable in accordance with the geotechnical investigation prepared for the Project.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings indicating layout, member sizes, connection details and construction sequence for bracing and shoring. No work related to bracing and shoring shall take place until shop drawings are reviewed.

C. Design calculations of bracing and shoring showing member stresses and connections due to imposed loads.

1.5 QUALITY ASSURANCE

A. Design calculations and Shop Drawings of proposed bracing and shoring of the structure shall be prepared, stamped, and signed by a structural engineer registered in the State of Idaho.

1.6 PROJECT CONDITIONS

A. Refer to the Project Constraints for the Project construction requirements relating to schedules, sequencing, and system protection.

PART 2 - PRODUCTS

2.1 MATERIALS FOR SHORING AND BRACING

A. Materials for shoring and bracing shall be undamaged, high-quality materials. Reuse of materials is allowable, but the material shall be in undamaged condition.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. Construction of bracing and shoring shall be in accordance with the reviewed Shop Drawings prepared by the Contractor's Engineer.

B. The Contractor shall hire the Engineer responsible for the design of bracing, shoring and inspection of the Work as detailed on the bracing and shoring Shop Drawings, prior to saw cutting or removing portions of the structure.

C. The Engineer responsible for design of bracing and shoring shall inform the Owner’s Project Engineer in writing that construction of bracing and shoring was completed in accordance with the Shop Drawings and meets its approval, prior to placement of concrete, saw cutting, and removal or modification of portions of the structure.

D. Remove surplus excavated materials from site.

3.2 REMOVAL OF BRACING AND SHORING

A. Bracing and shoring shall not be removed until the new Work has acquired sufficient strength to support their weight and the loads superimposed thereon safely. In no case may bracing or shoring be removed until the time and sequence has been approved by the Engineer responsible for bracing and shoring.

B. In general, bracing and shoring of concrete shall remain in place for at least ten days, when they may be removed provided the concrete is sufficiently hard and will not be injured.

END OF SECTION 31 40 00

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SECTION 31 66 13.13 – RAMMED AGGREGATE PIERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work shall consist of designing, furnishing, and installing Rammed Aggregate Pier foundations to the lines and grades designated on the project foundation plan and as specified herein. The aggregate piers shall be constructed by either augering a cavity or driving a hollow mandrel to the design depth and vertically ramming lifts of aggregate using the specially designed tamper head and high-energy impact densification equipment to create the compacted aggregate pier. The Rammed Aggregate Pier elements shall be in a columnar-type configuration and shall be used to produce an intermediate foundation system for support of foundation loads.

B. Extents of Rammed Aggregate Pier installation shown on project drawings are conceptual in nature. Final design (spacing, depth, etc.) and construction of Rammed Aggregate Piers is ultimately the responsibility of the contractor based on the requirements outlined herein and shall be included in the final bid cost. Changes in the layout of the Rammed Aggregate Piers will be at no cost to the Owner.

1.2 WORK INCLUDED

A. Provision of all equipment, material, labor, and supervision to design and install Rammed Aggregate Pier elements. Design shall rely on subsurface information presented in the project geotechnical report. Layout of Rammed Aggregate Pier elements, spoil removal (as required), footing excavations, and subgrade preparation following aggregate pier installation is not included.

B. The Rammed Aggregate Pier design and installation shall adhere to all methods and standards described in this Specification.

C. Drawings and General Provisions of the Contract, including General and Supplemental Conditions, and Division 1 Specifications, apply to the work in this specification.

1.3 APPROVED INSTALLERS

A. The Rammed Aggregate Pier Installer (the Installer) shall be approved by the Owner’s Engineer prior to bid opening. Without exception, no alternate installer will be accepted unless approved by the Owner’s Engineer at least two (2) weeks prior to bid opening.

B. Installers of Rammed Aggregate Pier foundation systems shall have a minimum of 5 years of experience with the installation of Rammed Aggregate Pier systems and shall have completed at least 50 projects.

C. Without exception, no alternate installer will be accepted unless approved by Owner and Engineer.

D. Installers currently approved for these works are:

1. Geopier-Northwest, Inc., Bellevue, WA

2. Inland Foundation Company, Boise, ID

3. Farrell Design-Build, Placerville, CA

4. GeoConstructors, Inc., Leesburg, VA

1.4 REFERENCE STANDARDS

A. Design

1. "Control of Settlement and Uplift of Structures Using Short Aggregate Piers," by Evert C. Lawton (Assoc. Prof., Dept. of Civil Eng., Univ. of Utah), Nathaniel S. Fox (President, Geopier Foundation Co., Inc.), and Richard L. Handy (Distinguished Prof. Emeritus, Iowa State Univ., Dept. of Civil Eng.), reprinted from *IN-SITU DEEP SOIL IMPROVEMENT, Proceedings of sessions sponsored by the Geotechnical Engineering Division/ASCE in conjunction with the ASCE National Convention held October 9-13, 1994, Atlanta, Georgia*.

2. "Settlement of Structures Supported on Marginal or Inadequate Soils Stiffened with Short Aggregate Piers," by Evert C. Lawton and Nathaniel S. Fox. *Geotechnical Special Publication No. 40: Vertical and Horizontal Deformations of Foundations and Embankments,* ASCE, 2, 962-974.

3. "Behavior of Geopier®-Supported Foundation Systems during Seismic Events," by Kord Wissmann, Evert C. Lawton, and Tom Farrell. Geopier Foundation Company, Inc. Blacksburg, VA ©1999.

B. Modulus Testing

1. ASTM D 1143 - Pile Load Test Procedures

2. ASTM D 1194 - Spread Footing Load Test

C. Materials and Inspection

1. ASTM D 1241 - Aggregate Quality

2. ASTM D 422 - Gradation of Soils

D. Where specifications and reference documents conflict, the Rammed Aggregate Pier Designer shall make the final determination of the applicable document.

1.5 CERTIFICATIONS & SUBMITTALS

A. Provide shop drawings per Section 01 33 00 – Submittal Procedures.

B. Design Calculations - The Installer shall submit detailed design calculations and construction drawings prepared by the Rammed Aggregate Pier Designer (the Designer) for review and approval by the Owner or Owner's Engineer. All plans shall be sealed by a Professional Engineer in the State in which the project is constructed.

C. Professional Liability Insurance - The Rammed Aggregate Pier Designer shall have Errors and Omissions design insurance for the work. The insurance policy should provide a minimum coverage of $3 million per occurrence.

D. Modulus Test Reports – A modulus test(s) is performed on a non-production Rammed Aggregate Pier element as required by the Rammed Aggregate Pier Designer to verify the design assumptions. The Installer shall furnish the General Contractor a description of the installation equipment, installation records, complete test data, analysis of the test data and verification of the design parameter values based on the modulus test results. The report shall be prepared under the direction of a Registered Professional Engineer.

E. Daily Rammed Aggregate Pier Progress Reports – The Installer shall furnish a complete and accurate record of Rammed Aggregate Pier installation to the General Contractor. The record shall indicate the pier location, length, volume of aggregate used or number of lifts, densification forces during installation, and final elevations or depths of the base and top of piers. The record shall also indicate the type and size of the installation equipment used, and the type of aggregate used. The Installer shall immediately report any unusual conditions encountered during installation to the General Contractor, to the Designer and to the Testing Agency.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregate used by the Rammed Aggregate Pier Installer for pier construction shall be pre-approved by the Designer and shall demonstrate suitable performance during modulus testing. Typical aggregate consists of Type 1 Grade B in accordance with ASTM D-1241-68, No. 57 stone, recycled concrete or other graded aggregate approved by the Designer.

B. Potable water or other suitable sources shall be used to increase aggregate moisture content where required. The General Contractor shall provide such water to the Installer.

2.2 AGGREGATE PIER DESIGN

A. The design of the Rammed Aggregate Pier system shall be based on the service load bearing pressure and the allowable total and differential settlement criteria of all footings indicated by the design team for support by the Rammed Aggregate Pier system. The Rammed Aggregate Pier system shall be designed in accordance with generally accepted engineering practice and the methods described in Section 1 of these Specifications. The design life of the structure shall be 50+ years.

B. The design shall meet the following criteria.

a. Estimated Total Long-Term Settlement for Footings: ≤ 1-inch

b. Estimated Long-Term Differential Settlement of Adjacent Footings: ≤ 1/2-inch

c. Minimum Allowable Bearing Pressure for Footings Supported by Rammed Aggregate Pier Reinforced Soils for the following structures:

a) Tertiary Treatment (Structure D): 5,000 psf

b) Control & Dewatering (Structure E):5,000 psf

C. The Rammed Aggregate Pier elements shall be designed and installed to completely penetrate existing fill.

D. The Rammed Aggregate Pier elements shall be designed using a Rammed Aggregate Pier stiffness modulus to be verified by the results of the modulus test described in Section 3.4 of these specifications.

2.3 DESIGN SUBMITTAL

The Installer shall submit detailed design calculations, construction drawings, and shop drawings, (the Design Submittal), for approval at least 2 week(s) prior to the beginning of construction. A detailed explanation of the design parameters for settlement calculations shall be included in the Design Submittal. Additionally, the quality control test program for Aggregate Pier system, meeting these design requirements, shall be submitted. All computer-generated calculations and drawings shall be prepared and sealed by a Professional Engineer, licensed in the State of Idaho. Submittals will be submitted electronically only unless otherwise required by specific submittal instructions.

PART 3 - EXECUTION

3.1 INSTALLATION PROCEDURES

The following sections provide general criteria for the construction of the Rammed Aggregate Pier elements. Unless otherwise approved by the Designer, the installation method used for Rammed Aggregate Pier construction shall be that as used in the construction of the successful modulus test.

A. Augered Rammed Aggregate Pier systems –

1. Augered Rammed Aggregate Pier system shall be pre-augered using mechanical drilling or excavation equipment.

2. If cave-ins exceeding 10% of the lift volume occur during excavation such that the sidewalls of the hole are deemed to be unstable, steel casing shall be used to stabilize the cavity or a displacement Rammed Aggregate Pier system may be used.

3. Aggregate shall be placed in the augered cavity in lift thicknesses as determined by the Rammed Aggregate Pier Designer.

4. A specially designed beveled tamper and high-energy impact densification apparatus shall be employed to densify lifts of aggregate during installation. The apparatus shall apply direct **downward** impact energy to each lift of aggregate. Compaction equipment that induces horizontal vibratory energy (such as Vibroflot equipment) is not permitted.

B. Displacement Rammed Aggregate Pier systems –

1. Displacement Rammed Aggregate Pier systems shall be constructed by advancing a specially designed mandrel with a minimum 15-ton static force augmented by dynamic vertical ramming energy to the full design depth. The hollow-shaft mandrel, filled with aggregate, is incrementally raised, permitting the aggregate to be released into the cavity, and then lowered by vertically advancing and/or ramming to densify the aggregate and force it laterally into the adjacent soil. The cycle of raising and lowering the mandrel is repeated to the top of pier elevation. The cycle distance shall be determined by the Rammed Aggregate Pier designer.

2. Special high-energy impact densification apparatus shall be employed to vertically densify the Rammed Aggregate Pier elements during installation of each constructed lift of aggregate.

3. Densification shall be performed using a mandrel/tamper. The mandrel/tamper foot is required to adequately increase the lateral earth pressure in the matrix soil during installation. Compaction equipment that induces horizontal vibratory energy (such as Vibroflot equipment) is not permitted.

4. Downward crowd pressure shall be applied to the mandrel during installation.

C. The equipment shall have the capability to properly install a rammed aggregate pier to a minimum depth as determined by the geopier designer.

3.2 PLAN LOCATION & ELEVATION OF RAMMED PIERS

A. The as-built center of each pier shall be within 6 inches of the locations indicated on the plans. Piers installed outside of the above tolerances and deemed not acceptable shall be rebuilt at no additional expense to the Owner.

3.3 REJECTED RAMMED AGGREGATE PIERS

A. Rammed Aggregate Pier elements installed beyond the maximum allowable tolerances shall be abandoned and replaced with new piers unless the Designer approves the condition or provides other remedial measures. All material and labor required to replace rejected piers shall be provided at no additional cost to the Owner unless the cause of rejection is due to an obstruction or mislocation.

3.4 QUALITY CONTROL

A. Control Technician

1. The Installer shall have a full-time, on-site Control Technician to verify and report on all installation procedures. The Installer shall immediately report any unusual conditions encountered during installation to the Rammed Aggregate Pier Designer, the General Contractor, and to the Testing Agency.

B. Rammed Aggregate Pier Modulus Test

1. As required by the RAP designer, a Rammed Aggregate Pier Modulus Test(s) will be performed at locations agreed upon by the Rammed Aggregate Pier Designer and the Testing Agency to verify or modify Rammed Aggregate Pier designs. Modulus Test Procedures shall utilize appropriate portions of ASTM D 1143 and ASTM D 1194, as outlined in the Rammed Aggregate Pier design submittal.

C. Bottom Stabilization Testing (BSTs) / Crowd Stabilization Testing (CSTs)

1. Bottom stabilization testing (BSTs) or Crowd stabilization testing (CSTs) shall be performed by the Control Technician during the installation of the modulus test pier. Additional testing as required by the Rammed Aggregate Pier Designer shall be performed on selected production Rammed Aggregate Pier elements to compare results with the modulus test pier.

3.5 QUALITY ASSURANCE

A. Independent Engineering Testing Agency (Owner's Quality Assurance)

1. The Rammed Aggregate Pier Installer shall provide full-time Quality Control monitoring of Rammed Aggregate Pier construction activities. The General Contractor is responsible for retaining an independent engineering testing firm to provide Quality Assurance services to verify bearing capacities.

B. Responsibilities of Independent Engineering Testing Agency

1. The Testing Agency shall monitor the modulus test pier installation and testing. The Installer shall provide and install all dial indicators and other measuring devices.

2. The Testing Agency shall monitor the installation of Rammed Aggregate Pier elements to verify that the production installation practices are similar to those used during the installation of the modulus test elements.

3. The Testing Agency shall report any discrepancies to the Installer and General Contractor immediately.

4. The Testing Agency shall observe the excavation, compaction and placement of the foundations as described in Section 7.05. Dynamic Cone Penetration testing may be performed to evaluate the footing bottom condition as determined by the Testing Agency.

3.6 RESPONSIBILITIES OF THE GENERAL CONTRACTOR

A. Site Preparation and Protection

1. The General Contractor shall locate and protect underground and aboveground utilities and other structures from damage during installation of the Rammed Aggregate Pier elements.

2. Site grades for Rammed Aggregate Pier installation shall be within 1 foot of the top of footing elevation or finished grade elevation to minimize Rammed Aggregate Pier installation depths. Ground elevations and bottom of footing elevations shall be provided to the Rammed Aggregate Pier Installer in sufficient detail to estimate installation depth elevations to within 3 inches.

3. The General Contractor will provide site access to the Installer, after earthwork in the area has been completed. A working surface shall be established and maintained by the General Contractor to provide wet weather protection of the subgrade and to provide access for efficient operation of the Rammed Aggregate Pier installation.

4. Prior to, during and following Rammed Aggregate Pier installation, the General Contractor shall provide positive drainage to protect the site from wet weather and surface ponding of water.

5. If spoils are generated by Rammed Aggregate Pier installation, spoil removal from the Rammed Aggregate Pier work area in a timely manner to prevent interruption of Rammed Aggregate Pier installation is required.

B. Rammed Aggregate Pier Layout

1. The location of Rammed Aggregate Pier-supported foundations for this project, including layout of individual Rammed Aggregate Pier elements, shall be marked in the field using survey stakes or similar means at locations shown on the drawings.

C. Contractor’s / Owner’s Independent Testing Agency (Owner’s Quality Assurance)

1. General Contractor is responsible for acquiring an Independent Testing Agency (Quality Assurance) as required. Testing Agency roles are as described in Part 3.5 of this specification. The Aggregate Pier Installer will provide Quality Control services as described in Part 3.4 of this specification.

D. Excavations of Obstructions

1. Should any obstruction be encountered during Rammed Aggregate Pier installation, the General Contractor shall be responsible for promptly removing such obstruction, or the pier shall be relocated or abandoned. Obstructions include, but are not limited to, boulders, timbers, concrete, bricks, utility lines, etc., which shall prevent placing the piers to the required depth or shall cause the pier to drift from the required location.

2. Dense natural rock or weathered rock layers shall not be deemed obstructions, and piers may be terminated short of design lengths on such materials.

E. Utility Excavations

1. The General Contractor shall coordinate all excavations made after Rammed Aggregate Pier installations so that excavations do not encroach on the piers as shown in the Rammed Aggregate Pier construction drawings. Protection of completed Rammed Aggregate Pier elements is the responsibility of the General Contractor. In the event that utility excavations are required in close proximity to the installed Rammed Aggregate Pier elements, the General Contractor shall contact the Rammed Aggregate Pier Designer immediately to develop construction solutions to minimize impacts on the installed Aggregate Pier elements.

F. Footing Bottoms

1. Excavation and surface compaction of all footings shall be the responsibility of the General Contractor.

2. Foundation excavations to expose the tops of Rammed Aggregate Pier elements shall be made in a workman-like manner, and shall be protected until concrete placement, with procedures and equipment best suited to (1) avoid exposure to water, (2) prevent softening of the matrix soil between and around the Rammed Aggregate Pier elements before pouring structural concrete, and (3) achieve direct and firm contact between the dense, undisturbed Rammed Aggregate Pier elements and the concrete footing.

3. All excavations for footing bottoms supported by Rammed Aggregate Pier foundations shall be prepared in the following manner by the General Contractor. Recommended procedures for achieving these goals are to:

   a. Limit over-excavation below the bottom of the footing to 3-inches (including disturbance from the teeth of the excavation equipment).

   b. Compaction of surface soil and top of Rammed Aggregate Pier elements shall be prepared using a motorized impact compactor (“Wacker Packer,” “Jumping Jack,” or similar). Sled-type tamping devices shall only be used in granular soils and when approved by the designer. Loose or soft surficial soil over the entire footing bottom shall be recompacted or removed, respectively. The surface of the aggregate pier shall be recompacted prior to completing footing bottom preparation.

   c. Place footing concrete immediately after footing excavation is made and approved, preferably the same day as the excavation. Footing concrete must be placed on the same day if the footing is bearing on moisture-sensitive soils. If same day placement of footing concrete is not possible, open excavations shall be protected from surface water accumulation. A lean concrete mud-mat may be used to accomplish this. Other methods must be pre-approved by the Designer.

4. The following criteria shall apply, and a written inspection report sealed by the project Testing Agency shall be furnished to the Installer to confirm:

a. That water (which may soften the unconfined matrix soil between and around the Rammed Aggregate Pier elements, and may have detrimental effects on the supporting capability of the Rammed Aggregate Pier reinforced subgrade) has not been allowed to pond in the footing excavation at any time.

b. That all Rammed Aggregate Pier elements designed for each footing have been exposed in the footing excavation.

c. That immediately before footing construction, the tops of Rammed Aggregate Pier elements exposed in each footing excavation have been inspected and recompacted as necessary with mechanical compaction equipment.

d. That no excavations or drilled shafts (elevator, etc.) have been made after installation of Aggregate Pier elements within the excavation limits described in the Rammed Aggregate Pier construction drawings, without the written approval of the Installer or Designer.

G. Failure to provide the above inspection and certification by the Testing Agency, which is beyond the responsibility of the Rammed Aggregate Pier Installer, may void any written or implied warranty on the performance of the Rammed Aggregate Pier system.

END OF SECTION 31 66 13.13

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SECTION 32 12 16 – ASPHALT PAVING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, equipment and materials as required to provide new pavement, and to repair existing asphalt surfaced, streets, roads, driveways, or other similar improved areas damaged or removed by excavations.

B. Additive Bid No. 1: Provide and install asphalt pavement in lieu of gravel surfacing as shown on the drawings.

1.2 SUBMITTALS

A. Submit in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

C. Superpave Hot Mix Asphalt: Submit job mix formula and ITD approval letter of previously approved Mix Design. Prepare a submittal that includes:

1. The original approved mix design that includes the confirmed JMF from the previous project

2. adjustments made to the JMF that make it the C-JMF

3. adjustments made to the C-JMF during production

4. documentation supporting these adjustments.

5. Current Stockpile Quality Control testing that includes the following to confirm the material in stockpile is similar to the material used for the original mix design, including RAP:

    a. Sieve analysis on the stockpiles to be used, including crusher control charts.

6. Note: Previously used mix designs that are used during the calendar year of confirmation may omit Step 5 if the stockpiles consist of the crushed material, including RAP, from the original mix design. Previously used mix designs that more than one calendar year has elapsed from the time of confirmation must include Step 5.

7. JMF with a content of more than 30% recycle asphalt pavement (rap) will not be accepted, regardless of prior ITD approval.

D. Material Test Reports: For each paving material.

1.3 QUALITY CONTROL

A. Testing Agency Qualifications: Qualified according to ASTM D3666 for testing indicated.

B. Pre-Paving Conference: Conduct conference at Project Site. Immediately before paving, the Contractor, the asphalt supplier, the Engineer, and the Owner personnel involved in the paving operation will hold a pre-paving conference to discuss the means that will achieve the highest quality surface.

1. Before the pre-paving conference, submit a Superpave HMA paving plan to the Engineer. Tailor the plan to the asphalt to be supplied, the anticipated JMF, and the Contractor's equipment and operation. Include at least the following:

a. Breakdown, intermediate, and finish rollers to be used

b. Static or vibratory rolling for breakdown and intermediate rolling

c. Frequency, amplitude, force/impact, and roller velocity for vibratory rolling

d. Proximity of breakdown roller to paver with respect to horizontal displacement

e. Proximity of intermediate roller to breakdown roller

f. Compaction temperatures for breakdown, intermediate, and finish rolling

g. Adjustments to paving/compaction operation with respect to temperature, amplitude, frequency, lift thickness, gradation, force/impact, and roller velocity

h. Rubber tired rolling with respect to pickup of pavement material

i. Paving equipment and preheating and vibratory settings of the screed

j. Coordination of plant production and paving operations; climate, haul distance

k. Surface and air temperatures anticipated during production

l. Temperature necessary to allow public traffic onto the new pavement surface

m. Anticipated traffic control issues as necessary

n. Additional equipment required

o. Inspection, sampling and testing requirements

p. Other paving issues as necessary

PART 2 - PRODUCTS

2.1 PLANT MIX PAVEMENT

A. General: Superpave hot mix asphalt shall conform to the 2023 Idaho Department of Transportation Standard Specifications for Highway Construction, Section 405.

1. Mixture Type: SP3

2. Grade of Asphalt: PG 58-28

3. Aggregate Size: 1/2”

4. Anti-Stripping Additive: Provide anti-stripping additive if the immersion compression retained strength (ASTM T165) of the design mix is less than 70 percent of the dry compressive strength. Anti-stripping additive shall be added at the refinery at a rate of 0.5 to 1.0 percent of asphalt cement as determined by laboratory test.

2.2 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, or crushed gravel.

C. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, or combinations thereof.

1. For plant mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

2.3 AUXILIARY MATERIALS

A. Tack Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

PART 3 - EXECUTION

3.1 GENERAL

A. Do not place pavement on a wet or frozen surface or when weather or surface conditions will otherwise prevent the proper handling or finishing of the pavement placement.

B. Air and Surface Temperature Limitations:

Compacted Thickness of Individual Courses	Top Course	Leveling and Courses Below the Top Course
Less than 1.5”	60°F	-
1.5” to 3”	50°F	40°F
Greater than 3”	40°F	40°F

C. Asphalt concrete shall not be placed when the surface and atmospheric temperature is below 40 degrees F, if rain is imminent or expected before time required for adequate cure, or if subgrade is wet or excessively damp.

3.2 SURFACE PREPARATION

A. Aggregate base shall be provided where indicated to the thickness indicated. The compacted surface of the finished aggregate shall be hard, uniform, smooth and at any point shall not vary more than 0.02 feet from the indicated grade or cross-section.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.

2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.

3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed at no cost to the Owner.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

D. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Verify that subgrade is dry and in suitable condition to begin paving.

E. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, plant mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying plant mix asphalt paving.

2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.3 PATCHING

A. Plant Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches minimum into adjacent sound pavement. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Patching: Fill excavated pavements with plant mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.4 SUPERPAVE HOT MIX ASPHALT PAVING

A. Machine place Hot Mix Asphalt on prepared surface, spread uniformly, and strike off. Place Hot Mix Asphalt by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place Hot Mix Asphalt base course in number of lifts and thicknesses indicated.

2. Place Hot Mix Asphalt surface course in single lift.

3. Spread mix at minimum temperature of 250 deg F (121 deg C).

4. Begin applying Hot Mix Asphalt along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.

5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place Hot Mix Asphalt in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with plant mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.5 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of Hot Mix Asphalt courses.

1. Clean contact surfaces and apply tack coat to joints.

2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.

3. Offset transverse joints, in successive courses, a minimum of 24 inches.

4. Construct transverse joints at each point where paver ends work each day and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method.

5. Compact joints as soon as Hot Mix Asphalt will bear roller weight without excessive displacement.

6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.6 COMPACTION

A. General: Begin compaction as soon as placed plant mix paving will bear roller weight without excessive displacement. Compact plant mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Do not operate vibratory rollers in the vibratory mode when the internal mix temperature is less than 175 °F or when checking or cracking of the mat occurs at a higher temperature.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while plant mix asphalt is still hot enough to achieve specified density. Continue rolling until plant mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while plant mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, plant mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.7 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Surface Course: 1/8 inch.

C. Corrective Actions:

1. Grind the asphalt pavement to within the surface smoothness tolerance, if thickness permits in accordance with the above criteria.

2. All grinding shall be done parallel to centerline. Adjacent grinder passes within any single ground area shall be extended to produce a neat rectangular area having a uniform surface appearance. At transverse boundaries between ground and unground areas, smoothly feathered transitions shall be made.

3. The Contractor shall check the pavement for smoothness after grinding, in accordance with this specifications and shall make any additional corrections necessary to the pavement to achieve smoothness.

4. After grinding has been completed, the ground pavement surface shall receive a fog coat at a rate approved by the Engineer.

5. The cost of such grinding or milling, and all related work such as fog coat, disposal of milled material, traffic control, flagging, profiling, surface repair of ground or milled areas, and temporary pavement markings shall be at the Contactor’s expense.

6. If correction of the pavement as listed above will not produce satisfactory results as to smoothness, or will reduce pavement thicknesses and serviceability excessively, the pavement shall be removed and replaced or overlaid to correct the deficiency at no additional cost to the project.

3.8 FIELD QUALITY CONTROL & ACCEPTANCE

A. Thickness: The Contractor shall extract core samples from the in-place compacted plant mix pavement. Thickness will be determined according to ASTM D 3549.

1. Take two samples minimum. Take one core samples for every 3,500 square feet, at least one sample every day.

2. Tolerance: Plus 1/4 inch (6 mm), no minus.

3. If more than 25% of pavement core samples fail to meet thickness requirements with a tolerance of 0-1/4” minus of the project requirements, or if more than 10% fail to meet thickness requirements with a thickness deficit greater than 1/4", corrective actions shall be taken at no additional cost to the Owner.

4. Corrective Actions:

   a. Install 1.5-inch asphalt overlay with same Job Mix Formula and Plant Mix Pavement, if grades allow, or

   b. Remove and replace pavement to specified thickness, grades, and smoothness.

   c. If allowed by the Engineer, adjusts price for asphalt pavement that does not meet thickness requirements in accordance with the following pay factor (PF) reductions:

      1) If thickness is ≥ 100% of Required Thickness, PF = 1.0.

      2) If thickness is 1/4" less than the Require Thickness, PF = 0.80.

      3) If thickness is 1/2" less than the Require Thickness, subject to rejection, if allowed to remain in place, the PF will be 0.75.

5. Core Samples during Pavement Placement: If cores are taken during placement of pavement, fill core sample holes with hot mix asphalt.

6. Core Samples after Pavement Placement: If cores are taken after placement of pavement, fill core sample hole with 4,000 psi concrete. Prevent concrete from staining asphalt pavement by using a plastic sheet around the core hole while filling with concrete. Tap plastic sheet down.

B. The relative density after compaction shall be 92-96 percent of the density obtained by using ASTM D 1188 or D 2726. A properly calibrated nuclear asphalt testing device shall be used for determining the field density of compacted asphalt concrete, or slabs or cores may be laboratory tested in accordance with ASTM D 1188.

3.9 CLEAN-UP

A. After Work of this Section is complete, remove all debris, rocks, gravel, excess asphalt.

END OF SECTION 32 12 16

SECTION 32 13 13 - CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish all labor, materials, and equipment required for concrete work including forming, reinforcing steel, anchor bolts and site concrete.

B. Anchor bolt templates to be supplied by light pole manufacturer.

1.2 JOB CONDITIONS

A. In hot and cold weather, comply with the requirements of ACI 305 and 306.

B. Do not place concrete on frozen ground. Unless adequate protection is provided, do not place concrete during rain, sleet, or snow.

C. Do not allow rain water to increase mixing water or damage surface finish.

D. When temperature of surrounding air is expected to be below 40°F, during placing, or within 24 hours thereafter, do not allow concrete temperature to drop below 55°F, for sections less than twelve inches (12”) in any dimension, or 55°F, for any other sections.

1. Keep the temperature of concrete, when placed, under 80°F, to preclude loss of slump, flash set, or cold joints.

2. When temperature of steel is greater than 120°F, spray steel forms and reinforcement with water just prior to placing concrete. Do not allow any water to pond in forms.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 00 – Submittal Procedures.

B. Submit mix design to be used for each class of concrete.

C. Submit location of materials source, admixtures to be used, and other related data.

D. Submit test reports showing suitability of aggregates used in concrete mixes.

E. Indicate sizes, spacing, locations of reinforcing steel, wire fabric, bending and cutting schedules, splicing, stirrup spacing, supporting, and spacing devices.

F. Alkali-Silica Reaction (ASR) test results.

G. Control joint placement plan.

H. The Contractor shall pay any material testing expenses associated with material submittals.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement: Use Portland cement conforming to the requirements of ASTM C 150 Type II for low alkali cement.

B. General Admixtures: Admixtures, other than air-entraining agents, may be used when the type and amount to be used are approved. Calcium chloride will not be allowed as an admixture.

C. Air-Entraining Agents: Use air-entraining agents conforming to the requirements of ASTM C 260. Air entraining admixtures shall be added to the mixing water.

D. Water Reducing Agents: Water reducing admixtures may be used to increase workability of the concrete when approved by the Engineer. Use water reducing admixtures conforming to ASTM C 494.

E. Water: Use potable water for mixing concrete.

F. General Aggregate Requirement: The proposed aggregate for the mix shall be tested for expansion and Alkali-Silica Reaction (ASR) in accordance with AASHTO T 303. Where testing indicates aggregates are reactive, the contractor shall use fly ash, lithium compound admixtures, or both to produce a concrete mix that successfully mitigates ASR. Contractor shall provide test results of successful mitigation, using ASTM C 1567, with results showing a linear expansion at 14 days not exceeding 0.10 percent when tested

G. Coarse Aggregate: Use coarse aggregate that consists of gravel, crushed slag, crushed stone or other approved inert materials, composed of hard, strong and durable particles, free of injurious coatings, and conforming to the requirements of ASTM C 33, except as modified herein.

1. Use only aggregates that include deleterious substances not exceeding the following:

	Percent (by weight)
Soft Fragments	0.20
Coal and Lignite	0.30
Clay Lumps	0.30
Other Deleterious Substances	2.00
Minus 200 Material	1.75

2. Use coarse aggregate meeting the following gradations when tested in accordance to the requirements of ASTM C 136.

	Percent Passing (by weight)				
Course Aggregate Size	1"	3/4”	3/8"	No. 4	No. 8
3/4” to No. 4	100	90-100	20-55	1-10	0-5

H. Fine Aggregate: Use aggregate of natural sand or other approved inert materials composed of hard, strong, and durable particles conforming to the requirements of ASTM C 33 except as modified herein.

1. Use only aggregates that include deleterious substances not exceeding the following:

	Percent (by weight)
Clay Lumps	0.50
Coal and Lignite	0.30
Other Deleterious Substances	2.00
Minus 200 Material	1.75

2. Moisture content of fine aggregate shall not exceed 8 percent.

3. Use fine aggregate that is uniformly graded from coarse to fine within the following gradation, when tested in accordance to the requirements of ASTM C 136.

Sieve Size	Percent Passing (by weight)
3/8"	100
No. 4	95 - 100
No. 8	80 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	10 - 30
No. 100	2 - 10

I. Patch Mortar: Make patching mortar using Portland cement and sand to form a workable mortar suitable for filling defects in concrete surfaces.

1. Mortar: 1 part Portland cement to 2 parts sand by damp loose volume.

2. Mix white and gray Portland cement as required to match surrounding concrete.

3. Keep mixing water to a minimum.

4. Mix patching mortar in advance and allow to stand with frequent manipulation, without addition of water, until it has reached stiffest placeable consistency.

J. Curing Compounds: Use curing compounds that meet the requirements of ASTM C 309.

K. Sealer: Use Conspec Silane 40 or approved equal.

L. Joint Sealant: Use BASF MasterProtect H 1001 or approved equal. Use Sonolastic Polysulfide Sealant or approved equal for submerged in water applications. Color to match that of concrete.

2.2 REINFORCING STEEL AND WELDED WIRE MESH

A. Reinforcement Steel: ASTM A 615 Grade 60

B. Welded Wire Fabric: 12x12 W5.4/5.4

2.3 FORMING MATERIALS

A. Smooth Forms: Faced with material which will produce smooth, hard, uniform texture on concrete.

B. Form accessories that are to be partially or wholly embedded in concrete are to be a commercially manufactured type:

1. Use form ties constructed so that ends or end fasteners can be removed without causing appreciable spalling of concrete faces.

C. Form Release Agent: Colorless material which will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.

D. Contraction Joint Material: Wood strips; maximum possible length.

E. Dobie Blocks: Commercial grade blocks to support horizontal reinforcement.

2.4 READY MIX CONCRETE

A. Furnished commercial ready mix shall have the following properties:

Construction Type	Minimum Compressive Strength	Minimum Cement Content	Maximum Water / Cement Ratio	Air Entrainment Percentage	Maximum Slump
Light Pole, Sign, Fence Foundations	3,000 psi	560 LB/CY	0.49	6.5 ±1.5	4 ±1
Curbs, Gutters	4,000 psi	560 LB/CY	0.44	6.5 ±1.5	2.5 ±1
Concrete Pavement	4,000 psi	560 LB/CY	0.44	6.5 ±1.5	4 ±1
Retaining Walls	4,000 psi	560 LB/CY	0.44	6.5 ±1.5	4 ±1
Walking Surfaces – Sidewalks, Patios, Driveways, Stairs	4,500 psi	564 LB/CY	0.44	6.5 ±1.5	4 ±1
Walking Surfaces with Reinforcement – Sidewalks, Patios, Driveways, Stairs	5,000 psi	611 LB/CY	0.40	6.5 ±1.5	4 ±1

B. Fly ash may be used to replace a portion of the Portland cement in the concrete mix. The fly ash used shall not exceed twenty five percent of the total cement material in the mix. The cement material in the mix includes both Portland cement and fly ash. Fly Ash shall be Class F conforming to AASHTO M 295 with the additional requirement that the available alkalies in the fly ash shall not exceed 2 percent.

C. Ready-mixed concrete shall conform to the provisions in ASTM C 94 regarding batching, mixers and agitators, mixing and delivery, inspection, consistency and air content, and certification of batches.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall not incorporate ready mix concrete into the work that does not meet these specifications. The ready-mix concrete that is in non-compliance shall be removed from the project.

3.2 FORMING

A. Make forms sufficiently tight to prevent loss of cement paste. Arrange facing material orderly and symmetrical, keeping number of seams to a practical minimum.

B. Place chamfer strips in corners of forms to produce beveled edges on permanently exposed surfaces.

C. To maintain specified finish tolerances, chamfer formwork to compensate for anticipated deflections.

D. Provide positive means of adjustment using wedges or jacks, or shores and struts, and take up all settlement during concrete placing operation.

E. Securely brace forms against lateral deflection.

F. Provide temporary ports in formwork to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain. Close ports with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be apparent in exposed concrete surfaces.

G. At construction joints, overlap forms over hardened concrete at least six inches (6"). Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain true surface.

H. Anchor formwork to shores or other supporting surfaces or members so that upward or lateral movement of any part of formwork system is prevented during concrete placement.

I. Anchor formwork to shores or other supporting surfaces or members so that upward or lateral movement of any part of formwork system is prevented during concrete placement.

J. Position expansion joint material and other embedded items accurately and support against displacement.

3.3 REINFORCING

A. Place all reinforcement in the exact position shown on the plans and approved shop drawings and secure in position during the placing and compacting of concrete. Wire bars together with No. 16 gage wire with ties at all intersections except where spacing is less than 12 inches in each direction, in which case tie alternate intersections.

B. Place dobie blocks to maintain clearance from subgrade.

3.4 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Coordinate work of other sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

B. Install accessories in accordance with manufacturer's instructions, level and plumb with templates where necessary. Ensure items are not disturbed during concrete placement.

3.5 CONVEYING CONCRETE MIX

A. Unless specifically approved by the Engineer prior to placement of ready-mix concrete, all concrete mix shall be placed and discharged completely within 90 minutes of the introduction of water into the mix or before the drum has been revolved 300 revolutions, whichever comes first.

B. Handle concrete from mixer to location of final placing as rapidly as practicable by methods which prevent segregation or loss of ingredients and assure that quality is maintained.

C. Use only equipment conforming to ASTM C 94.

D. Use only approved pumping equipment that is rated for the lift and the capacity required for placement.

1. Control pneumatic placement to prevent segregation.

2. Loss of slump in pumping or pneumatic conveying equipment shall not exceed two inches (2”).

3. Do not use aluminum or aluminum alloy pipes.

3.6 CONTROL JOINTS

A. For flatwork, place control (contraction) joints of the type indicated in the plans prior to concrete curing.

B. Install joints spaced no more than 24 times the slap thickness (i.e. a 4-inch thick slab shall have a control joint at least every 96-inches = 8-feet). Contraction joints should be placed to produce panels that are as square as possible and never exceeding a length to width ratio of 1 ½ to 1

C. Joint depth shall be at least 25% of slab depth.

D. Tooled joints shall be installed using a grooving tool. Contraction joints may be tooled into the concrete surface at the time of placement. Joints may be tooled into the surface (first pass) prior to the onset of bleeding or immediately with the first pass of the floating operation.

E. Sawcut joints between 6-12 hours after finishing concrete, unless specifically approved otherwise by the engineer. Sawcut as soon as the concrete is hard enough to withstand the energy of sawing without raveling or dislodging aggregate particles, and that the edges abutting the cut do not chip from the saw blade.

3.7 REMOVAL OF FORMS

A. Formwork for columns, walls, and other parts not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.

3.8 FINISHES

A. Provide formed concrete walls to be left exposed with Sacked Finish.

1. Point and Patch: Patch defects, chip or rub off fins exceeding one-quarter inch (1/4) in height with Patch Mortar. Patch tie holes and defects and remove fins completely. When surface texture is impaired and form joints misaligned by more than one-eighth (1/8) inch, grind or bushhammer.

2. Sacked Finish: Remove forms and perform necessary patching as soon after placement as possible. Finish newly hardened concrete no later than the day following form removal. Wet surfaces and rub with carborundum brick or other abrasive until uniform color and texture are produced. No cement grout is to be used other than cement paste drawn from concrete by rubbing process.

B. Concrete flatwork shall not be trowelled, use screed, float, and broom.

C. Stairs to receive a light broom finish parallel to the nose of the tread. And shall receive nose end treatment as shown in the plans.

D. Sidewalks to receive a light broom finish perpendicular to the direction of travel.

E. Patios to receive light broom finish.

F. Curbs and Gutter to receive light broom finish parallel to flow line of gutter.

G. Pedestrian ramps to receive a light broom finish perpendicular to the direction of travel.

H. Light pole, sign, fence foundations to receive light broom finish.

3.9 CURING AND PROTECTION

A. To preserve moisture in unformed concrete surfaces, apply one of the following immediately after placement and finishing.

1. Continuous mist spray.

2. Waterproof sheet materials, ASTM C 171.

3. Curing compound, ASTM C 309. Apply in accordance with recommendations of manufacturer immediately after water sheen has disappeared. Do not use on any surface against which additional concrete or other material is to be bonded or adhesively applied, unless it is proven that curing compound will not prevent bond, or unless positive measures are taken to remove it completely from areas to receive bonded applications. Provide curing compound compatible with hardener in areas where hardener is to be used.

B. Cure concrete for seven (7) days.

C. When the mean daily outdoor temperature is less than 40°F, maintain temperature of concrete between 50°F and 70°F for required curing period.

3.10 SEALER

A. Apply sealer to vertical walls, stairs, and walkways. Apply two coats. Apply in accordance with manufacturer's recommendations.

3.11 TESTING

A. The Contractor shall obtain and pay for the services of certified materials testing laboratory to perform all sampling and testing of installed materials to assure that the requirements of this specification are met. The Contractor shall pay all testing costs associated with product submittal prior to use in the Work.

B. Perform the following testing:

1. Entrained Air – Test every 30 yards of concrete delivered to the project.

2. Slump – Test every 30 yards of concrete delivered to the project.

3. Strength characteristics – Test every 30 yards of concrete placement with four compressive test cylinders.

4. Temperature: If the air temperature is less than 40°F, test every 30 yards of concrete delivered.

C. Test results shall be reported in writing to the Engineer within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

D. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

3.12 ACCEPTANCE

A. The Engineer will base acceptance of the concrete on parameters specified for the given concrete class. The Engineer will base acceptance of strength from the results of 28-day compression strength test results on cylinders made from concrete being placed. The engineer will consider average strength from three companion cylinders as one test.

B. Replace unacceptable concrete at no additional cost to the Owner.

C. The Engineer will use a price adjustment for concrete that does not meet the intended strength, but is allowed to remain in place by the Engineer, in accordance with the following pay factor (PF) reductions:

1. If compression strength is ≥ 100% of required, PF = 1.0.

2. If compression strength is ≥ 95% < 100% of required, PF = 0.90.

3. If compression strength is ≥ 90% < 95% of required, PF = 0.80.

4. If compression strength is < 90% of required, subject to rejection, if allowed to remain in place, the PF will be 0.50.

3.13 SPECIAL WARRANTY

A. Scaled or spalled surfaces exceeding 5% (randomly dispersed or concentrated) per twenty (20) square feet of concrete surfacing area will be considered defective and shall be replaced at the Contractor's expense. The area requiring replacement will be as directed by the Engineer.

END OF SECTION 32 13 13

SECTION 32 92 19.16 – HYDRAULIC SEEDING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials, and equipment as required to hydroseed the areas shown on the plans, including soil preparation, and hydroseeding.

1.2 REFERENCE STANDARDS

A. FS O-F-241 – Fertilizers, Mixed, Commercial

1.3 SUBMITTALS

A. Submit product data in accordance with Section 01 33 00 – Submittal Procedures.

B. The Contractor shall furnish a certificate with each delivery of bulk material delivery, stating source, quantity, and type of material.

C. Certification of Grass Seed: From seed Vendor for each type of seed.

1.4 QUALITY ASSURANCE

A. Field Inspections: The Contractor shall request inspection at least 24 hours in advance of the time inspection is required. Inspection will be required when all specified work, except the maintenance period, has been completed.

B. Maintenance Guarantee: The Contractor shall be responsible for all plantings until acceptance of all work under the Contract.

1. The Work covered by the maintenance and guarantee portions of these specifications consists of providing all replacements of hydroseeded areas, labor, materials, equipment, and supplies and in performing all operations in connection with maintenance and guarantees.

2. The inspection of the hydroseeded areas is independent of the final inspection and maintenance period.

3. Inspection of work will be made at conclusion of contract period. Written notice requesting inspection shall be submitted to the Engineer at least ten (10) days prior to the anticipated inspection date.

4. Final acceptance of the Work prior to maintenance guarantee period of the contract will be accepted upon written approval by the Engineer, on the satisfactory completion of all work, but exclusive of the replacement of plant material.

1.5 LANDSCAPING MAINTENANCE

A. The Contractor shall be responsible for protecting hydroseeded areas until final acceptance of all work under the contract.

B. At time of acceptance of the complete project, all hydroseeded areas shall be totally established with no bare spots.

C. Protection: The Contractor shall provide adequate protection to all newly seeded areas including the installation of approved temporary fences to prevent trespassing and damage, as well as erosion control, until acceptance.

D. The Contractor shall replace any materials damaged by its employees or subcontractors.

E. Partial utilization of the project shall not relieve the Contractor of any of the requirements contained in this specification.

F. Maintenance shall also include cleaning, the repair of erosion, and all other necessary work of maintenance.

PART 2 - PRODUCTS

2.1 GROWING MEDIA

A. Topsoil: Natural, fertile, agricultural soil capable of sustaining vigorous plant growth; not in frozen or muddy condition; and free from subsoil, slag, clay, stones, lumps, live plants, roots, sticks, crabgrass, couch grass, noxious weeds, and foreign matter.

B. Fertilizer: Use commercial fertilizer that is a 16-16-8 grade commercial fertilizer, uniform in composition, dry and free flowing, containing by weight: 16 percent nitrogen, 16 percent phosphorous acid, 8 percent potash. Deliver fertilizer mixed as specified in standard size bags showing weight, analysis, name of manufacturer, as required by State regulations. Store in a weatherproof storage location in such a manner that it will be kept dry and its effectiveness will not be impaired.

2.2 PLANT MATERIALS

A. Grass Seed

1. Furnish grass seed that is fresh, clean, and new-crop seed composed of the following varieties mixed in the proportions by weight as shown, and tested to have a minimum of ninety (90) percent of purity and a minimum of eighty (80) percent germination.

2. Do not use seed which has become wet, moldy, or otherwise damaged prior to use.

3. Provide the following seed blend:

Common Name	PLS Pounds Per Acre
Annual Grasses	
Kentucky Bluegrass	244
Perennial Grasses	
Perennial Rye	61
Seed Mix lbs/acres = 305	

PART 3 - EXECUTION

3.1 GENERAL

A. Seeding shall not begin until all other trades have repaired all areas of settlement, erosion, rutting, etc., and the soils have been re-established, recompacted, and refinished to finish grades. The contract operations shall be completed to a point where the landscape areas will not be disturbed.

B. The hydroseeding work shall not be performed at any time when it may be subject to damage by climatic conditions.

1. Grass seed shall be hydro seeded between September 1st and September 15th.

3.2 SOIL PREPARATION

A. Waste materials shall be removed and disposed of off the Owner's property, unless otherwise indicated.

B. Spread subgrade material evenly; smooth over to remove ridges and depressions so evenly graded.

C. Spread topsoil evenly across subgrade area to be hydroseeded.

3.3 HYDROSEEDING

A. Do not apply hydroseeding mixture if rainy conditions within three days or outside manufacturer's recommendations are anticipated. In the event of unanticipated rainy conditions, re-apply the hydroseeding mixture to uncured areas at no additional cost to the Owner.

B. Equipment: Mixing shall be performed in a tank. The tank shall have a built-in continuous agitation and circulation system, of sufficient operating capacity to produce homogenous slurry of mulch, stabilizer, seed, fertilizer and water in the designated unit proportions for a minimum coverage of one-half acre. The tank shall have a discharge system that will permit attachment of at least 500 feet of hose extensions, a change of elevation of 150 feet in height from tank to discharge nozzle, and still retain enough pressure to apply the slurry to the areas at a continuous and uniform rate.

C. Proportions: Proportions per acre shall be as follows:

1. Mulch: 2,500 pounds

2. Seed: 305 pounds per acre

3. Stabilizer: 120 pounds

4. Fertilizer: 350 pounds

5. Water: 3,000 gallons

D. Application: With agitation system operating at part speed, water shall be added to the tank and good recirculation shall be established. Materials shall be added in such a manner that they are uniformly blended into the mixture. When the tank is 1/3 filled with water, add the following materials in the sequence listed:

Sequence	Material
1	Stabilizer, 1/2 acre requirement
2	Three 50-pounds bales mulch
3	Seed, 1/2 acre requirement
4	Fertilizer, 1/2 acre requirement

1. Agitate mixture at full speed when the tank is half filled with water.

2. Add remainder of mulch requirement before tank is 3/4 full.

3. Slurry distribution shall begin immediately. The entire tank of each batch of slurry shall be emptied and the slurry evenly applied to areas to be hydroseeded within a 2-hour period following the mixing of each slurry batch. Slurry batches not applied during this time will be rejected.

3.4 BONDED FIBER MATRIX

A. After hydroseeding, apply bonded fiber matrix soil stabilization application.

B. Bonded fiber matrix shall be a mixture of cellulosic fibers and binding agents mixed at 70 pounds of dry fiber to 100 gallons of water. Apply using a hydroseeding machine at a rate of 3,500 to 4,000 pounds of dry fibers per acre.

END OF SECTION 32 92 19.16

SECTION 33 01 12 – INSPECTION AND TESTING OF WATER UTILITIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall test all potable water pipelines, utility water, pressure sewer pipe and appurtenant piping, fittings, valves, and meters.

B. The Contractor shall be responsible for obtaining permits for discharging excess testing and disinfection water and dechlorination of such water if required to satisfy permit limits.

1.2 SUBMITTALS

A. Submit in accordance with Section 01 33 00 – Submittal Procedures.

B. The Contractor shall furnish the following information:

1. A testing plan and schedule, including method for conveyance, control, disposal, de-chlorination, and disinfection shall be submitted in writing for approval.

2. Name of certified bacteriological testing laboratory.

3. Provide a record of test duration calculations to Engineer for each segment tested.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, and other water control equipment, and choice of disinfectant shall be as determined by the Contractor.

B. Chlorine for disinfection may be in one of the following forms:

1. Sodium hypochlorite liquid containing approximately 5 to 15% available chlorine, per ANSI/AWWA B 300.

2. Calcium hypochlorite, granular or in 5g tablets containing approximately 65% available chlorine by weight, per ANSI/AWWA B 301.

3. Liquid chlorine: Only with written authorization of Engineer, in accordance with the requirements of ANSI/AWWA B301 – Liquid Chlorine and only by trained personnel using appropriate safety practices.

C. Dechlorinate water prior to discharge. Dechlorination agents may be sodium bisulfite, calcium bisulfite, sodium sulfite, or sodium thiosulfate.

PART 3 - EXECUTION

3.1 GENERAL

A. Water for testing pipelines will be furnished by the Owner; however, the Contractor shall convey the water from the Owner-designated source to the points of use.

B. All pressure pipelines shall be pressure tested; those for potable water shall be disinfected. All chlorinating and testing operations shall be performed in the presence of the Engineer.

C. Disposal of flushing water and water containing chlorine shall be by methods acceptable to the Idaho Department of Environmental Quality.

D. Disinfection operations shall be scheduled as late as possible during the Contract Time to maximize the degree of sterility of the facilities at the time the Work is accepted by the Owner. Bacteriological testing shall be performed by a certified testing laboratory and paid by the Contractor.

3.2 HYDROSTATIC TESTING OF PIPELINES

A. Prior to hydrostatic testing, pipelines shall be flushed or blown out as appropriate. Flushing pipe velocity shall be 2.5 ft/second minimum.

B. The Contractor shall test pipelines either in sections or as a unit. No section of the pipeline shall be tested until the trench has been properly backfilled and all field-placed concrete or mortar has attained an age of 7 days, or until adequately cured. The test shall be made by closing valves when available or by placing temporary bulkheads in the pipe and filling the line slowly with water. The Contractor shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to or movement of the adjacent pipe. Unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test to avoid movement and damage to piping and equipment. Remove or protect any pipeline-mounted devices that may be damaged by the test pressure. The Contractor shall provide sufficient temporary tapping's in the pipelines to allow for all entrapped air to exit. After completion of the tests, such taps shall be permanently plugged. Open all air relief valves during filling.

C. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the release valves at a reasonable velocity. All the air within the pipeline shall be allowed to escape. The differential pressure across the orifices in the air release valves shall not be allowed to exceed 5 psi at any time during filling

D. Verify that, in a minimum two-hour test, the pipe does not leak in excess of the allowable leakage as defined by the following formula in which L is the allowable leakage in gallons per hour.

$$L = \frac{ND(P)^{1/2}}{7{,}400}$$

Where L = Allowable Leakage (gallons/hours)

N = Number of Joints in Tested Line - including fittings (number)

D = Nominal Pipe Diameter (inches)

P = Tested Pressure (psi, gauge)

E. For pipe working pressures less than or equal to 100 psi, sustain a test pressure of 150 psi. For pipe working pressures greater than 100 psi, sustain a test pressure at least 1.5 times the working pressure or as determined by the Engineer.

F. Pressure test pipe per ASTM F 2164-02 Field Leaking Testing of Polyethylene (PE) Pressure Piping Systems using Hydrostatic Pressure.

3.3 DISINFECTING PIPELINES – TABLET OR GRANULE METHOD

A. Solution Strength: 25 mg/L minimum.

B. Use: Only if the pipes and appurtenances are kept clean and dry during construction. Do not use on solvent welded plastic or screwed joint steel pipe.

C. Placement When Using Granules: During construction, place calcium hypochlorite granules at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500-foot intervals.

D. Granular Quantity:

Ounces of Granules	
Pipe Diameter (inches)	Amount (ounces)
4	0.5
6	1.0
8	2.0
10	3.2
12	4.0
16	8.0
18	10.2
20	12.5
24	18.0

E. Placement When Using Tablets: During construction, place 5g calcium hypochlorite tablets in each section of pipe as noted in Table 2, and also place one tablet in each hydrant, hydrant branch and other appurtenances. Attach tablets to the inside of the pipe using an adhesive such as Permatex No. 2 or approved substitution. Assure no adhesive is on the tablet except on the broad side attached to the surface of the pipe. Attach all the tablets at the inside top of the main, with approximately equal numbers of tablets at each end of a given pipe length. If the tablets are attached before the pipe section is placed in the trench, mark their position on the section so it can be readily determined that the pipe is installed with the tablets at the top.

Number of Tablets [1]	
Pipe Diameter (inches)	No. of 5g Tablets [2]
4	1
6	1
8	2
10	3
12	4
16	6
18	7
20	9
24	13

[1] Adjust for pipe length other than 18 feet.

[2] Based on 3.25g available chlorine per tablet.

F. Filling Procedure: When granule or tablet installation has been completed, fill the main with clean water at a velocity not exceeding 1 fps. Take precautions to assure that air pockets are eliminated. Leave this water in the pipe for at least 24 hours. If the water temperature is less than 41°F, leave the water in the pipe for at least 48 hours. Position valve so that the chlorine solution in the main being treated will not flow into water mains in active service.

3.4 DISINFECTING PIPELINES – CONTINUOUS FEED METHOD

A. Solution Strength: Dose at 25 mg/L for 4 hours

B. Residual: 10 mg/L at 24 hours.

C. Dosing Methods:

1. Liquid Chlorine: Solution feed vacuum-operated chlorinator in combination with a booster pump. Direct feed is not allowed.

2. Hypochlorite Solution: Chemical feed pump designed for feeding chlorine solutions.

3. Calcium Hypochlorite Granules: Refer to previous section.

D. Filling Procedure: Use approved source to flow clean water at a constant, measured rate into the newly laid water main. Fill at a point not more than 10 feet downstream from the beginning of the new main. Measure concentration at regular intervals to ensure a 25 mg/L dose. Position valves so that the chlorine solution in the main being treated does not flow into water mains in active service. Do not stop chlorine application until the entire main is filled with chlorinated water. Retain the chlorinated water in the main for at least 4 hours, operating all valves and hydrants in the section treated. At the end of the 24-hour period, verify the treated water in all portions of the main has a residual of 10 mg/L free chlorine.

3.5 DISINFECTING PIPELINES – SLUG METHOD

A. Solution Strength: 100 mg/L.

B. Dosing Methods: Per Engineer's direction

C. Filling Procedure: Use approved source to flow clean water at a constant, measured rate into the newly laid water main. Fill at a point not more than 10 feet downstream from the beginning of the new main. Measure concentration at regular intervals to ensure 100 mg/L dose. Apply the chlorine continuously and for the time required to develop a solid column or "slug" of chlorinated water that will, expose all interior surfaces to a 100 mg/L for at least 3 hours. Measure the chlorine residual in the slug as it moves through the main. If at any time it drops below 50 mg/L, stop flow and relocate chlorination equipment at the head of the slug, and as flow is resumed, add chlorine to restore the free chlorine in the slug to not less than 100 mg/L. As the chlorinated water flows past fittings and valves, operate valves and hydrants to disinfect appurtenances and pipe branches.

3.6 DISINFECTING PIPELINES – FINAL FLUSHING

A. After the retention period, flush the chlorinated water from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than that in the system, or is acceptable for domestic use.

B. Dispose of flushing water to a location approved by the Engineer.

3.7 DISINFECTING PIPELINES – BACTERIOLOGICAL TESTS

A. After final flushing and before the water main is placed in service, test samples collected from the main(s) for coliform bacteria. Take 2 samples from each location at least 24 hours apart.

B. If the initial disinfection fails to produce approved bacteriological samples, reflush and resample the main. If check samples show bacterial contamination, re-chlorinate the main until approved results are obtained.

3.8 DISINFECTING PIPELINES – SWABBING

A. If connections are not disinfected along with the newly installed main, swab or spray the interior of all pipe and fittings used in making the connections with a 1% hypochlorite solution before installation.

END OF SECTION 33 01 12

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SECTION 33 05 05.41 – GRAVITY PIPE TESTING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials and equipment as required for pressure testing and flushing of gravity pipeline installations.

B. The Contractor shall be responsible for conveying test water from the Owner designated source to the point of usage and also for disposal of water used in the testing operations.

C. The testing schedule shall be as shown on the pipe schedule included in the Drawings.

1.2 DEFINITIONS

A. Leakage: The quantity of water/air required to maintain the specified test pressure after the line has been filled with water or air.

1.3 REFERENCE STANDARDS

A. ASTM F1417 Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

1.4 SUBMITTALS

A. Notify Engineer 48 hours in advance of test and submit outline of proposed testing procedure for approval in accordance with Section 01 33 00 – Submittal Procedures.

B. All test records shall be submitted to the Engineer. Include the following items in the test records:

1. Type of test
2. Identification of pipe system
3. Size and type of pipe
4. Length of pipe in test section
5. Test pressure and time
6. Date of test approval
7. Signature of test witness

PART 2 - PRODUCTS

2.1 MATERIAL REQUIREMENTS

A. Temporary valves, plug, bulkheads, and other air pressure testing and water control equipment and materials shall be provided by the Contractor subject to the Engineer's review. No materials shall be used which would be injurious to pipeline structure and future function.

PART 3 - EXECUTION

3.1 GENERAL

A. Gravity sewer pipes and service laterals shall be tested for exfiltration or infiltration as indicated. Manholes and pipe shall be backfilled prior to testing. The maximum length of pipe tested shall be the 4 reaches between 5 manholes. Leakage test shall be completed and approved prior to placing of permanent resurfacing of pavement. When leakage or infiltration exceeds the allowable amount, the Contractor shall locate the leaks and make the necessary repairs or replacements to reduce the leakage or infiltration to the allowable limits. Individually detectable leaks shall be repaired, regardless of whether the test results are acceptable or not.

B. Unless otherwise indicated, water for testing will be furnished by the Owner; however, the Contractor shall convey the water from the Owner designated source to the points of use.

C. No materials shall be used which would be injurious to pipeline structure and future function. Air test gauges shall be laboratory-calibrated test gauges, and if required by the Engineer, shall be recalibrated by a certified laboratory prior to the leakage test. Air test gauges shall have a size and pressure range appropriate for the pipe being tested.

D. Testing operations shall be performed in the presence of the Engineer.

E. Release of water from pipelines, after testing has been completed, shall be performed as reviewed by the Engineer.

F. Pipeline 30-inches diameter and larger shall be visually inspected after all debris has been removed prior to testing.

3.2 TESTING

A. Perform testing in the presence of the Engineer.

B. Visual Inspection: Visually inspect the pipeline between manholes with mirrors or lights after each trench has been backfilled to check alignment and grade, and to check for pipe distortions, leaks, infiltrations, and other defects. Verify that a full diameter of pipe is visible from one manhole to the next. Uncover and repair leaks and defects in the pipeline. Do not reinstall damaged pipe. In lieu of visual inspection, a mandrel may be pulled through the pipeline.

C. Air Pressure Testing: Low pressure air test shall be used in pipe lines that are 24 inches and smaller in diameter. Provide equipment including gauges and instrumentation and calibrate the equipment at the request of the Engineer.

1. Preliminary and Final Testing: At the discretion of the Contractor preliminary testing may be done at any time prior to installation of other utilities. Perform final testing after backfilling and compaction and following installation of other utilities, but prior to surface restoration.

2. Test Procedure: securely brace plugs to prevent unintentional release of the plug. Prohibit workers from entering a manhole where a plugged pipe is under pressure.

a. Locate pressure gauges, valves and instrumentation required for the test and operation of the equipment at the ground surface.

b. Equipment testing apparatus with a pressure release device such as a rupture disk or pressure relief valve to relieve pressure in the pipe being tested at 6 psi.

c. Measure static groundwater depth above the pipe at the low end of the pipe. If static groundwater level is below the centerline of the pipe use the test pressures noted in this Section. If the groundwater is above the centerline, add 0.5 psi to the test pressure for every foot of groundwater above the centerline of the pipe. If pressure will exceed 6 psi, use hydrostatic exfiltration testing.

d. Pressurize the pipe at 4.0 psi or pressure listed in testing schedule and maintain pipe pressure between 3.5 and 4.0 psi for at least 2 minutes.

e. With the pressure at exactly 3.5 psi, disconnect the air supply, start a stopwatch and record the time for pressure to drop to 3.0 psi.

f. If the pressure drops more than 0.5 psi in the pipe faster than the minimum holding time presented in the following table, make necessary corrections to reduce the leakage to acceptable limits and retest the pipe.

Time Holding Chart											
1	2	3	4	Specification Time for Length (L) Shown (min:sec)							
Pipe Diameter (in)	Min. Time (min:sec)	Length for Min. Time (ft)	Time for Longer Length (sec)	100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	1:53	597	0.190L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	0.427L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	0.760L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187L	4:43	4:43	4:57	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709L	5;40	5:40	5:42	7:08	8:33	9:58	11:24	12:60
15	7:05	159	2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846L	3:30	3:30	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235L	9:55	9:55	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.537L	11:24	11:24	22:48	28:30	34:11	39:53	46:35	51:17

D. Hydrostatic Exfiltration Testing.

1. Hydrostatic exfiltration shall be used to test pipes larger than 24 inches in diameter or test pipes 24 inches and smaller in diameter with groundwater conditions above pipe invert.

2. Test Procedure.

   a. If necessary, fill pipe with clean water 24 hours prior to the test to allow time for absorption into the pipe walls.

   b. Conduct exfiltration testing with a test pressure of at least 6 feet of water column above the static water table or the crown of the pipe at the upper end of the pipe, whichever is higher.

   c. If exfiltration exceeds 0.16 gallon/hour/inch of inside diameter of pipe per 100 feet of sewer main, lateral, service line and stub-out, make the necessary corrections to reduce leakage to acceptable limits and retest the pipe. If manholes are included in the test section, increase the allowable leakage by 0.1 gallon/hour/foot of manhole depth tested.

   d. Minimum test time is four hours.

3. Preliminary and Final Testing:

   a. Preliminary Testing: At the discretion of the Contractor, preliminary testing may be done at any time prior to installation of other utilities.

   b. Final Testing: Perform final testing after backfilling and compaction and following installation of other utilities but prior to surface restoration.

E. Pipe Cleaning: Prior to CCTV inspection, clean the completed pipeline with a hydro-cleaner, or other Engineer approved cleaning equipment, and provide a pipeline free of dirt, mud, rocks, or other material. Leave downstream plugs in place during cleaning and do not introduce foreign material into existing sewer lines. Closed Circuit Television (CCTV) Inspection.

F. Closed Circuit Television (CCTV) Inspection

1. Acceptance criteria

a. If standing water is observed due to grade defects, use the following table to determine allowable depth of standing water in relationship to the design slope of pipe.

Pipeline Slope (ft/ft)	Allowable Standing Water Depth (inches)
Grade < 0.10%	≤ 5/8”
0.10% ≤ Grade < 0.20%	≤ 1/2"
0.20% ≤ Grade < 0.40%	≤ 3/8”
0.40% ≤ Grade < 0.60%	≤ 1/4"
0.60% ≤ Grade < 0.80%	≤ 1/8”
Grade > 0.80%	No Standing Water

b. No pipeline structural defects observed.

c. No pipeline installation defects observed.

d. No infiltration observed.

2. CCTV sewer line inspection to be performed by an experienced service approved by Engineer.

3. Ensure all manholes grout work is completed prior to CCTV to prevent pipe breakage at the pipe connection to the manhole.

4. Perform CCTV inspection after backfill and prior to surface repair. Uncover and reinstall sections of the pipe found to have defects in workmanship (including standing water caused by grade defects) as directed by the Owner. After repair re-CCTV the repaired section. Do not reinstall damaged or rejected pipe.

5. Notify Engineer at least 24 hours prior to CCTV inspection to allow for Engineer, at Engineer’s discretion, to witness.

6. Clean lines prior to CCTV inspection using hydro cleaner, flushing balls or other suitable means acceptable to the Engineer. Remove debris from lines rather than washing them downstream.

7. Immediately prior to CCTV inspection, pour sufficient water/dye mixture in upstream manhole to produce visible flow in downstream manhole(s). Allow excess water to drain from pipe prior to commencing CCTV inspection.

8. Provide CCTV records in high quality DVD format unless otherwise directed by the Engineer.

9. Provide CCTV sewer line inspection equipment including a color camera system, DVD recording system, camera propulsion equipment, and van to allow witness of CCTV by Engineer.

10. The DVD shall include the following video and audio information:

    a. Video

        1) Project Number and Name.

        2) Date of TV Inspection.

        3) Upstream and downstream manhole numbers.

        4) Current distance along line segment.

    b. Audio

        1) Date of TV Inspection

        2) Verbal confirmation of upstream and downstream manhole number and/or locations.

        3) Verbal description of pipe, size, type and pipe joint length.

        4) Verbal description of location of each service connection.

    c. Tape Identification Tag

        1) Manhole to Manhole Designation.

11. If no defects are observed, submit DVD and logs to Engineer for review and acceptance.

END OF SECTION 33 05 05.41

SECTION 33 05 62 – PRECAST CONCRETE MANHOLES AND VAULTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, materials and equipment as required to install precast manholes and vaults, including but not limited to, excavation, backfill, forms, concrete work, precast barrel sections and cone section, aluminum hatches, cast iron frame and cover, and all incidental work and appurtenances.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures. At a minimum, the Contractor shall submit the following:

1. Show dimensions, locations, lifting inserts, reinforcements, and joints. Drawings shall include design standards, concrete strength, and material specifications for each structure and shall be stamped by a registered Professional Engineer in the State of Idaho.

2. Manufacturer catalog sheets on vaults doors, access hatches, and manhole lids, frames and covers.

3. Provide concrete mix design and cylinder test results for proposed concrete.

4. Structural design calculations, including buoyancy calculations, shall be stamped and signed by a registered Professional Engineer in the State of Idaho.

5. Protective coatings, if required.

6. Provide product literature for all accessories specified in this section.

7. Submit fabricator’s installation instructions.

1.3 QUALITY ASSURANCE

A. Inspection: Prior to installation, the Contractor shall inspect all vaults and manhole components. No cracked or damaged vault or manhole shall be installed. The Contractor shall notify the Engineer when the vault and manhole components are delivered.

B. Precast water-holding structures, such as wet wells, shall be tested in accordance with Specification Section 03 15 58 – Concrete Structure Hydraulic Leak Testing prior to backfilling. Precast sections shall be designed for leak testing without structural backfill.

C. Testing: When vacuum testing and water testing, perform final testing before backfilling and compaction and following installation of other utilities, but prior to surface restoration or paving. Testing shall be performed in the presence of the Engineer. Use one of the following testing methods for manholes and vaults in gravity sewer systems:

1. Hydrostatic Testing

a. Plug holes: Plug all piping, inlets and outlets in the manhole.

b. Pre-fill: Fill manhole or vault with water 24 hours prior to the time of the test.

c. Requirement: An allowance of 0.1 gallon/hour for each 1 foot of manhole depth is allowed. If test fails, repair and retest.

d. Duration: Minimum time duration of test to be one continuous hour.

e. If liner is specified, test to occur prior to installation of liner.

2. Vacuum Testing (for 4-foot to 6-foot diameter manholes):

a. Tester: NPC Manhole Vacuum Tester, or approved substitution.

b. Procedure

1) Plug holes: Plug all piping, inlets and outlets in the manhole.

2) Brace pipe plugs to prevent them from being drawn into the manhole.

3) Place Test Head: Inside of the top of the cone section and inflate seal in accordance with the manufacturer’s recommendations.

4) Draw a Vacuum to 10 inches of mercury and shut off the vacuum pump.

5) Measurement: With the valves closed, measure the time for the vacuum to drop to 9 inches.

6) Requirement: Time to be greater than those indicated in following:

Manhole Depth (ft)	Diameter (in)				
	48	54	60	66	72
	Time (sec)				
6	40	43	46	49	53
8	40	43	46	49	53
10	45	49	53	56	61
12	50	55	59	63	69
14	55	61	66	71	77
16	60	66	72	78	87
18	60	68	75	83	90
20	60	68	75	83	90
22	60	68	75	83	90
24	60	68	78	87	97
26	60	75	85	94	105
28	64	81	91	101	113
30	69	87	98	108	121

7) Repair and retest if manhole fails the initial test.

PART 2 - PRODUCTS

2.1 GENERAL

A. The minimum wall thickness for vaults and manholes shall be 5-inches. Cement shall be Type V Portland cement as specified in ASTM C 150. The minimum 28-day concrete compressive strength shall be 4,000 psi.

B. Design Loading: All vaults and manholes shall be designed for HS-20 traffic loading.

C. The groundwater table shall be assumed to be at grade. The weight of the manhole or vault plus weight of the soil cover shall be greater than 1.1 times the hydrostatic uplift force on the base of the manhole. Skin frictional resistance between the backfill and vault wall surfaces shall not be considered.

2.2 PRECAST MANHOLE BASES

A. Base Sections shall conform to ASTM C 478.

B. Provide a flexible connection between manhole and pipe as indicated on the drawings. Pipes in submerged manholes shall be sealed with Link seals rated for a pressure of 20 psi. Other listed connectors are acceptable for installation when pipes are partially full under peak conditions. The connector shall be of a size specifically designed for the pipe material and size being utilized. Approved manufacturers are:

1. Power Sleeve Expansion (PSX) by the Press-Seal Gasket Corporation.

2. A-lok by A-lok Products, Inc.

3. Kor-N-Seal as manufactured by NPC, Inc.

4. Link seal as manufactured by PSI, Inc. Note that wall thicknesses may need to be increased based on size of link seal, hole, and manhole diameter to provide adequate surface for sealing.

5. Approved Equal.

C. If a manhole is core-drilled use Kor-N-Seal boot or Link Seal as required.

D. Manhole joints shall be fabricated to form an interlocking joint.

E. Precast trough to a section identical with that of the lower half of the pipe flowing through the manhole. Trough to be smooth, with flow-through characteristics and in accordance with the plans. At transitions of different pipe diameters, form a smooth transition.

F. Shelf of trough to slope towards trough.

2.3 PRECAST MANHOLE RISER SECTIONS AND CONICAL TOP

A. Risers and Conical Tops shall conform to ASTM C 478.

B. Manhole joints shall be fabricated to form an interlocking joint.

2.4 PRECAST CONCRETE VAULTS

A. Precast vaults for water and wastewater structures, including valve and meter vaults, shall conform to ASTM C890, ASTM C913, and ACI 350.

B. Culverts, Storm Drain and utility precast reinforced concrete box sections shall conform to AASHTO M 259 and ASTM C 858.

2.5 APPROVED PRECAST MANUFACTURERS

A. Oldcastle Infrastructure

B. Idaho Precast

2.6 EXTERIOR COATING

A. Apply bituminous damp-proofing to precast structure exterior in accordance with Section 07 11 13 – Bituminous Dampproofing prior to backfilling.

2.7 FRAMES AND COVERS

A. Castings: Castings for frames and covers shall conform to the requirements of ASTM A 48, Class 30. Cast iron covers and frames shall be heavy traffic type. Frame and cover shall be designed for HS-20 traffic loading.

B. Sewer, Water, Storm Sewer, and Irrigation covers shall be 24 inches in diameter, with embossed lettering saying SEWER, WATER, STORM SEWER, or IRRIGATION.

C. Power and Communication covers shall be 30 inches in diameter with embossed lettering saying POWER or COMMUNICATION.

D. Lock-type Castings: Provide a locking device made of corrosion resistant metal such that the cover may be readily released from the frame, where indicated on plans.

E. Castings Manufacturers or equal include:

1. EJ

2. Neenah Foundry Co.

2.8 ACCESSORIES

A. Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 6,000 psi in 28 days.

B. Steps – Plastic Coated Steel. Material: 1/2-inch steel reinforced bar covered with a polypropylene plastic.

C. Grade Rings

1. Concrete grade rings.

2. WHIRLyGIG Collaring System.

D. Joint Materials

1. Exterior Wrap: EZ-WRAP or approved substitute.

2. Mastic Gasket: Ram-Nek or approved substitute.

3. Joint Sealant: Vulkem 116 or approved substitute.

PART 3 - EXECUTION

3.1 CONCRETE BASES

A. Aggregate base to be leveled within 1/2 inch of true grade.

B. Grouting of troughs, sharp edges, or rough trough sections are not permitted.

C. Divert flow for at least 24 hours following construction of the trough section.

3.2 BARREL SECTIONS

A. Construct manhole base and sections so they are absolutely watertight both in the floor and for the full height of the walls.

B. Prior to installation of barrel sections, clean all joining surfaces thoroughly and place mastic gasket and joint sealant to the top of the concrete base or section providing a watertight seal.

C. Place section plumb and true.

D. Trim mastic gasket flush with the inside wall of the manhole.

E. Seal exterior manhole surface at joint with exterior wrap.

F. Grouting of joints is not acceptable.

3.3 SPECIAL MANHOLES

A. Drop Manholes. Construct drop manhole as shown on the plans and in accordance with other provisions of this specifications.

3.4 HEIGHT OF MANHOLE COVER

A. Where manholes are located in paved areas or unimproved traveled areas, place manhole covers flush with the ground surface. For manholes located in unimproved areas where there is no vehicular traffic, such as borrow pits, fences lines, easements, etc., attached the frame directly to the cone, with mastic gasket, place the cover 6” minimum above the ground surface to prevent water inflow into the manhole lid.

3.5 GRADE RINGS

A. Adjust frame elevation to finish grade with grade rings. Maximum distance from the top of the cone or lid shall be no more than 21”.

B. Place mastic gasket between cone and grade ring, grade ring and grade ring, and grade ring and frame.

3.6 CONCRETE COLLARS

A. Cement shall be Type III Portland cement as specified in ASTM C150. The minimum 28-day concrete compressive strength shall be 3,000 psi.

B. Rebar shall be grade 60 and placed as shown on plans.

C. Collar size and depth shall be as shown on the plans.

D. Finish the surface of the concrete collar with a smooth uniform lightly broomed surface 1/8 inch to 1/4 inch below the adjacent grade.

E. Install frame and lid even with the concrete surface.

F. In traffic areas, install 1” thick metal plate over concrete collar for 7-days.

3.7 CONNECTOR ASSEMBLY

A. Install pipe connectors per manufacturer's requirements.

END OF SECTION 33 05 62

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SECTION 40 05 00 – PIPING, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide the piping systems indicated, complete and operable, in accordance with the Contract Documents.

B. The mechanical drawings define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are not pipe construction or fabrication drawings. Where pipe supports and spacings are indicated on the drawings and referenced to a standard detail, the Contractor shall use that detail. Where pipe supports are not indicated on the drawings, it is the Contractor's responsibility to develop the details necessary to design and construct all mechanical piping systems, to accommodate the specified equipment, and to provide all spacers, adapters, and connectors for a complete and functional system.

C. Piping system drawings are diagrammatic and are intended to show the approximate location of equipment and piping. Dimensions given on the plans in figures take precedence over scaled dimensions. Verify dimensions, whether in figures or scaled, in the field. The Contractor shall be responsible for the installation of complete and workable systems whether completely detailed on the plans or not.

D. The Contractor shall ascertain locations of apparatus, fixtures, equipment, and piping in the field, and layout work accordingly. The Owner reserves the right to have minor changes in the location of piping and equipment made up to the time of installation without additional cost.

1.2 REFERENCE STANDARDS

A. All mechanical work shall conform to the latest edition of the International Mechanical Code.

B. Commercial Standards

1.	ASTM B 88	Hard Copper Tube
2.	ASME B 16.22	Copper Fittings
3.	ANSI/ASME B 1.20.1	Pipe Threads, General Purpose (inch)
4.	ANSI B 16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
5.	ANSI/AWWA C 207	Steel Pipe Flanges for Water Works Service; Sizes 4 in through 144 in.
6.	ANSI/AWWA C 606	Grooved and Shouldered Joints

7.	ANS/AWS D1.1	Structural Welding Code
8.	ASTM A 307	Specification for Carbon Steel Bolts and Studs, 6,000 psi Tensile
9.	ASTM A 325	Specification for High-Strength Bolts for Structural Steel Joints
10.	ASTM D 792	Test Methods for Specific Gravity and Density of Plastics by Displacement
11.	ASTM D 2000	Classification System for Rubber Products in Automotive Applications

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Submittal Procedures.

B. At a minimum, the following information shall be submitted for review and approval prior to ordering piping materials.

1. Manufacturer specifications for each pipe type, including all references to acceptable standards as referenced in each individual pipe section.

2. Indicate fittings and manufacturer recommended connections.

3. Pressure ratings.

4. Lining and coating type, thickness, and application procedures.

5. Fitting types and manufacturer recommended applications and acceptable installation procedures and tolerances.

6. Provide NSF 61 certification for all products to be in contact with potable water.

C. Fabrication Drawings: The Contractor shall submit piping fabrication drawings show in all fittings, pipe material, supports, and all dimensions for proper installation of piping system as illustrated on mechanical drawings.

1.4 QUALITY CONTROL

A. Certifications: Necessary certificates, test reports, and affidavits of compliance shall be obtained by the Contractor. A certification from the pipe fabricator that each pipe will be manufactured subject to the fabricators or a recognized quality control program. An outline of the program shall be submitted to the Engineer for review prior to the manufacture of any pipe.

B. Where the assistance of a manufacturer's service representative is advisable, in order to obtain recommended pipe joints, supports, or special connections, the Contractor shall furnish such assistance at no additional cost to the Owner.

C. All pipe, fittings, and gaskets used in potable water systems shall be compliant with NSF/ANSI 61, 14, and 372.

PART 2 - PRODUCTS

2.1 GENERAL

A. Extent of Work: Pipes, fittings, and appurtenances shall be provided in accordance with the requirements of the applicable sections of Divisions 31 and 40 and as indicated. Materials in contact with potable water shall be listed as compliant with NSF Standard 61.

B. Pipe Supports: Pipes shall be adequately supported, restrained, and anchored in accordance with Section 40 05 07 – Hangers and Supports for Process Piping, and as indicated.

C. Lining: Application, thickness, and curing of pipe lining shall be in accordance with the applicable sections of Division 40 unless otherwise indicated. Fittings and couplings shall be lined with the same material required for the pipeline in which the fittings and couplings are installed.

D. Coating: Application, thickness, and curing of pipe coating shall be in accordance with the applicable sections of Division unless otherwise indicated. Pipes above ground or in structures shall be field-coated in accordance with Section 09 90 00 – Painting and Coating.

E. Pressure Rating: Piping systems shall be designed for the maximum expected pressure as indicated on the drawings and individual pipe specifications.

F. Grooved Piping Systems: Piping systems with grooved joints and fittings may be provided in lieu of flanged, joint systems for exposed ductile iron piping. To assure uniform and compatible piping components, all grooved fittings, couplings, and valves shall be from the same manufacturer. The Contractor shall make the coupling manufacturer responsible for the selection of the correct style of coupling and gasket for each individual location.

G. Tests: Except where otherwise indicated, materials used in the manufacture of the pipe shall be tested in accordance with the applicable specifications and standards. Welds shall be tested as indicated. The Contractor shall be responsible for performing material tests.

H. Welding Requirements: Qualification of welding procedures used to fabricate pipe shall be in accordance with the provisions of ANSI/AWS D1.1 - Structural Welding Code. Welding procedures shall be submitted for the Engineer's review.

I. Welder Qualifications: Welding shall be done by skilled welders and welding operators who have adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 or the ASME Boiler and Pressure Vessel Code, Section 9, by an independent local, approved testing agency not more than six (6) months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the Work shall be used in qualification tests. Qualification testing of welders and materials used during testing is part of the Work.

J. Joining Dissimilar Materials: Di-electric unions shall be used at the junction of two dissimilar metallic pipes as required by the local adopted plumbing code. It shall be the responsibility of the Contractor to identify any such conditions whether indicated in the Project Drawings or not. Di-electric unions shall be lead free, appropriate for the two dissimilar metals and be stamped with an approved UPC seal.

2.2 PIPE FLANGES

A. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise indicated. Attachment of the flanges to the pipe shall conform to the applicable requirements of AWWA C207. Flange faces shall be perpendicular to the axis of the adjoining pipe. Flanges for miscellaneous small diameter pipes shall be in accordance with the standards indicated for these pipes. Flanges shall have pressure ranges corresponding to the following:

1. 150 PSI or less: Flanges shall conform to either AWWA C207 - Steel Pipe Flanges for Waterworks Service-Sizes 4 In. Through 144 In., Class D, or ASME B16.5 - Pipe Flanges and Flanged Fittings, 150 lb. class.

2. 150 to 275 PSI: Flanges shall conform to either AWWA C207 Class E or Class F, or ASME B16.5 150 lb. class.

3. 275 to 700 PSI: Flanges shall conform to ASME B16.5, 300 lb. class.

4. AWWA flanges shall not be exposed to test pressures greater than 125 percent of rated capacity. For higher test pressures, the next higher rated AWWA flange or an ANSI-rated flange shall be selected.

B. Blind Flanges: Blind flanges shall be in accordance with AWWA C207, or as indicated for miscellaneous small pipes. Blind flanges for pipe sizes 12-inches and greater shall be provided with lifting eyes in the form of welded or screwed eye bolts.

C. Flange Coating: Machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.

D. Flange Bolts: Bolts and nuts shall conform to Section 05 50 00 – Metal Fabrications. All-thread studs shall be used on all valve flange connections, where space restrictions preclude the use of regular bolts.

E. Insulating Flanges: Insulated flanges shall have bolt holes 1/4-inch diameter greater than the bolt diameter.

2.3 INSULATING CONNECTIONS

A. Insulating Flange Sets: Unless otherwise specified, insulating flange sets shall be provided at all locations where dissimilar metals are connected. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers, and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2 inch or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2 inch, insulating sleeves and washers shall be two (2) pieces and shall be made of polyethylene or phenolic material. Steel washers shall be in accordance with ASTM A 325 - Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength. Insulating gaskets shall be full-face.

1. Insulating Flange Manufacturers, or equal

a. JM Red Devil, Type E

b. Maloney Pipeline Products Co., Houston

c. PSI Products, Inc., (Frost Engineering Service Co., Costa Mesa, California).

B. Threaded insulating bushings, unions, or couplings, as appropriate, shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved. Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other non-conductive materials, and shall have ratings and properties to suit the service and loading conditions.

C. Insulating Sleeve Couplings: Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a sleeve of an insulating compound material compatible with the fluid service in order to obtain insulation of all coupling metal parts from the pipe.

2.4 SOLID COPPER PIPE CONNECTIONS

A. Solid Filler Materials: ASTM B 32 lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Brazing Filler Metals: AWS AS.B, BCUP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated, and AWS AS.B, Bag 1, silver alloy for refrigerant piping, unless otherwise indicated.

2.5 MECHANICAL-TYPE COUPLINGS (GROOVED OR BANDED PIPE)

A. Cast mechanical-type couplings shall be provided where indicated. The couplings shall conform to the requirements of AWWA C606 - Grooved and Shouldered Joints. Bolts and nuts shall conform to the requirements of Section 05 50 00 – Metal Fabrications. Mechanical-type couplings shall be bonded. The Contractor shall have the coupling manufacturer's service representative verify the correct choice and application of couplings and gaskets, and the workmanship, to assure a correct installation. To assure uniform and compatible piping components, grooved fittings, couplings, and valves shall be furnished by the same manufacturer as the coupling. Grooving tools shall be of the same manufacturer as the grooved components.

B. Gaskets for mechanical-type couplings shall be compatible with the piping service and fluid utilized, in accordance with the coupling manufacturer's recommendations.

C. The wall thickness of grooved piping shall conform to the coupling manufacturer’s recommendations to suit the highest expected pressure.

D. To avoid stress on equipment; equipment connections with mechanical-type couplings shall have rigid-grooved couplings or flexible type coupling with harness in sizes where rigid couplings are not available, unless thrust restraint is provided by other means.

E. Manufacturers of couplings for steel pipe, or equal

1. Gustin-Bacon (Aeroquip Corp.) (banded or grooved)

2. Victaulic Style 41 or 44 (banded, flexible)

3. Victaulic Style 77 (grooved, flexible)

4. Victaulic Style 07 or HP-70 (grooved, rigid)

F. Manufacturers of ductile iron pipe couplings, or equal

1. Gustin-Bacon, (Aeroquip Corp.)

2. Victaulic Style 31 (flexible or rigid grooving)

Note: Ductile iron pipe couplings shall be furnished with flush seal gaskets.

2.6 SLEEVE-TYPE COUPLINGS

A. Sleeve-type couplings shall be provided where indicated. The Contractor will not be allowed to substitute a sleeve-split coupling for the sleeve coupling unless approved by the Engineer.

B. Construction: Sleeve couplings shall be in accordance with AWWA C219 - Standard for Bolted Sleeve- Type Couplings for Plain-End Pipe. Couplings shall be steel with steel bolts, without pipe stop. Couplings shall be of sizes to fit the pipe and fittings indicated.

1. The middle ring shall be not less than 1/4-inch thick or at least the same wall thickness as the pipe to which the coupling is connected. If the strength of the middle ring material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe. Buried sleeve-type couplings shall be epoxy-coated at the factory as indicated.

2. The coupling shall be either 5- or 7- inches long for sizes up to and including 30-inches and 10-inches long for sizes greater than 30-inches, for standard steel couplings, and 16-inches long for long-sleeve couplings.

3. The followers shall be single-piece contoured mill sections welded and cold-expanded as required for the middle rings, and of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket.

4. Bolts and nuts shall conform to the requirements of Section 05 50 00 – Metal Fabrications.

C. Pipe Preparation: Where indicated, the ends of the pipe shall be prepared for flexible steel couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12-inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof- test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.

2.7 GASKETS

A. Gaskets for wastewater and sewerage applications shall be Buna N (NBR), Grade 60, or equivalent suitable elastomer and shall be rated for a temperature range of -30°F to 150°F.

B. Gaskets for drinking water and tertiary effluent applications shall be SBR (Styrene Butadiene) or EPDM (Ethylene Propylene Diene Monomer), and suitable for a temperature range of -30 °F to 150 °F minimum. Provide non-asbestos compressed fiber gaskets when system working pressure exceeds 150 psi.

C. All gaskets for potable water systems shall by NSF 61 Certified.

D. Gaskets for compressed air pipe shall be Viton and rated for a working temperature of 300 °F, minimum.

E. The flanged joint rating for pressure and temperature performance shall match or exceed the working pressure and temperature of the pipe system in which it is installed.

F. Flange gaskets in ductile iron pipe shall be full-faced type with a minimum thickness of 1/8 inch. Flanged gaskets shall be the high performance type satisfying the special requirements of ANSI/AWWA C111/A21.11, Appendix C, Section C.2 with a minimum of two bulb type rings molded into both faces of the gasket.

G. Flange gaskets for steel and stainless steel pipe shall comply with ASME B16.21 for ASME B16.5 flanged joints. Gaskets shall be full-face type with a minimum thickness of 1/8 inch for Class 150 pipe flanges and fittings.

H. Flange gaskets for Sch. 40 and Sch. 80 PVC and CPVC shall be 1/8" thick, full face gaskets with ANSI Class 150 bolt pattern and a Shore "A" Durometer of approximately 70.

I. Gaskets in bell ends of PVC gravity and pressure pipe shall be Rieber-style with a steel insert in the gasket that complies with ASTM F477. Gaskets in ductile iron pipe bells shall be a molded synthetic rubber ring gasket consisting of two hardnesses, shaped to fit the gasket socket in accordance with ANSI/AWWA C111/A21.11.

J. Gaskets for flanged joints used in chemicals, ozone, solvents, hydrocarbons, steam, chlorine and other fluids shall be made of materials compatible with the service, pressure, and temperature.

2.8 FLANGE COUPLING ADAPTERS

A. Flange coupling adapters shall only be used where shown on the drawings or accepted by the Engineer. Otherwise, the Contractor shall only use dismantling joints if additional flexibility is required for the pipe installation.

B. Flange coupling adapters shall be designed for a water working pressure not less than the design pressure of the pipe on which they are to be installed, and shall be equipped with suitable rubber gaskets.

C. Couplings shall be Romac RFCA, or equal. Thrust ties shall be provided for all flexible couplings to sustain the force developed by the test pressure. Anchor studs will not be acceptable.

2.9 MECHANICAL JOINT ADAPTERS

A. Flanged joints shall not be allowed in buried applications unless shown on the drawings. If there is limited space for installation, mechanical joint fittings may be connected with a MJ x MJ adapter.

B. MJ adapters and spacers shall be constructed of high strength ductile iron that complies with ASTM A536 Grade 65-45-12.

C. The hardware kit shall consist of Type 316 t-head and pigtail bolts.

D. Gasket materials shall comply with the gasket section of this specification section.

E. Adapter shall be rated for 350 psi working pressure in sizes 3" to 24" and 250 psi working pressure in sizes 30" through 36".

2.10 FLEXIBLE CONNECTORS

A. Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, pumps and other vibrating equipment, and where indicated. Flexible connectors for service temperatures up to 180 degrees F shall be flanged reinforced neoprene or butyl single-arched spools, rated for a working pressure of 40 to 150 psi, or reinforced flanged duck and rubber, as best suited for the application. Flexible connectors for service temperatures above 180 degrees F shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for minimum 150 psi working pressure, unless otherwise indicated. The connectors shall be a minimum of 9-inches long, face-to-face flanges, unless otherwise indicated. The final material selection shall be approved by the manufacturer. The Contractor shall submit manufacturer's shop drawings and calculations.

B. Grooved pipe flexible mechanical couplings may be used in lieu of the above paragraph on pumps only. The Contractor shall submit manufacturer's shop drawings and calculations.

2.11 MISCELLANEOUS

A. Expansion Joints: Piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement without exertion of undue forces to equipment or structures. This may be accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints. Expansion joints shall be flanged end, stainless steel, Monel, rubber, or other materials best suited for each individual service. The Contractor shall submit detailed calculations and manufacturer's Shop Drawings of all proposed expansion joints, piping layouts, and anchors and guides, including information on materials, temperature, and pressure ratings.

B. Piping Connection to Equipment: Where piping connects to mechanical equipment such as pumps, compressors, and blowers, the piping shall be brought to the equipment connection aligned and perpendicular to the axis of the flange or fitting for which the piping is to be connected to the equipment. The piping shall not impose excessive stress to the equipment connection so much to cause misalignment of the equipment. The Contractor shall assign the responsibility to the equipment manufacturer to review the piping connection to the equipment and submit any modifications to the Engineer for review.

C. Restrained Joints: Sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means. Harnesses shall be designed by the pipe manufacturer in accordance with Manual M11, or as indicated. Harness sets shall be designed for the maximum test pressure of the pipe in which they are installed. Where harness sets are installed near the suction and discharge of the pump. Harness bolts shall have zero elongation to prevent misalignment of the pump imparted by the thrust within the piping system. Thrust restraints systems shall be manufactured by Victaulic, “Depend-O-Lok”; Dresser, “Style 38”; Ford Meter Box Co., Inc., “Style FC1 or FC3”; and Smith-Blair, “Style 411.”

D. Pipe Threads: Pipe threads shall be in accordance with ANSI/ASME B1.20.1 - Pipe Threads, General Purpose (inch), and be made up with Teflon tape unless otherwise indicated.

E. Air and Gas Traps: Air and gas pipes shall slope to low points and be provided with drip legs, shut-off valves, strainers, and traps. The traps shall be piped to the nearest drain. Air and gas traps shall be not less than 150 lb. iron body float type with copper or stainless steel float. Bracket, lever, and pins shall be of stainless steel. Drain traps shall have threaded connections acceptable manufacturers include Armstrong International, Inc. and Spirax Sarco, Inc.

2.12 COUPLINGS

A. Flexible Pipe Couplings – Smith Blair OMNI 441 coupling system, or approved equal. Couplings shall be lined and coated with a minimum thickness of 0.012" fusion-bonded epoxy or approved equal. Coating must comply with ASTM C213 and AWWA C550.

2.13 DISMANTLING JOINTS

A. Dismantling joints shall be Romac Style DJ400, Smith Blair Model 975 or approved equal. Dismantling joints shall be coated with fusion bonded epoxy per AWWA C213. Provide high strength stainless steel bolts, nuts and tie rods. Use anti seize lubricant when assembling all stainless-steel hardware.

2.14 TAPPING SADDLES

A. Tapping saddles shall have a ductile iron body meeting ASTM A536, Grade 65-45-12. Gasket shall be Nitrile Butadiene Rubber (NBR) for water and sewer service. Saddles shall have two, 2" straps constructed of Type 304 stainless steel with GMAW and GTAW welds. Stainless steel shall be passivated for corrosion resistance. Casting shall be coated with fusion bonded black nylon, 10 – 12 mils thick, with a dielectric strength of 1,000 v/mil. Threads as required for installation of instrumentation.

B. Bolts, nuts and washers shall be Type 304 (18-8) heavy gauge stainless steel.

C. Saddles shall comply with AWWA C800 and shall have a pressure rating of 350 psi for pipe sizes up to 24 inch.

D. Provide Romac 202 service saddles or equivalent.

2.15 THRUST BLOCKS

A. Concrete to have a minimum compressive strength of 2,500 psi at 7 days. Place in accordance with plan details.

2.16 MECHANICAL RESTRAINT

A. Type: Standard mechanical joint restraint gland, restraint devices for MJ fittings and appurtenances to conform to ANSI/AWWA C111 or ANSI/AWWA C153.

B. Product: EBAA Iron Series 2000 PV (for PVC Pipe) or EBAA Iron Series 1100 Megalug (for DIP) or approved equal, and to meet requirements of ASTM F1674.

C. Application: Approved for above ground installation and below ground where specifically specified on the Plans. Also, mechanical restraint shall be installed in locations where the pipeline must be used immediately as a temporary restraint while thrust blocks cure.

D. Pipe joints shall be restrained 30 ft. or a minimum of two pipe joints (whichever is longer) upstream and downstream of a mechanically restrained fitting.

2.17 INTERNALLY RESTRAINED PRESSURE PIPE

A. Internally restrained PVC Pressure Pipe shall conform to ANSI/AWWA C900, FM 1612 for 4" to 12" inside diameter pipe and ANSI/AWWA C905 for 14" to 24" inside diameter pipe. Pipe Compound shall conform to ASTM D1784 Cells Class 12454. Integral bell joints shall conform to ASTM D3139. All internally restrained pipe shall be ANSI/NSFF Standard 61 FM approved and certified and shall be provided in full pipe lengths.

B. Pipe shall be rated for pressures indicated or required within the Contract Documents.

C. Internally reinforced pipe shall consist of a molded metal casing within the bell end of the pipe. The casing will be equipped with uni-directional serrated grip rings. The casing and grip rings will be constructed of ductile iron and coated with a corrosion protection system.

D. Internally reinforced pipe lengths shall be labeled to identify that it is equipped with an internal restraining system.

E. Approved products include PVC pipe manufacturers who integrate the BullDog™ Integral Joint Restraint System, including Diamond Plastics Diamond Lok-21®, JM Eagle Eagle LOC 900™.

F. Application or use of the internally restrained pipe is approved for below ground installation where specifically specified on the Plans or in applications where pipelines must be used immediately or where use of alternative restraining methods or prohibitive.

G. Pipe joints shall be restrained 30 ft. or a minimum of two pipe joints (whichever is longer) upstream and downstream of a mechanically restrained fitting.

2.18 BOLTS AND ANCHORS

A. Bolts and anchors for fittings, pipe couplings, valves, piping and accessories shall comply with Section 05 50 00 – Metal Fabrications.

2.19 POLYETHYLENE PIPE WRAP

A. Polyethylene encasement shall comply with ISO 8180, ANSI A21.5, AWWA C105, and ASTM A674. Utilize Protective Wrap V-Bio or approved equal. Polyethylene encasement shall be installed on all buried pipe, valves, and fittings (including all nuts, bolts, and other apparatuses installed below grade) per manufacturers recommendations and shall meet all the requirements of AWWA C105/A21.5 standard for polyethylene encasement.

PART 3 - EXECUTION

3.1 GENERAL

A. Piping, fittings, and appurtenances shall be installed in accordance with the requirements of applicable sections of Division 31 and Division 40. Proprietary manufactured couplings shall be installed in accordance with the coupling manufacturer's recommendation.

B. Care shall be taken to ensure that piping flanges, mechanical-type couplings, sleeve-type couplings, flexible connectors, and expansion joints are property installed as follows:

1. Gasket surfaces shall be carefully cleaned and inspected prior to making up the connection. Each gasket shall be centered properly on the contact surfaces.

2. Connections shall be installed to prevent inducing stress to the piping system or the equipment to which the piping is connected. Contact surfaces for flanges, couplings, and piping ends shall be aligned parallel, concentric, and square to each axis at the piping connections.

3. Bolts shall be initially hand-tightened with the piping connections properly aligned. Bolts shall be tightened with a torque wrench in a staggered sequence to the AISC recommended torque for the bolt material.

4. Groove ends shall be clean and free from indentations, projections, and roll marks in the area from the pipe end to the groove.

5. After installation, joints shall meet the indicated leakage rate. Flanges shall not be deformed nor cracked.

C. Soldered Pipe Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook", using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS ASB.

E. Lined Piping Systems: The lining manufacturer shall take full responsibility for the complete, final product and its application. Pipe ends and joints of lined pipes at screwed flanges shall be epoxy-coated to assure continuous protection.

F. Core Drilling: Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiograph of concrete construction to avoid damage to embedded raceways and reinforcing bars.

G. Cleanup: After completion of the Work, cuttings, joining and wrapping materials, and other scattered debris shall be removed from the Site. The entire piping system shall be handed over in a clean and functional condition.

H. Protective Coating: All pipes shall be coated in accordance with Section 09 90 00-Painting and Coating.

3.2 MATERIAL DELIVERY, STORAGE, AND PROTECTION

A. Piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground for protection against oxidation caused by ground contact Defective or damaged materials shall be replaced with new materials.

3.3 PIPING INSTALLATION

A. Cut piping accurately for fabrication to measurements established at the construction site and work into place without springing and/or forcing.

B. Remove burrs and cutting slag from pipe by reaming or other approved cleaning methods.

C. Make changes in direction with proper fittings.

D. Arrange piping so as not to interfere with the removal of other equipment, ducts, or devices. Do not block access doors, windows, or access openings. Provide unions in the piping at connections to all equipment. Unions must be accessible.

E. Make connections of dissimilar metals (such as copper and steel) with insulating couplings suitable for at least 175 psi working pressure at 250 degrees F.

F. Cap or plug open ends of pipes and equipment with PVC caps or expanding neoprene plugs to keep dirt and other foreign materials out of the system. Plugs of rags, wool, cotton, waste, or similar materials are not acceptable.

G. Install all piping systems so they can easily be drained. Provide hose bibs at low point of water lines.

H. Slope all soil and waste lines within the building at 1/4 inch fall per foot in the direction of flow unless otherwise noted on drawings.

3.4 YARD PIPING INSTALLATION

A. If excavation enters an area of petroleum or other contamination, stop work and notify the Engineer for verification of piping and gasket material usage.

B. Install pipe per manufacturer's specific instructions. Do not install pipe without continuous support under the barrel or where a dry joint connection cannot be made.

C. Install pipe with a minimum of 5 feet of cover or as indicated on the drawings. Insure that the pipe has adequate cover from sub-grade as listed above and installed below frost depth.

D. Pipe bedding is required; bed pipe in accordance with Section 31 23 33 – Trenching and Backfilling.

E. Mechanical Joint Pipe

1. Gland shall be placed on spigot end of pipe with lip extension toward the joint, and the rubber gasket shall be slipped on the pipe with its thick edge toward the gland.

2. The gasket and joint surfaces shall be thoroughly wetted using a soapy solution made with vegetable soap or similar soap as recommended by the manufacturer.

3. After inserting the spigot end of the pipe to full depth and pressing the gasket firmly into place in the bell, the gland shall be moved into place, the bolts inserted, and the nuts finger tightened. The nuts shall then be tightened gradually with a wrench - a half turn at a time, moving wrench from one nut to another repeating until all nuts are uniformly tight. Final tightness shall be with a torque wrench: 60 - 90 pounds torque for ¾" bolts. Install gland retainer on thrust retainer glands as recommended by the manufacturer.

F. Gravity Pipelines

1. Begin construction at the low point of the pipeline. Install pipe upgrade with the bell end upgrade.

2. Control line and grade of the pipe installation by use of a pipeline laser. Limit variance of installed pipe from design line and grade to less than 0.02 feet, unless a smaller variance is necessary to prevent a level or negative slope.

G. Pressure Pipelines: All buried pipe installations shall be capable of withstanding maximum thrust at test pressure; provide thrust blocks at each angled fitting, tee, cross, reducer, cap, and plug, or mechanically restrained joints where shown. All buried valves shall be mechanically restrained in accordance with this specification section. For thrust blocks, provide bearing area against undisturbed earth. Place such that thrust block may be removed in the future without damage to pipe or fitting. Place V-Bio polyethylene plastic between thrust blocks and fittings.

H. Furnish and install plugs or caps on pipe ends and stub-outs. Insure watertight connection. Provide a bell end or joint suitable for making a gasketed connection when the pipeline is extended. Thrust block all pressure pipe stubs. Protect against displacement during backfilling operations and testing.

I. When pipe installation is suspended at the end of each day, ensure that no dirt or other foreign material is allowed in pipe or fittings. Block or plug the open end of the pipe to prevent creep, uplift or floating, entrance of water, dirt, or other materials.

J. Place pipe anchors on all pipes installed on slopes 20% and greater.

K. Do not operate existing or active valves without the authorization of the Engineer.

L. Install pipe end markers to surface. Pipe marker to be 2x4 wood stud, painted green for sewer, purple for reclaimed or utility water or irrigation, or blue for potable water. Attach finder wire attached to stub and 2x4.

M. Assure that continuity is maintained in locating wire, in accordance with Section 31 23 33 – Trenching and Backfilling.

3.5 WORKMANSHIP

A. Care shall be taken at all times to protect floors, stairways, and walls during the make-up, erection of piping, and placing of equipment. The Contractor shall remove all stains and repair all damage before final acceptance of the work.

3.6 TESTING

A. Test all pressure piping according to the requirements of Section 33 01 12 – Site Pressure Pipe Testing and Disinfection.

B. Repair defects which develop under tests promptly and repeat tests. No caulking of screwed joints, cracks, or holes will be permitted. Repair leaks in screwed joints by replacing pipe or fitting or both with new material.

C. Repair leaks in copper tubing by melting out joint, thoroughly cleaning both tubing and fitting, and resoldering.

3.7 CLEANUP

A. After completion of the work, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris, shall be removed from the site. The entire piping system shall be handed over in a clean and functional condition.

END OF SECTION 40 05 00

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SECTION 40 05 06 - FLEXIBLE PIPING CONNECTIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall furnish and install flexible connections in piping as described in this Section and Section 40 05 00 – Piping, General.

1.2 PERFORMANCE AND SERVICE CONDITIONS

A. Expansion joints that are used in potable water systems shall be NSF/ANSI 61 approved.

B. Expansion joints shall be designed in accordance with Expansion Joints Manufacturers Association Standards (latest edition) for pressure, temperature and service as specified.

C. Flexible metal hose shall be suitable for a line pressure equal to the test pressure listed in the piping schedule.

D. Design Requirements

1. Flexible Metal Hose: Live lengths for flexible metal hose shall be based upon the service conditions listed above and a design life of 1,000,000 full displacement cycles.

2. Expansion Joints: Corrugated type expansion joints shall be suitable for a minimum of 10,000 pressure, temperature and deflection cycles (non-concurrent).

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

PART 2 - PRODUCTS

2.1 EXPANSION JOINTS - METAL CONSTRUCTION

A. Formed Bellows Type

1. Medium Temperature: Formed bellows type expansion joints for temperatures up to 800° F shall have 300 series stainless steel multi-ply bellows rated for the specified design temperature and pressure. Test pressures are specified in the piping schedule on the drawings. Each expansion joint shall be factory tested at the test pressure. Ductwork expansion joints may be rated at less than 50 psig but must be rated equal to the design pressure and, in no case, less than 2 psig. Engine and gas turbine exhaust expansion joints shall be as specified in paragraph 2.1 A.2. Expansion joint design shall be determined by the amount and kind of movement specified (axial, lateral, angular). Unless otherwise specified, end connections shall be flanged. Formed bellows type expansion joints shall be as manufactured by Flexonics, Inc., Hyspan Precision Products, Inc., American BOA Inc. or equal.

2. High Temperature: Engine and gas turbine exhaust expansion joints for temperatures up to 1300° F shall be the multi-ply bellows type designed for 15 psig. Bellows shall be constructed of 300 series stainless steel. Unless otherwise specified, end connections shall be either the fixed flange or Vanstone flange configuration. Flange material shall be carbon steel for temperatures up to 1000°F and stainless steel for temperatures 1000-1300° F. Vanstone materials and flow liners, where specified, shall be the same as bellows material. Exhaust expansion joints shall be Flexonics DEX Series, Hyspan Series 2500, American BOA Series 025E, or equal.

B. Steel Expansion Compensator Type: Steel expansion compensator type expansion joints shall be Flexonics Model H Expansion Compensator, Hyspan Series 8500, Keflex 70, or equal. Compensators shall have 2-ply stainless steel bellows and carbon steel shroud and end fittings. Compensators shall be rated for 175 psi maximum working pressure and 750° F.

C. Bronze Expansion Compensator Type: Bronze expansion compensator type expansion joints shall be Flexonics Model HB Expansion Compensator, Hyspan Series 8500, Keflex 70, American BOA Inc., or equal. Compensators shall have multi-ply phosphor bronze or stainless steel bellows and copper tube end fittings. Compensators shall be rated for 150 psi maximum working pressure and 400° F.

2.2 EXPANSION JOINTS - ELASTOMERIC AND FABRIC CONSTRUCTION

A. General: Elastomer and fabric expansion joints shall be the standard spool arch type or the precision molded spherical design type as indicated or specified. Expansion joint connectors shall have control units (restraints) to prevent excessive axial elongation and to accept the static pressure thrust in the piping system. Number and sizes of control rods or restraints shall be as determined by the manufacturer. Unless otherwise specified, single arch and sphere type expansion joints shall have 6-inch face-to-face dimension for pipe up to 8 inches, and 8-inch face-to-face dimension for pipe 10 and 12 inches. The cover elastomer shall be chlorobutyl, neoprene or EPDM. For temperatures between 180 and 240° F, the tube elastomer shall be chlorobutyl or EPDM. Neoprene or Buna N liners are acceptable for temperatures to 180° F.

B. Spool Type: Spool type expansion joints shall be of the resilient arch type and shall be standard or tapered as specified. Unless otherwise specified, all tapered connectors shall be eccentric. Spool type expansion joints shall be constructed of multiple plies of woven fabric impregnated with elastomer and reinforced with steel rings or wire embedded in the body. Standard arch type expansion joints suitable for the specified temperature and pressure shall be provided with retaining rings or backup rings. Retaining rings shall be 3/8-inch thick steel, split, either galvanized or zinc shield coated. Expansion joints, single, multiple, or filled arch, shall be Red Valve Redflex Expansion Joints, Mason Style EJBN, Garlock Style 204, Mercer Style 500, Goodall Style E-1462, General Style 1025, or equal. Filled arch type shall be used on all piping systems carrying fluids containing solids. High pressure couplings suitable for 240° F operating temperatures shall be Red Valve Redflex Expansion Joints, Mason Style EJBN-HD, Mercer Style 510, Garlock Style 204-HP, Goodall Style E-1489, General Style 1015, or equal.

C. Spherical Molded Type: Spherical molded type expansion joints shall be precision molded of multiple plys of nylon tire cord fabric and elastomer suitable for specified temperature and pressure. Spherical molded type expansion joints shall have steel or ductile iron floating flanges, and no metal parts shall come in contact with the fluid. Single sphere molded connectors shall be Red Valve Redflex Expansion Joints, Mason Type MFNC, Mercer Type 5500, Goodall Type E-611, General Type 1010, Garlock Style 8100, or equal. Double sphere or triple sphere connectors shall be provided where required to provide for the specified movement.

D. Flexible Rubber Pipe: Flexible rubber pipe expansion joints shall be constructed of butyl or other elastomer tube and cover suitable for the service specified, with multiple plies of polyester or nylon cord. Pressure rating shall be suitable for the service specified. Pipe shall be 12" long unless indicated otherwise, and shall include galvanized split retaining rings drilled to 150 lb. ANSI standards.

2.3 EXPANSION JOINTS - PVC CONSTRUCTION

A. Polyvinylchloride expansion joints shall be Celanese "Chemtrol" CPVC slip type with Teflon impregnated seal rings, Certain-teed Fluid Tite PVC, Johns-Manville PVC double bell expansion joint, or equal.

2.4 EXPANSION JOINTS - TEFLON CONSTRUCTION

A. Teflon expansion joints shall be molded TFE bellows and shall be Metraflex T-2, Garlock Style 215, Resistoflex R-6905, EGC Style M-150, or equal.

2.5 FLEXIBLE METAL HOSE

A. General: Flexible metal hose shall be corrugated type 321 stainless steel with stainless steel fittings and shall be provided with stainless steel single braid, unless otherwise specified. End connections shall be attached by the heliarc welding process using stainless steel welding rod. Bronze flexible metal hose shall be provided for copper and brass systems.

B. B. BRAIDED TYPE

1. Type A: Type A braided flexible metal hose shall be Flexonics Series 401 M/402M, Flexweld USFWSS-31/32, American BOA Series B, or equal.

2. Type B: Type B braided flexible metal hose shall be Flexonics Series 301, Flexweld USFWB-31, American BOA Series B, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Expansion joints and anchors shall be located as specified. Location and number of guides shall be determined from EJMA Standards.

B. Expansion joints shall not be installed during times of temperature extreme or in a fully compressed or fully expanded condition.

C. Alignment: Piping systems shall be aligned prior to installation of expansion joints. Expansion joints shall not be used to correct piping misalignment during installations. Expansion joints normally preset at the factory for rated axial compression and expansion shall be installed in this preset condition.

3.2 EXPANSION JOINT AND CONNECTOR SCHEDULE

A. Expansion joints and/or flexible metal hose connectors provided for specific equipment items or piping systems are specified on the following schedule. The location of piping system expansion joints and design criteria, including temperature, pressure and movement for each joint, are specified on the drawings and in the piping schedule.

Expansion Joint and Connector Schedule	
Type of Expansion Joint/Connection	Type of Service/Use
Formed metal bellows, medium temperature	Hot and chilled water, jacket water, high pressure air and gas and steel lines subjected to ambient temperature differentials sufficient to require expansion joints.
Steel expansion compensator	Same type service/use as for "formed metal bellow type expansion joint" except size of piping is limited to 3" diameter or less.
Bronze expansion compensator	Copper piping
Elastomer spherical molded	Pump/blower connectors and expansion joints for piping 12" diameter and less.
PVC	PVC piping
Teflon	Reinforced thermosetting resin pipe
Stainless steel braided hose	Circulating sludge, gas, and mixed service connections to digester.
Bronze braided hose	Air compressor discharge and pump connectors for copper lines.

END OF SECTION 40 05 06

SECTION 40 05 07- HANGERS AND SUPPORTS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials, and equipment as required for the installation of all piping and all related work required for complete pipe installations. Coordinate Work with other trades.

B. Furnish and install all pipe hangers, sleeves, supports, brackets, and other related items required to support the piping systems as required whether shown on the plans or not.

C. Test all piping systems and correct any problems found to exist.

1.2 REFERENCE STANDARDS

A. All mechanical piping systems shall conform to requirements under the latest revision of International Mechanical Code, ASA Code for Pressure Piping and the International Building Code.

1. ASA Codes as sponsored by ASME
2. ASME B31.1 Power Piping
3. ASME B31.2 Fuel Gas Piping
4. ASME B31.3 Process Piping
5. ASTM A 123 Zinc (Hot-Dip Galvanized) Coatings on Iron & Steel Products
6. Piping Handbook Nayyar, Mohinder L. (2000). Piping Handbook (7th Edition). McGraw-Hill.

B. Install Work in accordance with applicable provisions of codes, rules, regulations, statutes, and ordinances of governing bodies having jurisdiction. Such codes, rules, regulations, statutes, and ordinances are hereby incorporated into these specifications. Comply with specification requirements which are in excess of code requirements and not in conflict therewith.

1.3 SUBMITTALS

A. Submit shop drawings shall be in accordance with Section 01 33 00 – Submittal Procedures. Shop Drawings shall include the following information:

1. Plans and details of pipe supports, hangers, anchors, and guides.
2. Calculations for supports and anchors stamped by a Licensed Engineer in the State where equipment is to be installed.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Pipe hangers shall be capable of supporting the pipe in all conditions of operation, allowing free expansion and contraction of the piping, and preventing excessive stress on equipment. All hangers shall have a means of vertical adjustment after erection. Hangers shall be designed to prevent becoming disengaged by any movement of the supported pipe. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves, shall include hydraulic shock suppressors. All hanger rods shall be subject to tensile loading only.

B. Unless shown otherwise, provide vertical piping supports for all pipe except copper:

1. Support vertical piping with wrought steel riser clamps. Make adequate provision for expansion, contraction, and lateral stability.

2. Use steel extension pipe clamps for vertical pipe supports similar to Anvil Figure 261, refer to manufacturer's rated maximum loading for each size pipe. Bolt clamp securely to pipe rest, clamp end extension on building structure.

3. Where pipe sleeves extend above floor, place pipe clamps at ceiling below, support clamp end extension from inserts.

4. Use beam clamps that are of malleable iron, Anvil Figure 86 for 3/8-inch hanger rods; forged steel beam clamp, Anvil Figure 228 for hanger rod up to 1-1/2 inch.

C. Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given where components such as flanges and valves impose concentrated loads. For temperatures other than ambient temperatures, or those listed, and for other piping materials or wall thicknesses, the pipe support spacing shall be modified in accordance with the pipe manufacturer’s recommendations. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of all loading effects. Use one of the following means of supporting horizontal piping from a wall.

1. Steel J-Hook for pipe located close to wall, up to three-inch pipe, Fee and Mason Figure 146.

2. For hanger suspension with 750 lbs. maximum loading, use light welded steel bracket with hole for one rod, 3/4-inch diameter, Fee and Mason Figure 153.

3. For pipe-roll stand support use welded-steel bracket, light for 700 lbs. maximum loading, Fee and Mason Figure 150; medium for 1,500 lbs. maximum loading, Figure 151; and heavy for 3,000 lbs. maximum loading, Figure 155.

D. Unless otherwise specified, support spacing for Steel and Copper shall conform to the following:

Nominal Pipe Diameter (inches)	Maximum Span (feet)
1 - 1/4" and smaller	6' - 0" on center
1 - 1/2" thru 3"	8' - 0" on center
4" thru 8”	12' - 0" on center
10” and larger	20’ - 0” on center

E. Unless otherwise specified, support spacing for Ductile-Iron Pipe shall conform to the following:

Nominal Pipe Diameter (inches)	Maximum Span (feet)
All Diameters	Two supports per pipe length or 10 feet (one of the 2 supports located at joint)

F. Unless otherwise specified, support spacing for PVC, CVC, and ABS shall conform to the following:

Nominal Pipe Diameter (inches)	Maximum Span (feet)
1" and smaller	4' - 0" on center
1 - 1/4" thru 2"	5' - 0" on center
2 - /2" thru 4"	6' - 0" on center
5" and larger	7' - 6" on center

G. Thermal Expansion: Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or expansion joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints permitting the piping to expand and contract freely in directions away from the anchored points. All components shall be structurally suitable to withstand all loads imposed.

H. Heat Transmission: Supports, hangers, anchors, and guides shall be so designed and insulated, that excessive heat will not be transmitted to the structure or to other equipment. Support insulated piping with pipe saddles and hangers that fit on the outside of the insulation. Do not compress or damage pipe insulation with hangers or supports.

I. Point Loads: Any meters, valves, heavy equipment, and other point loads on PVC, FRP, and other plastic pipes, shall be supported on both sides, according to manufacturer's recommendations to avoid undue pipe stresses and failures. To avoid point loads, all supports on PVC, FRP, and other plastic piping shall be equipped with extra wide pipe saddles or galvanized steel shields.

J. Materials of Construction: All pipe support assemblies, including framing, hardware, and anchors, shall be steel construction, galvanized after fabrication, unless otherwise indicated.

1. All submerged piping and top of tank walls, as well as piping, conduits, and equipment in hydraulic structures within 24-inches of the water level, shall be supported with support, assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel, unless otherwise indicated.

2. All other locations noted on the drawings shall be Type 316 stainless steel.

3. All piping in chemical and corrosive areas shall be supported with support assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel or FRP, unless otherwise indicated. Provide materials that are compatible with chemicals being stored.

K. Manufactured Supports

1. Stock Parts: Where not specifically indicated, designs which are generally accepted as exemplifying good engineering practice and use stock or production parts, shall be utilized wherever possible. Such parts shall be locally available, new, of best commercial quality, designed and rated for the intended purpose.

2. Manufacturers, or equal:

a. Cooper B-Line;

b. Anvil International, Inc.;

c. Bergen-Paterson Pipesupport Corp.;

d. Fee & Mason Mfg., Co.;

e. Tolco Incorporated.

f. Standon Pipe Supports Inc.

L. Galvanizing: Unless otherwise indicated, all fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

2.2 INSERTS

A. Furnish and set inserts in concrete forms; provide reinforcing rods for pipe sizes over three inches or equivalent.

B. Furnish concrete inserts as follows: Black, malleable iron, Universal type for threaded connections with lateral adjustment, Anvil Figure 279 for pipe sizes up to 3 - 1/2 inches; Anvil Figure 282 for pipe sizes up to eight inches.

2.3 SHIELDS

A. Provide shields to protect insulation in all areas. Provide approved galvanized form shields to protect insulation at areas of contact with hangers and supports. Size in accordance with shield manufacturer's recommendations.

2.4 SLEEVES

A. Where pipes pass through floors, footings, foundations, walls, or ceilings, furnish and install pipe sleeves. Sleeves for concealed piping shall be of galvanized iron, and I.P.S. black steel pipe for exposed piping installed so as to be completely covered by escutcheons, hereinafter specified. Extend sleeves through floors 1/2 inch above finish floor.

2.5 ESCUTCHEONS

A. Fit pipe passing through walls, floors, or ceilings with escutcheons with set screws as shown on the plans. Use prime painted escutcheons where surface is to receive a paint finish; otherwise, use escutcheons that are nickel or chromium plated. Where piping is insulated, use escutcheon outside the insulation.

2.6 JOINTS

A. For screwed pipe make ends with sharp, clean tapered threads using pipe compound on male thread only. Do not use mill cut threads. Ream cut pipe to full inside diameter.

B. Welding may be done by either the arc or acetylene process conforming to the requirements of the ASME B31.1 – Power Piping.

C. For solder joints use fittings specifically made for soldering. Clean all burrs and roughen pipe to clean; solder complete around joint.

D. For grooved pipe jointing systems use Victaulic couplers or equal.

E. For no-hub cast iron pipe use double screw joint neoprene coupler.

2.7 UNIONS

A. Furnish and install unions necessary for installation and necessary to permit removal of equipment.

B. For unions in steel pipe 1-1/2 inch and smaller use malleable iron ground joint unions with brass to iron seat, galvanized or black as required.

C. For larger unions in steel pipe, use standard weight cast iron flange unions with 1/16 -inch thick gaskets, galvanized or black as required.

PART 3 - EXECUTION

3.1 GENERAL

A. Prior to installation of piping, verify that it will not interfere with clearances required for the erection and finish of structural members, architectural members, electrical, or mechanical items.

B. Code Compliance: All piping systems and pipe connections to equipment shall be properly anchored and supported to prevent undue deflection, vibration, dislocation due to seismic events and line pressures, and stresses on piping, equipment, and structures. All supports and parts thereof shall conform to the requirements of ANSI/ASME 831.1 - Power Piping, except as supplemented or modified below. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code or local administration requirements.

C. Structural Members: Wherever possible, pipes shall be supported from structural members. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by the Contractor and coordinated with the Engineer. All supplementary members shall be in accordance with the requirements of the building code and the American Institute of Steel Construction and shall be acceptable to the Engineer.

D. Do not cut or modify any structural members for installation of piping.

E. All pipe supports, hangers, brackets, anchors, guides, and inserts shall be fabricated and installed in accordance with the manufacturer's printed instructions and ASME B31.1 - Power Piping. All concrete inserts for pipe hangers and supports shall be coordinated with the formwork.

3.2 INSERTS

A. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.

B. Set inserts in position in advance of concrete work. Contractor to coordinate openings with reinforcing supplier prior and Engineer prior to construction. Provide reinforcement rod in concrete for inserts carrying pipe over 12-inches in diameter.

C. Where concrete slabs form finished ceiling, finish inserts flush with slab surface.

D. Where inserts are omitted, drill through concrete slab from below and provide rod with recessed square steel plate and nut above slab.

3.3 SLEEVES

A. Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.

B. Extend sleeves through potentially wet floors one inch above finished floor level. Caulk sleeves full depth and provide floor plate.

C. Where piping passes through floor, ceiling, or wall, close-off space between pipe and construction with noncombustible insulation. Provide tight-fitting metal caps on both sides and caulk.

3.4 PIPE HANGERS AND SUPPORTS

A. Appearance: Pipe supports and hangers shall be positioned to produce an orderly, neat piping system. All hanger rods shall be vertical, without offsets. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, without interference with other work.

B. Support all piping and make adequate provisions for expansion, contraction, slope, and anchorage.

C. The use of pipe hooks, chains, or perforated metal for pipe support will not be permitted.

D. Suspend all piping in the building as shown on the plans.

1. Install hangers to provide minimum 1/2-inch clear space between finished covering and adjacent work.

E. Place a hanger within one foot of each horizontal elbow.

F. Use hangers which are vertically adjustable 1-1/2 inch minimum after piping is erected.

G. Support horizontal soil pipe near each hub, with five feet maximum spacing between hangers.

H. Support vertical piping at every other floor. Support vertical soil pipe at each floor at hub.

I. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

J. Where practical, support riser piping independently of connected horizontal piping.

3.5 FINISHING

A. Paint exposed piping and supports in accordance with Section 09 90 00 – Painting and Coating.

END OF SECTION 40 05 07

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SECTION 40 05 19 - DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials and equipment as required for the installation of all ductile iron pipe, couplings, fittings, and jointing materials shown on the Plans, including all piping installed under buildings that is connected to PVC yard piping.

B. Coordinate Work with all other trades.

1.2 REFERENCE STANDARDS

A.	AWWA C104	Cement-Mortar Lining for Ductile-Iron and Grey-Iron Pipe and Fittings for Water
B.	AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems.
C.	AWWA C110	Ductile-Iron and Gray-Fittings, 3 in through 48 in for water
D.	AWWA C111	Rubber Gasket Joints for Ductile-Iron and Grey-Iron Pressure Pipe and Fittings
E.	AWWA C115	Flanged Cast-Iron and Ductile-Iron Pipe with Threaded Flanges
F.	AWWA C151	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water or Other Liquids
G.	AWWA C153	Grey-Iron and Ductile-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids
H.	AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances

I. State Plumbing Code, as applicable.

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures and Section 40 05 00 – Piping, General and include, but not limited to the following information:

1. Pipe Manufacturer information, including pipe class and pressure rating and joint design.

2. Pipe Manufacturer information regarding epoxy, glass, and cement-mortar lining, including lining thickness and descriptions of material properties.

3. Certifications: The Contractor shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section and as specified in the referenced standard and the following supplemental requirements:

   a. Physical and chemical properties.

4. Submit manufacturer's certification that pipe and fittings meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Tests: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.

   1. The Contractor shall perform said material tests at no additional cost to the Owner. The Engineer shall have the right to witness all testing conducted by the Contractor; provided that the Contractor's schedule is not delayed for the convenience of the Engineer.

B. Reject any pipe which does not conform to specifications or is cracked, chipped, or otherwise unacceptable.

C. Use the type, size, and strength rating of the pipe as specified in the proposal or as shown on the Plans.

PART 2 - PRODUCTS

2.1 GENERAL

A. All pipe and fittings used in potable water systems shall be compliant with NSF/ANSI 61, 14, and 372.

2.2 MATERIALS

A. Use ductile iron pipe conforming to AWWA C151 pressure class 250 minimum unless otherwise required by the plans. Nominal pipe laying lengths shall be 18 - 20 ft. The pipe and associated fittings shall be of the diameter and class indicated. The interior lining shall be as indicated in the Pipe Schedule and as described below. Exterior coatings are described in 2.1.I.

B. Use Class 150 grey-iron or ductile iron fittings conforming to AWWA C153 unless otherwise required by the Plans.

C. Use flanged fittings, spools and flanged couplings for all above grade piping whether shown or not and for buried locations if indicated on the Plans to provide a complete functional pipe system. Fittings shall conform to AWWA C110, C111, and C115. All valve and equipment connections shall be flanged.

D. Use mechanical joint fittings, spools, and couplings for all below grade piping whether shown or not and for above grade locations if mechanically restrained and shown on the Plans to provide a complete functional pipe system. Pipe and fittings shall conform to AWWA C110, C111, and C153. The pipe manufacturer shall provide gasket bolt sets for each pipe and spool provided. All buried valve connections shall be mechanical joint.

E. Joint Design: Ductile iron pipe and fittings shall be furnished with mechanical joints, push-on joints, flanged joints, or restrained joints as required.

1. Mechanical and push-on joint shall conform to AWWA C111. Mechanical joints shall be installed with little or no deflection. Following complete assembly, the joint can be deflected as necessary.

2. Flanged joints shall conform to AWWA C115. Where threaded flanges are provided, the pipe wall thickness under the cut threads shall not be less than the calculated net thickness required for the pressure class of the pipe.

3. Restrained joints shall be “Flex-Ring” restrained joint by American Ductile Iron Pipe, “HDSS” restrained joint by U.S. Pipe, Griffen BOLT-LOK or MECH-LOK or equal.

4. When ductile iron fittings are called out to be mechanically restrained on the Plans, mechanical restraint shall comply with Section 40 05 00 – Piping, General. In addition, the pipe joints shall be restrained 30 ft. or a minimum of two pipe joints (whichever is longer) upstream and downstream of a mechanically restrained fitting.

F. Cement-Mortar Lining: Except as otherwise provided herein, interior surfaces of all ductile iron pipe, fittings, and specials used for potable water and non-potable water service (i.e. tertiary effluent) shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with AWWA C104. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found fault at the Site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these specifications.

1. Cement: Cement for mortar lining shall conform to the requirements of AWWA C104. Cement shall not originate from kilns that burn metal-rich hazardous waste fuel, nor shall a fly ash or pozzolan be used as a cement replacement.

2. The minimum lining thickness shall be double the thickness defined by AWWA C104.

3. Protection of Pipe Lining/Interior: Shop-applied cement mortar lining shall be given a seal coat of asphaltic material in conformance with AWWA C104.

G. Epoxy Lining: Except as otherwise provided herein, interior surfaces of all ductile iron pipe, fittings, and specials used for sewer service shall be cleaned and lined in the shop with 40 mils of Protecto 401 ceramic epoxy coating or approved equal. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found fault at the Site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these specifications.

H. Glass Lining: Ductile iron pipe and fittings shall be glass-lined where indicated and shall be manufactured in full compliance with ASTM B1000 – Standard Practices for Casting Preparation and Test Procedure of Porcelain Enamel-lined Pipe, Fittings, and Valves for Use in the Municipal Wastewater, Sewage, and Water Treatment Industry. Minimum wall thickness shall be ANSI Thickness Class 53. The glass lining shall be suitable for handling sewage, primary sludge, digested sludge, and scum. It shall be smooth, continuous, and suitable for prevention of grease and form build-up. The glass lining shall be capable of withstanding thermal shock of 350 degrees F (430 degrees to 80 degrees) without crazing, blistering, or spalling.

1. Criteria: The glass lining shall consist of a vitreous material to meet or exceed the following criteria:

    a. Unaffected by scraping with a sharp knife, simulating the effects of rodding.

    b. Unaffected by continuous application of live steam from a steam generator, immediately followed by a cold-water quench.

    c. Unaffected by an 8 percent sulfuric acid solution at 148 degrees F for a ten-minute period.

    d. Minimum thickness: 10 mils by micro test.

    e. Spark tested: In accordance with ASTM B1000.

    f. Hardness: 5-6 mohs.

    g. Density: 2.5 – 3.0 g/cu cm, measured by ASTM D 792 – Test Method for Specific Gravity (Relative Density) and Density of Plastics by Displacement.

I. Exterior Coating:

1. The exterior surfaces of the pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer and finish coat conforming to the requirements of Section 09 90 00 – Painting and Coating.

2. All buried mechanical joints, piping and fittings shall be wrapped with a polyethylene encasement as specified in Section 40 05 00 – Piping, General. All buried ductile iron piping shall be provided with a bituminous tar coating on the pipe exterior.

J. Bolts and Nuts: The flange and MJ bolts shall comply with the material specified in Section 05 50 00 – Metal Fabrications.

K. Gaskets materials shall be as specified in Section 40 05 00 – Piping, General.

PART 3 - EXECUTION

3.1 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect pipe and components against dirt and damage during shipment and storage.

B. The pipe shall be handled according to the manufacturer’s specifications to prevent damage to the pipe coating/exterior. The use of chains, hooks, or other equipment that might damage the pipe coating/exterior is prohibited. Stockpiled pipe shall be supported on padded skids, sand or earth berms free of rock exceeding 3 inches in diameter, sandbags, or suitable means so the coating will not be damaged. The pipe shall not be rolled and shall be secured to prevent accidental rolling.

C. Keep jointing material sealed when not in use.

D. Unload and string out the pipe in accordance with manufacturer's recommendations and in a manner approved by the Engineer.

3.2 INSTALLATION

A. The pipe shall be installed in accordance with AWWA C600 and per manufacturer's specific instructions. Do not install pipe without continuous support under the barrel or where a dry joint connection cannot be made.

B. Coat all mechanical joints with low density polyethylene film sleeve as per AWWA C105, except where concrete encased as shown.

C. Where necessary to raise or lower the pipe due to unforeseen obstruction or other causes, the Engineer may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed 75 percent of the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount that will be detrimental to the strength and water tightness of the finished joint.

3.3 RUBBER GASKETED JOINTS

A. Rubber Gasketed Joints.

1. For bell end pipe, the bell end of the pipe shall be thoroughly cleaned immediately before joining the pipe, and a clean rubber gasket shall be placed in the bell groove. The spigot end of the pipe and the inside surface of the gasket shall be carefully cleaned and lubricated. The lubricant shall be suitable for lubricating the parts of the joint for assembly.

    a. For potable water pipe the lubricant shall be a compound listed as in compliance with NSF Standard 61. The lubricant shall be nontoxic, shall not support the growth of bacteria, and shall have no deleterious effects on the gasket material. The lubricant shall not impart taste or odor of water in the pipe. Tilting of the pipe to insert the spigot into the bell will not be permitted.

2. For mechanical joint pipe, once the gasket is placed over the plain end of the pipe and prior to assembly, the gasket shall be thoroughly lubricated so the gasket will "flow" into the wedge-shaped gasket seat during tightening of the bolts.

3.4 INSTALLATION OF PIPE APPURTENANCES

A. Protection of Appurtenances: When the joining pipe is dielectric-coated, buried appurtenances shall be coated in kind. Where pipe is encased in polyethylene sleeves, buried appurtenances shall also be encased in polyethylene.

B. Installation of Valves: Valves shall be handled in a manner to prevent any injury or damage to any part of the valve. Joints shall be thoroughly cleaned and prepared prior to installation. The Contractor shall adjust all stem packing and operate each valve prior to installation to insure proper operation.

C. Valves shall be installed so that the valve stems are plumb in the location indicated.

3.5 PIPELINE TESTING

A. All pipes shall be tested in accordance with Section 33 01 12– Inspection and Testing of Water Utilities or Section 33 05 05.41 – Gravity Pipe Testing, as shown on the pipe test ID on the drawings. The Contractor shall furnish all test equipment, labor, material, and devices at no extra cost to the Owner. Leaks shall be repaired to the satisfaction of the Engineer, and the system shall be re-tested until leakage complies with the testing schedule.

END OF SECTION 40 05 19

SECTION 40 05 23 - STAINLESS STEEL PIPE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide stainless steel pipe and appurtenances, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A.	ASTM A 312	Seamless and Welded Austenitic Stainless Steel Pipe
B.	ASTM A 409	Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service
C.	ASTM A 778	Welded, Unannealed Austenitic Stainless Steel Tubular Products
D.	ANSI/ASME B 31.1	Power Piping, and ANSI/AWWA C606.
E.	ASTM A 967	Passivation of Stainless Steel Pipe.

1.3 SUBMITTALS

A. Submit to the Engineer shop drawings in accordance with Section 40 05 00 – Piping, General.

PART 2 - PRODUCTS

2.1 GENERAL

A. All pipe fittings used in potable water systems shall be compliant with NSF/ANSI 61,14, and 372.

2.2 PIPE MATERIAL

A. Unless otherwise indicated, stainless steel pipe shall be in accordance with ASTM A 312, Type 304 or 316, seamless, of the schedules indicated, with threaded and socket-weld fittings for sizes up to and including 2-1/2 inches. Threaded fittings will only be allowed in above-ground installations; all buried fittings shall be welded, no exceptions. Stainless steel pipe 3 inches in diameter and larger shall be in accordance with ASTM A 409, Type 304 or 316 as indicated on Drawings of the schedules indicated, with welded or flanged fittings.

B. All fittings shall conform to the following schedule:

Fitting Type	Material	Standard
Threaded	Forged stainless steel per ANSI/ASME B 16.11	Type 304 & 316
Socket-Welded	Forged stainless steel, ANSI/ASME B 16.11	Type 304 & 316
Butt-Welded	Wrought stainless steel, ASTM A 403, and ANSI/ASME B 16.9	Type 304 &316
Flanged	Forged Stainless Steel, ANSI/ASME B 16.5	Type 304 & 316

C. Flanged Joints

1. Bolts shall be ASTM A320, B8M Class 1 Stainless Steel.

2. Nuts shall be ASTM A194 Grade 8M Stainless Steel.

3. Washers shall be 316 Stainless Steel.

4. Gaskets shall be Viton in air piping. Refer to Specification Section 40 05 00 – Piping, General for gasket materials in other applications.

D. Surface Treatment

1. All Stainless Steel pipe shall be surface treated and tested to meet ASTM A 967 Passivation Standard.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Stainless steel pipe shall be installed in a neat and workmanlike manner, properly aligned and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary all piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points. Installation shall be acceptable to the Engineer.

B. Supports and Anchors: Piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 40 05 07 – Hangers and Supports for Process Piping. Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature differences.

C. Valves and Unions: Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection.

D. Preparation. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and be straightened if not true. Ends of threaded pipes shall be reamed and filed smooth. Pipe fittings shall be equally cleaned before assembly.

3.2 PIPE JOINTS

A. Threaded Joints: Pipe threads shall conform to ANSI/ASME B 1.20.1 - Pipe Threads, General Purpose (inch), and shall be full and cleanly cut with sharp dies. Not more than three threads shall remain exposed after installation.

B. Welded Joints: Welded joints shall conform to the specifications and recommendations of ANSI/ASME B 31.1 - Power Piping. Welding shall be done by skilled and qualified welders per Section 40 05 00 – Piping, General.

1. Field welding shall be minimized to the greatest extent possible by use of couplings and prefabrication of pipe systems at the factory. Pipe butt welds may be performed at the Site, providing the butt welds are performed only with an inert gas shielded process and that other indicated welding requirements are followed rigidly.

2. Residue, oxide, and heat stain shall be removed from any type of field weld and the affected areas adjacent by the use of stainless steel wire brushes, followed by cleaning with an agent such as Eutectic Company's "Euclean" or equal, followed by complete removal of the agent.

3.3 INSPECTION AND FIELD TESTING

A. Inspection: The finished installation shall be carefully inspected for proper supports, anchoring, interferences, and damage to pipe, fittings, and coating. Damage shall be repaired to the satisfaction of the Engineer.

B. Field Testing: Prior to enclosure or burying, piping systems shall be pressure tested as required in the Piping Schedule, for a period of not less than one hour, without exceeding the tolerances listed in the Piping Schedule. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. The Contractor shall furnish all test equipment, labor, materials, and devices at no extra cost to the Owner. For additional testing requirements refer to Section 33 01 12 – Inspection and Testing of Water Utilities.

END OF SECTION 40 05 23

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SECTION 40 05 31 – PVC PROCESS AND YARD PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide polyvinyl chloride (PVC) pipe (pressure and gravity) and chlorinated polyvinyl chloride (CPVC) pressure pipe, complete and in place, in accordance with the Contract Documents. PVC pipe shall be in accordance with the Piping Schedule shown on the drawings.

B. Refer to Section 40 05 00 – Piping, General for Process Interconnections for additional requirements.

1.2 REFERENCE STANDARDS

A.	ASTM D 1785	Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
B.	ANSI/ASME B 16.5	Pipe Ranges and Flanged Fittings, Class 150
C.	ASTM D 2467	Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
D.	ASTM F 1498	Taper Pipe Threads 60 Degrees for Thermoplastic Pipe and Fittings
E.	ASTM D 2241	PVC Pressure Rated Pipe SDR 21 and SDR 35
F.	ASTM D 3034	PVC, SDR 21 and SDR 35 Fittings
G.	AWWA C900	PVC Pressure Pipe and Fabricated Fittings
H.	ASTM D 2241	PVC Pressure Rated Pipe
I.	ASTM D 3034	Type PSM PVC Sewer Pipe and Fittings
J.	NSF/ANSI 14	Plastics Piping System Components and Related Materials
K.	NSF/ANSI 61	Drinking Water System Components – Health Effects
L.	NSF/ANSI 372	Drinking Water System Components – Lead Content

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Section 40 05 00 – Piping, General for Process Interconnections, and Section 01 33 00 – Submittal Procedures.

PART 2 - PRODUCTS

2.1 GENERAL

A. All pipe and fittings used in potable water systems shall be compliant with NSF/ANSI 61, 14, and 372.

2.2 PIPE MATERIAL

A. PVC Schedule 40 and 80 pressure pipe, sizes ½ inch to 16-inch, ASTM D 1785.

1. Approved Use: As indicated in the Plans.

2. Pipe: Schedule 40 and Schedule 80 pipe shall be iron pipe size (IPS), made from all new rigid polyvinyl chloride compounds with a cell class of 12454 as per ASTM D 1784. Pipe shall be NSF 61 compliant if indicated in the pipe schedule on the drawings. Operating temperature will be less than 140 degrees F.

3. Joints:

a. Pipe joints shall be solvent-welded type with solvent cement and primer as recommended by the pipe manufacturer for the chemical to be used in the pipe. Solvent cements shall comply with ASTM D 2564. Primers shall comply with ASTM F656.

b. Schedule 80 screwed joints that are necessary to match up to threaded valves or fittings shall be made up with appropriate thread sealant, either paste or tape.

c. Flanged joints shall be made with Van-Stone type flanged connections.

4. Fittings:

a. Schedule 80 Fittings: Injection molded PVC Schedule 80 fittings shall conform to ASTM D 2467; threaded fittings shall conform to ASTM D 2464. Fittings shall conform to NSF International Standard 61 if indicated on the drawings.

b. Schedule 40 Fittings: Injection molded PVC Schedule 40 fittings shall comply with ASTM D 2466.

c. Flanged Fittings: Flanged fittings shall be Van-Stone type, Schedule 80 fabricated PVC fittings with 150 lb. flanges conforming to ANSI/ASME B 16.5. Gaskets shall be ANSI 150 lb. full face, 1/8-inch thick Neoprene for water or wastewater service. Gasket material shall be suitable for the chemical service shall be provided.

B. CPVC Pressure Pipe, sizes ½ inch to 8-inch, ASTM F 441.

1. Approved Use: As indicated in the Plans.

2. Schedule 40 and Schedule 80 pipe (iron pipe size) shall be made with a CPVC compound having a minimum cell classification of 24448, and shall be third party certified to NSF 14.

3. Fittings: CPVC Schedule 80 socket fittings shall conform to ASTM F439; Schedule 80 threaded fittings shall conform to ASTM F437. All fittings must be third party certified to NSF 14. CPVC Schedule 80 fabricated fittings shall be reinforced with fiberglass reinforced plastic (FRP). All CPVC fittings shall be molded or fabricated from a CPVC compound that is compatible with the pipe material.

C. PVC Pressure Pipe Sizes 4-inch through 60-inch for Water Distribution, ANSI/AWWA C900.

1. Approved Use: As indicated in the Plans.

2. Dimension Ratio: DR 18.

3. Joint: Bell and spigot end with ASTM F 477-02 elastomeric gaskets.

4. Fittings: Ductile Iron as per Section 40 05 19 – Ductile Iron Pipe and Fittings.

D. PVC SDR 35 Gravity Sewer Pipe, Sizes 4 inch to 15-inch, ASTM D 3034.

1. Approved Use: As indicated in the Plans.

2. Pipe: Pipe shall be manufactured from virgin rigid PVC compounds with a cell class of 12364 in accordance with ASTM D 1784. Pipe shall conform to ASTM D 3034 for gasket pipe with a minimum pipe stiffness of 115.

3. Joints: Elastomeric gasket joints with ASTM F477 elastomeric gaskets.

4. Buried pipe shall be installed in accordance with ASTM D 2321 and ASTM F 1668.

E. PVC Gravity Sewer Pipe, Sizes 18 inch to 60 inch, ASTM F679, (Solid Wall PVC).

1. Approved Use: As indicated in the Plans.

2. Pipe Stiffness: 115 psi.

3. PVC Pipe Material Cell Class: 12454.

4. Joint: Bell and spigot end with ASTM F 477-02 elastomeric gaskets.

5. Minimum Cover from Subgrade: 3 feet.

F. PVC SDR-21 Pressure Pipe (PR 200), Sizes ½ inch through 2 inch, ASTM D2241.

1. Approved Use: As indicated in the Plans.

2. Pipe and fittings shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with a Cell Class of 12454 as per ASTM D 1784, and shall comply with NSF 61.

3. PVC SDR pipe shall be iron pipe size (IPS) conforming to ASTM D 2241 for plain-end pipe and ASTM D 2672 for belled-end pipe.

4. PVC Schedule 40 (IPS) fittings shall conform to ASTM D2466.

5. Buried pipe shall be installed in accordance with ASTM F 1668 and ASTM D2774.

6. Joints: Solvent cement joints shall be made in a two-step process with primer conforming to ASTM F 656 and solvent cement conforming to ASTM D 2564.

G. Corrugated Polyethylene Pipe, 4 inch to 10 inch, AASHTO M252, 12-inch to 60-inch, AASTO M294 and AASHTO MP7-97, (Corrugated).

1. Approved Use: As indicated in the Plans.

2. Minimum Pipe Stiffness: Sufficient to accommodate HS-25 traffic loading considering depth of bury, soil conditions, bedding, and application.

3. Joints: Bells and spigot end with ASTM F477-02 elastomeric gaskets.

4. Minimum Cover from Subgrade: 3 feet.

H. COUPLINGS

1. Couplings shall be in accordance with Section 40 05 00 – Piping, General for Process Interconnections

I. THRUST BLOCKS

1. Thrust blocks shall be in accordance with Section 40 05 00 – Piping, General for Process Interconnections.

J. MECHANICAL RESTRAINT

1. Mechanical restraint shall be in accordance with Section 40 05 00 – Piping, General for Process Interconnections.

PART 3 - EXECUTION

3.1 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect pipe and components against dirt, damage and excessive sunlight during shipment and storage. Handle and store pipe to prevent damage or contamination.

B. Verify compatibility of pipe type and fittings prior to installation.

C. Keep jointing material sealed when not in use. Store gaskets in a cool, well-ventilated place and do not expose to the direct rays of the sun until immediately before joint assembly.

3.2 PIPE PREPARATION

A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and be straightened, if not true. Ends of threaded pipes shall be reamed and filed smooth. Pipe fittings shall be equally cleaned before assembly.

3.3 INSTALLATION

A. PVC pipe shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary, piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points. It is recommended that the Contractor obtain the assistance of the pipe manufacturer's field representative to instruct the pipe fitters in the correct installation and support of PVC piping.

B. Install pipe as per manufacturer's specific instructions. Do not install buried pipe without continuous support under the barrel or where a dry joint connection cannot be made.

C. Install buried pipe with cover indicated in the plans. Ensure that the pipe has adequate cover from subgrade and is installed below frost depth.

D. Supports and Anchors: Piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 40 05 07 – Hangers and Supports for Process Piping. Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature changes.

E. Valves and Unions: Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection. Valves and flanges attached to PVC pipe shall be provided with adequate supports.

F. Control line and grade of the pipe installation by use of a pipeline laser. Limit variance of installed pipe from design line and grade to less than 0.02 feet, unless a smaller variance is necessary to prevent a level or negative slope.

G. Furnish and install plugs or caps on pipe ends and stub-outs. Insure watertight connection. Provide a bell end or joint suitable for making a gasketed connection when the pipeline is extended. Thrust block all pressure pipe stubs. Protect against displacement during backfilling operations and testing.

H. If excavation enters an area of petroleum or other contamination, stop Work and notify the Engineer for verification of piping and gasket material usage.

I. When pipe installation is suspended, assure that no dirt or other foreign material is allowed in pipe or fittings. Block or plug the open end of the pipe to prevent creep, uplift or floating, entrance of water, dirt, or other materials.

J. Joint Gap: Rubber gasket pipe shall be installed with maximum joint gaps not exceeding 75% of the manufacturer's recommended gap, at any point around the internal joint perimeter. Joint gaps shall be internally verified for each joint.

K. Place thrust blocks at each angled fitting, tee, cross, reducer, cap, plug, and valve. Provide bearing area against undisturbed earth. Place such that thrust block may be removed in the future without damage to pipe or fitting. Place 6 mil polyethylene plastic between thrust blocks and fittings.

1. Concrete thrust blocks shall be cured one (1) day before the pipeline may be filled with water, and three (3) days before the pipeline may be pressurized.

L. Deflection: Long radius curves may be constructed by pulling the pipe at the joints. The maximum deflection angle at a pulled joint shall not exceed one degree (1°) or as recommended by the manufacturer, as long as the maximum joint gap does not exceed 75% of the manufacturer's recommended gap.

M. Do not operate existing or active valves without the authorization of the Engineer.

N. Pipe bedding is required, bed pipe in accordance with Section 31 23 33 – Trenching and Backfilling.

O. Except as required for backfilling, prohibit walking or working on the pipe until backfilling of the trench has been completed. Provide temporary bridging over pipe as necessary to provide crossings for workers or equipment.

P. Assure that continuity is maintained in locating wire, in accordance with Section 31 23 33 – Trenching and Backfilling.

3.4 PIPE JOINTS

A. Threaded Joints: Pipe threads shall conform to ASTM F 1498 - Taper Pipe Threads 60 Degrees for Thermoplastic Pipe and Fittings and shall be full and cleanly cut with sharp dies or molded. Joints shall be made with Teflon tape or thread sealant.

B. Solvent-Welded Joints: Solvent-welded joints shall be made with fresh primer and solvent cement on clean, dry pipe ends. The primer and cement cans shall be kept closed at all times and the joints shall be made up at the recommended ambient temperatures, to the pipe or cement manufacturer's written recommendations. Pipe ends shall be inserted to the full depth of the socket.

C. Flange Joints: Flanged joints shall be made with gaskets and Type 316 stainless steel bolts and nuts. Care shall be taken not to over-torque the bolts, in accordance with the manufacturer's written recommendations.

D. Mechanical Joints: As per Section 40 05 00 – Piping, General for Process Interconnections.

3.5 INSPECTION AND FIELD TESTING

A. Inspection: Finished installations shall be carefully inspected for proper joints and sufficient supports, anchoring, interferences, and damage to pipe, fittings, and coating. Damage shall be repaired to the satisfaction of the Engineer.

B. Field Testing: The Contractor shall allow adequate time for the solvent cement joints to cure. Curing time shall be per the solvent cement manufacturer's recommendation. Prior to enclosure or burying, piping systems shall be pressure tested as required in 40 05 00 – Piping, General for Process Interconnections, without exceeding the tolerances listed in the Piping Schedule. Caution - Do not use air or gas for testing PVC pipe. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. The Contractor shall furnish all test equipment, labor, materials, and devices.

C. Leakage shall be determined by loss of pressure. Fixtures, devices, or other accessories that would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines shall be plugged or capped as appropriate during the testing procedures.

D. Leaks shall be repaired to the satisfaction of the Engineer, and the system shall be re-tested until no leaks are found at Contractor’s expense.

E. Disinfect W1 (potable) water service lines in accordance with Section 33 01 12 – Inspection and Testing of Water Utilities.

END OF SECTION 40 05 31

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SECTION 40 05 51 - VALVES, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide valves, actuators, and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all valves and valve actuators pertaining to this Work as outlined in Contract Documents. Valves and actuators in particular locations may require a combination of units, sensors, and controls indicated in other sections of the Specifications.

C. Where a valve is to be supported by means other than the piping to which it is attached, the Contractor shall obtain from the valve manufacturer a design for support and foundation that satisfies the criteria in Section 43 05 01 – Equipment General Provisions. The design, including drawings and calculations sealed by an engineer, shall be submitted with the Shop Drawings. When the design is approved, support shall be provided.

D. Unit Responsibility: A single manufacturer shall be made responsible for coordination of design, assembly, testing, and furnishing of each valve; however, the Contractor shall be responsible to the Owner for compliance with the requirements of each valve section. Unless indicated otherwise, the responsible manufacturer shall be the manufacturer of the valve.

E. Single Manufacturer: Where two or more valves of the same type and size are required, the valves shall be furnished by the same manufacturer.

1.2 REFERENCE STANDARDS

A.	ANSI B1.20.1	Pipe Threads, General Purpose
B.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
C.	ANSI B16.5	Pipe Flanges and Flanged Fittings
D.	ANSI B16.18	Cast Copper Alloy Solder Joint Pressure Fittings Class 25, 125, 250 and 800
E.	AWWA C111	Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
F.	AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 through 144 IN
G.	NEMA	Motors and Generators

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Shop Drawings shall contain the following information:

1. Valve name, size, Cv factor, pressure rating, identification number (if any), and specification section number.

2. Complete information on valve actuator, including size, manufacturer, number, limit switches, and mounting.

3. Cavitation limits for control valves.

4. Assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, handwheels, position indicators, limit switches, integral control systems, needle valves, and control systems.

5. Data in accordance with Section 40 05 93 – Process Equipment for electric motor-actuated valves.

6. Complete wiring diagrams and control system schematics.

7. Valve Labeling: A schedule of valves to be furnished with stainless steel tags, indicating in each case the valve location and the proposed wording for the label.

8. Certification that products being used under requirements of standards referenced.

C. Operation and Maintenance Data: Provide in accordance with Section 01 78 23 – Operation Maintenance Data.

D. Spare Parts List: A Spare Parts List shall contain the required information for each valve assembly, where indicated.

E. Factory Test Data: Where indicated, signed, dated, and certified factory test data for each valve requiring certification shall be submitted before shipment of the valve. The data shall also include certification of quality and test results for factory-applied coatings.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Valve manufacturers shall have a successful record of not less than five (5) years in the manufacture of the valves indicated.

B. Valve Testing: As a minimum, unless otherwise indicated or recommended by the reference Standards, valves 3-inches in diameter and smaller shall be tested in accordance with manufacturer's standard, larger valves shall be factory tested as follows:

1. Hydrostatic Testing: Valve bodies shall be subjected to internal hydrostatic pressure equivalent to twice the water rated pressure of the valve. Metallic valves rating pressures shall be at 100 degrees F and plastic valves shall be at 73-degrees, higher temperature according to type of material. During the hydrostatic test, there shall be no leakage through the valve body, end joints, or shaft seals, nor shall any part of the valve be permanently deformed. The duration shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes.

2. Seat Testing: Valves shall be tested for leaks in the closed position with the pressure differential across the seat equal to the water rated pressure of the valve. The duration of the test shall be sufficient time to allow visual examination for leakage. The test duration shall be at least 10 minutes. Leakage past the closed valve shall not exceed 1 fluid ounce per hour per inch diameter for metal seated valves and drop-tight for resilient seated valves.

3. Performance Testing: Valves shall be shop operated from fully closed to fully open position and reverse under no-flow conditions in order to demonstrate the valve assembly operates properly.

C. Certification: Prior to shipment, the Contractor shall submit for valves over 12- inches in size, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, or ASTM.

PART 2 - PRODUCTS

2.1 GENERAL

A. All valves used in potable water systems shall be NSF/ANSI 61 certified and compliant with 14 and 372.

2.2 PRODUCTS

A. Valves and gates shall be new and of current manufacture. Shut-off valves 6-inches and larger shall have actuators with position indicators. Gate valves 18-inches and larger or where chain wheel is required, shall be furnished with spur gear and hand wheel. Buried valves shall be provided with valve boxes and covers containing position indicators and valve extensions. Manual shut-off valves mounted higher than 7-feet above working level shall be provided with chain actuators.

B. Valve Actuators: Unless otherwise indicated, valve actuators shall be in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.

C. Protective Coating: The exterior surfaces of all valves and the wet interior surfaces of ferrous valves of sizes 4-inches and larger shall be coated in accordance with manufacturer’s written instructions. The valve manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant prior to shipment. Flange faces of valves shall not be epoxy coated.

D. Valve Labeling: Except when such requirement is waived by the Engineer in writing, a label shall be provided on shut-off valves and control valves except for hose bibbs. The label shall be of 1/16-inch plastic or stainless steel, minimum 2-inches by 4-inches in size and shall be permanently attached to the valve or on the wall adjacent to the valve as directed by the Engineer.

E. Valve Lining: Each valve shall be lined with the same material required for the pipeline in which the valve is installed.

2.3 MATERIALS

A. Materials shall be suitable for the intended application. Materials in contact with potable water shall be listed as compliant with NSF Standard 61. Materials not indicated shall be high-grade standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended. Unless otherwise indicated, valve and actuator bodies shall conform to the following requirements:

1. Cast Iron: Close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

2. Ductile Iron: ASTM A 536 - Ductile Iron Castings, or to ASTM A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

3. Steel: ASTM A 216 - Steel Castings, Carbon Suitable for Fusion Welding for High- Temperature Service, or to ASTM A 515 - Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service.

4. Bronze: ASTM B 62 - Composition Bronze or Ounce Metal Castings, and valve stems not subject to dezincification shall conform to ASTM B 584 - Copper Alloy Sand Castings for General Applications.

5. Stainless Steel: Stainless steel valve and operator bodies and trim shall conform to ASTM A 351 - Steel Castings, Austenitic, for High-Temperature Service, Grade CF8M, or shall be Type 316 stainless steel.

6. PVC: Poly Vinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 12454.

7. CPVC: Chlorinated Poly Vinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 23447.

2.4 VALVE CONSTRUCTION

A. Bodies: Valve bodies shall be cast, molded (in the case of plastic valves), forged, or welded of the materials indicated, with smooth interior passages. Wall thicknesses shall be uniform in agreement with the applicable standards for each type of valve, without casting defects, pinholes, or other defects that could weaken the body. Welds on welded bodies shall be done by certified welders and shall be ground smooth. Valve ends shall be as indicated, and be rated for the maximum temperature and pressure to which the valve will be subjected.

B. Valve End Connections: Unless otherwise indicated, valves 2-1/2 inches diameter and smaller may be provided with threaded end connections. Valves 3-inches and larger shall have flanged end connections.

C. Bonnets: Valve bonnets shall be clamped, screwed, or flanged to the body and shall be of the same material, temperature, and pressure rating as the body. The bonnets shall have provision for the stem seal with the necessary glands, packing nuts, or yokes.

D. Stems: Valve stems shall be of the materials indicated, or, if not indicated, of the best commercial material for the specific service, with adjustable stem packing, O-rings, Chevron V-type packing, or other suitable seal. Where subject to dezincification, bronze valve stems shall conform to ASTM B 62, containing not more than 5 percent of zinc or more than 2 percent of aluminum, with a minimum tensile strength of 30,000 psi, a minimum yield strength of 14,000 psi, and an elongation of at least 10 percent in 2 inches.

E. Stem Guides: Stem guides shall be provided per the manufacturer’s recommendations. Submerged stem guides shall be 304 stainless steel.

F. Internal Parts: Internal parts and valve trim shall be as indicated for each individual valve. Where not indicated, valve trim shall be of Type 316 stainless steel or other best suited material.

G. Nuts and Bolts: Nuts and bolts on valve flanges and supports shall be in accordance with Section 43 05 50 – Equipment Mounting.

2.5 VALVE ACCESSORIES

A. Valves shall be furnished complete with the accessories required to provide a functional system.

2.6 SPARE PARTS

A. The Contractor shall furnish the required spare parts suitably packaged and labeled with the valve name, location, and identification number. The Contractor shall also furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve. Spare parts are intended for use by the Owner, after expiration of the correction of defects period.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation, inspect interconnecting piping and end connections to ensure compatibility.

B. Prior to installation, inspect and verify the condition of valve and appurtenances. Installation constitutes installer's acceptance of product condition for satisfactory installation.

C. Ensure exposed piping is sufficiently supported to bear weight of valve when it is installed.

3.2 PREPARATION

A. Correct defects or conditions, which may interfere with or prevent a satisfactory installation.

3.3 VALVE INSTALLATION

A. Valves, actuating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as indicated. Gates shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.

B. All buried valves shall be mechanically restrained as per Section 40 05 00 – Piping, General.

C. Access: Valves shall be installed with easy access for actuation, removal, and maintenance and to avoid interference between valve actuators and structural members, handrails, or other equipment.

D. Valve Accessories: Where combinations of valves, sensors, switches, and controls are indicated, the Contractor shall properly assemble and install such items so that systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on Shop Drawing submittals.

END OF SECTION 40 05 51

SECTION 40 05 57 – ACTUATORS FOR PROCESS VALVES AND GATES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide all valve actuators and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all valves and gates, except where otherwise indicated in the Contract Documents. This Section includes manual operators and motorized valve operators, and mechanical, gear type limit switches.

C. Unit Responsibility: A single manufacturer shall be responsible for furnishing and coordinating design, assembly, testing, and installation of each type of valve and gate; however, the Contractor shall be responsible to the Owner for compliance with the requirements of each valve and gate section.

D. Single Manufacturer: Where two or more valve or gate actuators of the same type or size are required, the actuators shall all be produced by the same Manufacturer.

1.2 REFERENCE STANDARDS

A. Unless otherwise indicated and where applicable, all actuators shall be in accordance with ANSI/AWWA C540 - AWWA Standard for Power-Actuating Devices for Valves and Sluice Gates.

B. National Electrical Manufacturer’s Association (NEMA).

1.3 SUBMITTALS

A. Submittals shall be furnished in accordance with Section 01 33 00 – Submittal Procedures and Section 40 05 51 - Valves, General.

B. Shop Drawings: Shop Drawings of all actuators shall be submitted together with the valve and gate submittals as a complete package.

C. Motorized valve submittals shall include the following:

1. Installation list of similar municipal applications with contacts and phone numbers to verify experience.

2. Shop drawings and product data.

3. Motor, gear type and design information.

4. Design Data shall include:

a. Operating calculations for max break and max dynamic torques and minimum safety factor at which degree of valve opening and at break.

b. Submit data and calculations to substantiate operating time.

c. Submit proposed operator configuration and dimensions for each valve.

5. Wiring Schematics.

6. Manufacturer's published installation instructions.

7. Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 – Operation and Maintenance Data.

8. Warranty.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. The motorized operators offered for this project shall have a minimum of 5 years of commercial use in municipal wastewater installations of a similar scope and use. New and prototype hardware/software will not be accepted.

2. Submit evidence of satisfactory operation of the proposed product in at least five separate facilities in accordance with the following requirements. Include contact names and phone numbers.

PART 2 - PRODUCTS

2.1 GENERAL

A. All valve and gate actuators shall comply with the requirements of Section 40 05 51 – Valves, General.

B. Unless otherwise indicated, all shut-off and throttling valves, and externally actuated valves and gates, shall be provided with manual or power actuators. The Contractor shall furnish all actuators complete and operable with mounting hardware, motors, gears, controls, wiring, solenoids, handwheels, levers, chains, and extensions, as applicable. All actuators shall be capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering. All wires of motor-driven actuators shall be identified by unique numbers.

C. Where indicated, certain valves and gates may be provided with actuators manufactured by the valve or gate Manufacturer. Where actuators are furnished by different manufacturers, the Contractor shall coordinate selection to have the fewest number of manufacturers possible.

D. Materials: All actuators shall be current models of the best commercial quality materials and liberally-sized for the maximum expected torque. All materials shall be suitable for the environment in which the valve or gate is to be installed.

E. Mounting: All actuators shall be securely mounted by means of brackets or hardware specially designed and sized for this purpose and of ample strength. The word "open" shall be cast on each valve or actuator with an arrow indicating the direction to open in the counter-clockwise direction. All gear and power actuators shall be equipped with position indicators. Where possible, manual actuators shall be located between 48 and 60 inches above the floor or the permanent working platform.

F. Functionality: Electric and pneumatic actuators shall be coordinated with power and instrumentation equipment indicated elsewhere in the Contract Documents.

2.2 MANUAL ACTUATORS

A. Unless otherwise indicated, all valves and gates shall be furnished with manual actuators as specified below:

1. Valves up to and including 4 inches in diameter shall have direct acting lever or handwheel actuators of the manufacturer’s best standard design.

2. Larger valves and gates shall have gear-assisted manual actuators, with a maximum operating pull of 60 pounds on the rim of the handwheel.

a. Above ground valves 6-inches to 24-inches in diameter may have traveling nut actuators, worm-gear actuators, spur- or bevel-gear actuators, as appropriate for each valve.

b. Above ground valves 30-inches in diameter and greater and valves for pressures higher than 250 psi shall have totally enclosed worm-gear actuators.

c. Buried and submerged valves, gates, and other valves as indicated shall have totally enclosed worm-gear actuators, hermetically-sealed water-tight and grease-packed.

B. Buried Valves: Unless otherwise indicated, buried valves shall have extension stems to grade, with square nuts or floor stands, position indicators, and cast-iron or steel pipe extensions with valve boxes, covers, and operating keys. Where so indicated, buried valves shall be in cast-iron, concrete, or similar valve boxes with covers of ample size to allow operation of the valve actuators. Covers of valve boxes shall be permanently labeled as required by the local Utility Company or the Engineer. Wrench-nuts shall comply with AWWA C500 – Metal-Seated Gate Valves for Water Supply Service.

C. Chain Actuator: Manually-activated valves with the stem located more than 7-feet above the floor or operating level shall be furnished with chain drives consisting of sprocket-rim chain wheels, chain guides, and operating chains, and be provided by the valve Manufacturer. The wheel and guide shall be of ductile-iron, cast-iron, or steel, and furnish heavy-duty, Type 304 stainless steel operating chain looped to extend within 3-feet of the operating floor level. The valve stem of chain-actuated valves shall be extra strong to allow for the extra weight and chain pull. Hooks shall be provided for chain storage where chains interfere with pedestrian traffic.

D. Floor Boxes: Hot-dip galvanized cast-iron or steel floor boxes and covers to fit the slab thickness shall be provided for all operating nuts in or below concrete slabs. For operating nuts in the concrete slab, the cover shall be bronze-bushed.

E. Manual Worm-Gear Actuator: The actuator shall consist of a single or double reduction gear unit contained in a weather-proof cast-iron or steel body with cover and minimum 12-inch diameter handwheel. The actuator shall be capable of 90-degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The actuator shall consist of spur or helical gears and worm-gearing. The spur or helical gears shall be of hardened alloy steel and the worm-gear shall be alloy bronze. The worm-gear shaft and the handwheel shaft shall be of stainless steel. All gearing shall be accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Actuator output gear changes shall be mechanically possible by simply changing the exposed or helical gear set ratio without further disassembly of the actuator. All gearing shall be designed for a 100 percent overload.

2.3 ELECTRIC MOTOR ACTUATORS

A. Where electric motor actuators are indicated, an electric motor-actuated valve control unit shall be attached to the actuating mechanism housing by means of a flanged motor adaptor piece.

B. Design:

1. The actuators shall be suitable for use on a nominal 480 volt, 3 phase, 60Hz power supply and are to incorporate motor, integral reversing starter, local control facilities and terminals for remote control and indication connections housed within a self-contained, sealed enclosure.

2. Meet applicable AWWA requirements and meet the requirements set out in EN15714-2 and ISA SP96.02.

3. The actuator shall be sized to guarantee valve closure. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. For linear operating valves, the operating speed shall be such as to give valve closing and opening at approximately 10-12 inches per minute unless otherwise stated in the data sheet. For quarter turn valve types, the operating time will be a maximum of 60 seconds.

4. Handwheels for Manual Operation:

a. Metallic with arrows to indicate "open" rotation; incapable of rotation during motor operation; unaffected by fused motor, being mechanically independent of the motor drive; maximum 80 pound pull on rim for manual operation. Actuators shall be fitted with 2-inch AWWA nut for portable operator. When in the manual operating mode, actuator to remain in this mode until motor is energized, at which time the actuator shall automatically return to electric operation.

5. Declutch Lever: Padlockable, capable of mechanically disengaging motor and related gearing positively when motor is de-energized and freeing handwheel for manual operation.

    a. Do not share any gearing between motor operation and handwheel operation.

    b. Design so that simultaneous manual and motor operation is impossible.

6. Motorized operators shall be provided with an integrally mounted communication module within the actuators, to allow non-intrusive set up, double sealed electrical housing and shall not require access after factory fitting. In order to maintain the integrity of the enclosure, setting of the torque levels, position limits and configuration of the indication contacts, etc., shall be carried out without the removal of any actuator covers and without mains power over an Infra-red or *Bluetooth*® wireless interface. Sufficient commissioning tools shall be provided with the actuators and must meet the enclosure protection and certification levels of the actuators. Commissioning tools shall not form an integral part of the actuator and must be removable for secure storage. In addition, provision shall be made for the protection of configured actuator settings by a means independent of access to the commissioning tool. Provision shall be made to disable *Bluetooth*® communications or only allow a *Bluetooth*® connection initiated by an Infra-Red command for maximum security.

    a. Each operator shall have independent HAND-OFF-AUTO selector switch and OPEN-CLOSE control devices that are wired to the motor starter circuit and completely isolated and independent of the valve actuator remote control network.

    b. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel irrespective of the connection sequence of the power supply.

7. The complete motorized operator enclosure shall be:

    a. NEMA 4 and NEMA 6 submersible to IP68 (20 feet of head for 72 hours). Actuators shall be suitable for indoor and outdoor use. The actuator shall be capable of functioning in an ambient temperature ranging from -33°C (22°F) to 70°C (140°F), up to 100% relative humidity.

    b. Actuators for hazardous area applications shall meet the area classification, gas group and surface temperature requirements specified in data sheet.

    c. Equipped with a separately sealed (double “O” ring) terminal area, such that with the terminal cover removed the actuator’s internal components are protected from environmental moisture and dust during storage and “no-power” conditions, start-up and working life. Enclosure must allow for temporary site storage without the need for electrical supply connection.

    d. All external fasteners shall be stainless steel.

C. Actuator Gearing:

1. Meet applicable AWWA requirements.

2. Single reduction type with hardened alloy steel worm gear, and aluminum bronze worm gear set; self-locking to maintain gate position.

3. Power Gearing: Accurately cut to assure minimum backlash; anti-friction bearing with caged balls or rollers throughout.

4. Stem Nuts: High tensile aluminum bronze; accurately machined and mounted in heavy ball or roller bearings.

5. Actuator Gear Housing: Aluminum housing with a separate cast iron thrust base.

6. Lubrication: Rotating power train components immersed in oil with provisions for inspection and re-lubrication without disassembly.

a. Lubricants: Suitable for ambient conditions of -20 degrees F to +150 degrees F.

b. Provide seals on shafting. All seals, feed throughs, and bearings shall provide sealing such that the actuator can be mounted in any position with no leakage of oil. Secondary gearboxes shall be externally attached to the actuator to accommodate variations in output speeds, torques or operating times and for use with quarter-turn valves. These multi-turn and quarter-turn gearboxes are to use accurately cut gears suitable for motor drive.

D. Motors:

1. The motor shall be an integral part of the actuator, designed specifically for valve actuator applications. It shall be a low inertia high torque design, class F insulated with a class B temperature rise giving a time rating of 15 minutes at 40°C (104°F) at an average load of at least 33% of maximum valve torque. Where the total cycle time (two complete strokes) is longer than 15 minutes then NEMA Class H motor for 30 minute duty rating is to be used, with a maximum continuous temperature rating of 125 degrees C rise over ambient Temperature shall be limited by 2 thermostats embedded in the motor end windings and integrated into its control. Type: Specifically designed for gate actuator service with high starting torque, low inertia, totally enclosed, non-ventilated construction.

2. Protection shall be provided for the motor as follows:

a. Stall - the motor shall be de-energized within 8 seconds in the event of a stall when attempting to unseat a jammed valve.

b. Over temperature - thermostat will cause tripping of the motor. Auto-reset on cooling.

c. Single phasing - lost phase protection

d. Direction – phase rotation correction

3. Motor Windings: Epoxy treated.

4. Size: Sufficient to provide the maximum torque required for valve opening/closing operation, with a safety factor of 1.5. Torque shall be based on the valve manufacture's calculated torque required for opening/closing at full differential and maximum valve dynamic torque.

5. Voltage Tolerance: Capable of operating at within 10 percent of specified voltage.

6. Motor Starters:

   a. For Open-Close Service: Self-contained electromechanical reversing starter suitable for 60 starts/hr.

   b. For Modulating Service: Self-contained solid-state reversing starter suitable for 1,200 starts per hour. The hammer action will be replaced by a direct drive.

7. Accessories: Internal thermal contacts embedded in the motor windings for detecting motor overload and a ground lug.

8. Power Supply: As scheduled or as indicated on the Drawings.

9. Enclosures for Motors, Switches, and Other Electrical Compartments shall be:

   a. In Class 1, Division 1 or Division 2, classified areas or where indicated in the Motorized Operator Schedule: NEMA 7 and NEMA 6 submersible to IP68.

   b. In other locations: NEMA 4 and NEMA 6 submersible to IP68.

   c. Terminal compartment shall have three threaded cable entries as a minimum. Provide additional threaded entries if required or indicated on the Drawings.

E. Controls:

1. Coordinate requirements with P&IDs, electrical schematics, and Specification Section 40 61 96 – Control Strategies.

2. Voltage Transformer:

   a. As required to step down power supply to control voltage.

   b. Size voltage transformer to provide 24VDC or 120 VAC control power, for customer signals, indication and interlock relays as needed with 25 percent spare capacity or 15 VA, whichever is greater, for the multi-turn actuator.

3. Control Station:

   a. Integral with operator. Enclosures shall be:

      1) In Class 1, Division 1 or Division 2 classified areas: NEMA 7 and NEMA 6 submersible to IP68.

      2) In other locations: NEMA 4 and NEMA 6 submersible to IP68.

   b. Provided with Following Devices:

      1) HAND-OFF-AUTO selector switch, lockable in the OFF position.

      2) OPEN and CLOSE pushbuttons.

      3) OPEN and CLOSE indicating lights.

4. Torque Sensing:

   a. Torque and thrust loads in both closing and opening directions shall be limited by a torque sensing device.

   b. Torque setting: 40 percent to 100 percent rated torque, adjustable in 1% increments and indicated locally.

5. Electric Circuit Diagrams:

   a. Identical regardless of whether gates are to open or close on torque or position limit.

   b. Non-intrusive calibration-adjustment and interrogation of the actuator shall be accomplished without the removal of any of the actuator's covers. Non-intrusive calibration, adjustment & interrogation will be by means of a setting tool to provide speedy interrogation capabilities as well as security. The setting tool shall be in a non-intrusive intrinsically safe watertight casing. In addition it shall be possible to use a PDA or laptop.

6. Valve Position/Actuator Status Indication:

   a. The actuator shall provide a local display of the position of the valve, even when the power supply is not present.

   b. In the event of a (main) power (supply) loss or failure, the position contacts shall continue to be able to supply remote position feedback and maintain interlock capabilities.

   c. Absolute position measurement should be incorporated within the actuator. The technology must be capable of reliably measuring position even in the case of a single fault. The design must be simple with the minimum amount of moving parts (no more than 5). Technologies such as LEDs or potentiometers for position measurement are considered unreliable and therefore not preferred. The position of the actuator and valve shall be updated contemporaneously, even when the power supply is not present.

d. Four contacts shall be provided which can be selected to indicate any position of the valve; Provision shall be made for the selection of a normally closed or open contact form. Contacts shall maintain and update position indication during handwheel operation when all external power to the actuator is isolated. The contacts shall be rated at 5 Amps, 250 VAC, 30 VDC. Provision shall be made in the design for an additional eight contacts having the same functionality. A configurable monitor relay shall be provided as standard, which can be used to indicate either Availability or Fault. The relay should be a spring return type with a Normally Open / Normally Closed contact pre-wired to the terminal bung.

e. As an alternative to providing valve position, any of the above contacts shall be selectable to signal one of the following:

1) Valve Opening or Closing.

2) Motor Tripped on Torque in Mid Travel.

3) Motor Stalled.

4) Actuator Being Operated by Handwheel.

f. For actuators in modulating service, provide a controller that will accept a 4-20 mA analog signal. Additionally, a 4-20 mA position transmitter shall be included to provide a valve position feedback. The controller shall compare the input signal with the feedback signal to produce an error signal. The controller shall cause the motor to move the valve or gate in a direction so as to reduce the magnitude of the error signal. The controller positioning accuracy shall be plus or minus 1.0 percent of travel or better. It shall be possible to adjust Dead Band (0 to 9.9 percent of travel) and a Motion Inhibit Timer (2 to 99 seconds), and select action upon loss of signal, open/close/stay put.

7. Integral Starter and Transformer

a. The reversing starter, control transformer and local controls shall be integral with the valve actuator, suitably housed to prevent breathing and condensation. The starter shall be suitable for 60 starts per hour and of rating appropriate to motor size. The controls supply transformer shall be fed from two of the incoming three phases and incorporate overload protection. It shall have the necessary tapping and be adequately rated to provide power for the following functions:

1) Energizing of the contactor Coils

2) 24VDC or 110V AC output for remote controls (maximum 5W/VA)

3) Supply for all internal electrical circuits

8. Local Position Indication:

   a. The actuator display shall include a dedicated numeric/symbol digital position indicator displaying valve position from fully open to fully close in 0.1% increments. Valve closed and open positions shall be indicated by symbols showing valve position in relation to the pipework to ensure that valve status is clearly interpreted. With mains power connected, the display shall be backlit to enhance contrast at all ambient light levels and shall be legible from a distance of at least 5m (16ft).

   b. Red, green, and yellow LEDs corresponding to open, closed and intermediate valve positions shall be included on the actuator display when power is switched on. The yellow LED should also be fully programmable for on/off, blinker and fault indication. The digital display shall be maintained and updated during handwheel operation when mains power to the actuator is isolated.

   c. The actuator display shall include a fully configurable dot-matrix display element with a minimum pixel resolution of 168 x 132 to display operational, alarm, configuration and graphical datalogger information. The text display shall be selectable between English and other languages such as: Spanish, German, French, and Italian. Provision shall be made to upload a different language without removal of any covers or using specialized tools not provided as standard with the actuator Local Display: Large enough to be readable from a distance of six feet when the actuator is powered up. It shall be possible to rotate the display in 90 degree increments to compensate for the actuators installed position.

   d. Each actuator shall include a Data Logger to provide diagnostic information for maintenance & preventative maintenance purposes, including torque curves for both open & close strokes. This information is to be accessed by means of a) the setting tool, b) PDA or c) laptop, and in a format that can be saved electronically or on paper and then viewed at a later date. The software to achieve this and any updates to the software are to be supplied at no extra cost to the end user. Datalogger graphical displays should as a minimum be able to display log and trend graphs on the local LCD for the following:

      1) Torque versus Position

      2) Number of Starts versus Position

      3) Number of starts per hour

      4) Dwell Time

      5) Average temperature.

   e. The main display shall be capable of indicating 4 different home-screens of the following configuration:

      1) Isolation and status

2) Position and torque (analogue)

3) Position and torque (digital)

4) Position and demand (positioning).

F. Operation:

1. Controller System: Rated as follows:

a. Open-Close Service - 60 starts per hour (minimum).

b. Modulating Service - 1,200 starts per hour (minimum).

G. Manufacturers:

1. Intelligent electric actuators with torque output requirements of 750 ft-lbs and less for butterfly valves and eccentric plug valves shall be quarter turn type. Acceptable manufactures include:

a. Rotork “IQT Series”

b. Limitorque “QX”

c. EIM “HQ Series”

2. Intelligent electric actuators for open-close service shall be multi-turn type. Acceptable manufacturers include:

a. Rotork “IQ Series”

b. Limitorque “MX”

c. EIM “TEC 2000”

3. Intelligent electric actuators for modulating service shall be as follows:

a. Rotork “IQ Series”

b. Limitorque “MX”

c. EIM “TEC 2000”

4. Intelligent actuators for explosion proof service shall be as follows:

a. Rotork “IQ Series”

b. Limitorque “MX”

c. EIM “TEC 2000”

PART 3 - EXECUTION

3.1 GENERAL

A. Field representatives of manufacturers of valves or gates with electric actuators shall adjust actuator controls and limit switches in the field for the required function.

B. All valve and gate actuators and accessories shall be installed in accordance with Section 40 05 51 - Valves, General. Actuators shall be located to be readily accessible for operation and maintenance, without obstructing walkways. Actuators shall not be mounted where shock or vibrations will impair their operation, nor shall the support systems be attached to handrails, process piping, or mechanical equipment.

3.2 SOURCE QUALITY CONTROL

A. Factory test each motorized operator assembly in accordance with AWWA C540, except as modified herein.

B. Demonstrate that the stroke time is within the specified range.

C. Verify limit switch and torque switch functions in both directions.

D. Provide individual factory test certificates for each motorized actuator at no additional cost. Record the following parameters as a minimum.

1. No load current.

2. Current at maximum torque setting.

3. Stall current.

4. Torque at maximum torque setting.

5. Stall torque.

6. Test voltage and frequency.

7. Flash test voltage.

8. Actuator output speed.

E. Record details of specification, such as gear ratios for both manual and automatic drive, closing direction, wiring diagram, and serial number on the test certificates.

F. Require the motorized actuator manufacturer to submit certified statements that proof-of-design tests were carried out per the “Valve Actuator” section of AWWA C540 and that all requirements were successfully met.

3.3 INSTALLATION

A. Install operators in accordance with manufacturer's instructions.

3.4 MANUFACTURER'S FIELD SERVICES

A. Coordinate field service work with Owner and Engineer prior to initiating such work.

B. Contractor shall furnish a qualified Manufacturer’s Representative to provide manufacturer’s field services for inspection, testing, equipment startup, and operator training.

C. Require manufacturer’s representative to perform the following services as described below and as specified in Section 01 75 00 - Equipment Testing and Startup Procedures.

1. Installation Assistance:

a. Advise/observe the Contractor on the installation of motorized operators.

b. Check and verify that installation of the motorized operators is in accordance with the Drawings and manufacturer’s installation instructions.

c. Provide additional assistance as required.

2. Provide a 2 year warranty from date of substantial completion for the project.

3. Training: Provide a minimum of four (4) hours of training for the Owner’s staff on the operation and maintenance of electric operated gates and valves.

3.5 COMMISSIONING KIT

A. Each actuator shall be supplied with a start-up kit comprising installation instruction manual, electrical wiring diagram and cover seals to make good any site losses during the commissioning period. In addition, sufficient actuator commissioning tools shall be supplied to enable actuator set up and adjustment during valve/actuator testing and site installation commissioning.

END OF SECTION 40 05 57

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SECTION 40 05 59 - HYDRAULIC GATES, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide hydraulic gates with appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all flap gates, slide gates, stop gates, sluice gates, and shear gates, except where otherwise indicated in the Contract Documents.

C. The Contractor shall assign to a single manufacturer responsibility for furnishing and functional operation of the hydraulic gates including operators and accessories. The designated single manufacturer, however, need not manufacture more than one part of the units but shall coordinate the design, assembly, testing, and installation of the units.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

1.	ANSI/AWWA C560	Cast Iron Slide Gates
2.	ANSI/AWWA C513	Open-Channel, Fabricated-Metal Slide Gates and Open-Channel, Fabricated-Metal Weir Gates
3.	ASTM A211	Specification for Aluminum and Aluminum Alloy Bar, Roll and Wire
4.	ASTM A276	Stainless Steel Bars and Shapes
5.	ASTM B21	Naval Brass Rod, Bar, and Shapes
6.	ASTM B209	Specification for Aluminum and Aluminum-Alloy Sheet and Plate
7.	ASTM B584	Copper Alloy Sand Castings for General Applications
8.	ASTM D2000	Classification System for Rubber Product in Automotive Applications
9.	ASTM F593	Specification for Stainless Steel Bolts, Hex Cap Screws and Studs
10.	Quality Assurance	Corrosion Resistant Equipment Report for Reinforced Thermoset Plastic (RTP)

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Shop Drawings of all hydraulic gates.

C. Technical Manuals: Complete technical manuals, including printed instructions for proper maintenance, lubrication, and complete parts list indicating the various parts by name, number, and exploded view where necessary. A list of recommended spare parts for the Owner to store at the facility shall be included.

D. Certification: The Contractor shall obtain written certification from the designated single manufacturer, addressed to the Owner, stating that the equipment will efficiently and thoroughly perform the required functions in accordance with these Contract Documents, and that the designated single manufacturer accepts the Contractor's assignment of responsibility for coordination of gate equipment, including operators, controls, and services required for proper installation and operation. The Contractor shall submit all such certificates to the Engineer.

E. Field Procedures: Instructions for field procedures for installation, adjustments, inspection, and testing shall be provided prior to installation of the gates.

F. Provide operation and maintenance data in accordance with Section 01 78 23.

1.4 QUALITY ASSURANCE

A. Equipment Field Testing: The Contractor shall be responsible for the coordination of the tests of each hydraulic gate in the presence of the manufacturer’s factory service representative. Excessive leaks shall be corrected, and the equipment retested until found satisfactory.

B. Warranty: The Contractor shall furnish the manufacturer's written guarantee that the hydraulic gates comply with these specifications. The Contractor shall also furnish the manufacturer's warranties as published in its literature.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment provided under this Section shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products and which have had previous experience in such manufacture. The Contractor shall, upon request, furnish the names of not less than 5 successful installations of the manufacturer's equipment of comparable nature to that offered under this contract.

B. All combinations of manufactured equipment which are provided under these Specifications shall be entirely compatible, and the Contractor and the manufacturer shall be responsible for the compatible and successful operation of the various components of the units. All necessary mountings and appurtenances shall be included.

2.2 MATERIALS

A. Materials employed in the manufacture and installation of the hydraulic gates and operators shall be suitable for the intended application. Material not specifically called for shall be high-grade, standard commercial quality, free from defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended.

2.3 HARDWARE

A. Unless otherwise specified, bolts and nuts shall be 304/316 stainless steel.

2.4 PROTECTIVE COATING

A. Coat ferrous metal in accordance with Section 09 90 00 – Painting and Coating.

2.5 TOOLS AND SPARE PARTS

A. Tools: Furnish special tools necessary for maintenance and repair of the gates. Such tools shall be suitably stored in metal toolboxes and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All gates shall be installed in strict accordance with the manufacturer's printed recommendations and the requirements herein. Operators shall be located to avoid interference with handrails and structural members.

B. Equipment shall be field tested to verify proper alignment, operation as specified, and freedom from binding, scraping, or other defects. Equipment shall be secure in position and neat in appearance.

C. Damage to surface coatings incurred during shipment and/or installation shall be repaired to the satisfaction of the Engineer prior to installation.

D. After completion of the installation and testing, the Contractor, shall remove all debris from the site, clean all the equipment and controls, and hand over his work in perfect operating condition.

END OF SECTION 40 05 59

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SECTION 40 05 59.21 - ALUMINUM SLIDE AND STOP GATES

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall provide slide/stop gates, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 59 00 – Hydraulic Gates, General apply to this Section.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Drawings of gates, frames, slides, and actuators, as well as design load calculations for deflection at the maximum expected head, and calculations for the lifting force generated by 40 pounds effort on the handwheel or crank to operate the gate.

C. Certificates: Factory test certificates

1.3 QUALITY ASSURANCE

A. The leakage allowance for slide gates under the design seating and unseating head shall not exceed 0.1 gpm/ft of seating perimeter or the leakage rate of AWWA C 513, whichever is the most stringent.

B. Factory Testing: Gates shall be factory-assembled and functional-tested prior to delivery to the Site. Test certificates shall be submitted.

PART 2 - PRODUCTS

2.1 GENERAL

A. Gates shall comply with AWWA C513 unless indicated otherwise.

B. Gates shall be new and of current manufacture, adequately braced to prevent warpage and bending under the intended use.

C. Gate actuators shall be sized, selected, and furnished by the gate manufacturer. Gate actuators throughout the project shall be products of a single manufacturer.

D. Guide frames shall be extended 3-feet 6-inches above the walkway to match the height of the handrail. Where a gate is mounted in an opening between 2 sections of handrail, additional horizontal members shall be added to the gate frame to match the handrail, guardrail, and kickplate spacing of the adjacent railing. Horizontal members shall be arranged so that the railing will not interfere with the operation of the actuator.

2.2 ALUMINUM SLIDE GATES

A. Construction: Unless otherwise indicated, materials of construction shall be in accordance with AWWA C513, suitable for the service. Materials used in the fabrication of the slide gates shall conform to the requirements of the standards designated for each material indicated below:

Description	Material Standards
Slide	Aluminum, ASTM B 209
Frame	Aluminum ASTM B 308 Alloy 6061-T6
Stem & Coupling	ASTM A 276, Type 316
Hardware	ASTM A 276, Type 316
Stem Cover	Aluminum pipe with slots and indicator
Guides and Seats	UHMW Polyethylene, ASTM D 4020
Seals	"J" bulb Type, Neoprene, ASTM D 2000. Flat seals are not acceptable.

B. Lifting Devices: Lifting devices shall be provided complete with stem, lifting nut, intermediate supports with steady bushings; stem cover, indicator, gear reducer, hand wheel, crank, electric or hydraulic cylinder, where indicated. Power lifting devices shall be in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.

1. Lifting devices shall be weatherproof and shall be mounted on cast iron or fabricated steel pedestals. The pedestals shall have an ample base or bracket area to evenly distribute the load to the supporting concrete structure.

2. The center line of the manual actuator shall be approximately 3-feet above the base for pedestal mounted, and approximately 4-feet above the floor for frame mounted actuator. Slide gate hoist heads shall be cast iron.

3. The operating nut shall be of solid bronze, ASTM B 584. Operating thrust shall be taken on roller or ball bearings. All parts shall be provided with an alternate lubrication system.

4. The unit shall be designed for a maximum of 40 lbs. effort on the crank to operate the gate. Clockwise movement of the handwheel shall close the gate. The operating crank shall be easily removable to facilitate the use of a portable power operator.

C. Manufacturers, or Equal

1. Rodney Hunt Company

2. Hydro Gate Corp.

3. Washington Aluminum Company, Inc. (WACO)

4. Waterman Industries, Inc.

5. Golden Harvest

2.3 ALUMINUM STOP GATES

A. Construction: Wall mounted, hand lift stop gates with handles shall be fabricated of 1/4-inch aluminum as indicated and shall be reinforced as necessary to assure long life under the indicated operating conditions. Calculations, and detail drawings, as necessary, shall show the method of fabrication and verify that the plates will withstand any normal pressures or forces exerted without buckling or otherwise being damaged.

1. Stop gates shall be provided with Ultra High Molecular Weight (UHMW) polyethylene seals on sides and neoprene seal on floor.

2. Mounting hardware, if required, shall be of Type 316 stainless steel.

B. Manufacturers, or Equal

1. F. B. Leopold Co. (Division of Sybron Corp.)

2. Washington Aluminum Co., Inc.

3. Waterman Industries, Inc.

4. Golden Harvest

PART 3 - EXECUTION

3.1 INSTALLATION

A. Slide/stop gates shall be installed in strict accordance with Manufacturer’s Instructions.

END OF SECTION 40 05 59.21

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SECTION 40 05 61 - GATE VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide gate valves and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Provide shop drawings per Section 01 33 00 – Submittal Procedures and Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 GENERAL

A. All buried valves shall be of the inside screw, non-rising stem type. The valve actuators shall be as indicated, with counter-clockwise opening stems, in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.

2.2 RESILIENT-SEATED GATE VALVES (2-INCH AND LARGER)

A. Construction: Resilient-seated gate valves for water and sewage service shall conform to ANSI/AWWA C515 – Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service. The valve bodies shall be of cast iron conforming to ASTM A 126 - Specifications for Gray Iron Castings for Valves, Flanges, and Pipe Fittings, or ductile iron conforming either to ASTM A 395 - Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures, or to ASTM A 536 - Specification for Ductile Iron Castings, with flanged, bell and spigot, or mechanical joint-ends as indicated.

1. The wedge shall be ductile iron or bronze encapsulated with EDPM rubber.

B. Body and bonnet wall thickness shall be equal to or greater than the minimum wall thickness as listed in Table 2 of ANSI/AWWA C500. The design working water pressure shall be 250 psig. For sewage or fluids containing solids, an outside thread shall be used.

C. The gate valve stem and wedge nut shall be copper alloy in accordance with Section 4.4.5.1 of the AWWA C515 Standard. The stem shall have an integral thrust collar.

D. Valves shall be certified NSF to Standard 61.

E. The operating nut shall be constructed of ductile iron and shall have four flats at stem connection.

F. Stem shall be sealed by three O-Rings.

G. All internal and external surfaces of the valve body and bonnet shall have a fusion-bonded epoxy coating, complying with ANSI/AWWA C550, applied electrostatically prior to assembly.

2.3 ACTUATORS

A. Unless otherwise indicated, all gate valves shall have manual actuators in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.

2.4 MANUFACTURERS, OR EQUAL

A. American Flow Control;

B. Clow Valve Co.;

C. Crane Valves;

D. Kennedy Valve;

E. M & H Valve Company.

2.5 GATE VALVES (SMALLER THAN 2-INCH)

A. Construction: Gate valves, smaller than 2-inch, for general purpose use, shall be non- rising stem, heavy-duty type for industrial service, with screwed or soldered ends to match the piping. The bodies shall have union bonnets of bronze conforming to ASTM B 62 - Specification for Composition Bronze or Ounce Metal Castings. The stems shall be of bronze conforming to ASTM B 62, or ASTM B 371 - Specification for Copper-Zinc-Silicon Alloy Rod. The solid wedges shall be of bronze conforming to ASTM B 62. The valves shall have malleable iron handwheels, unless otherwise indicated, and stem seals shall be of Teflon-impregnated or other acceptable non-asbestos packing. All valves shall have a pressure rating of minimum 125 psi steam, and 200 psi coldwater, unless otherwise indicated.

B. Manufacturers, or Equal:

1. Crane Company;

2. Milwaukee Valve Company;

3. Wm. Powell Company;

4. Stockham Valves and Fittings;

5. Walworth Company.

PART 3 - EXECUTION

3.1 GENERAL

A. All gate valves shall be installed in accordance with the provisions of Section 40 05 51 – Valves, General. Care shall be taken that all valves in plastic lines are well supported at each end of the valve.

END OF SECTION 40 05 61

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SECTION 40 05 62 - PLUG VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide plug valves and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A. ASTM A 126 Gray Iron Castings for Valves

B. ASTM A 536 Ductile Iron Castings

1.3 SUBMITTALS

A. The Contractor shall furnish submittals in accordance with Section 40 05 51 – Valves, General.

B. Contractor shall indicate actuator position for each valve in submittal. Valves installed in horizontal piping shall have the plug swing upward when opening, no exceptions.

PART 2 - PRODUCTS

2.1 ECCENTRIC PLUG VALVES (1/2 INCH TO 72-INCH)

A. Construction: Eccentric plug valves shall be of the non-lubricated, eccentric plug design with cast iron bodies conforming to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with ANSI 125 lb. flanged ends for valves 3-inch and larger, and screwed or flanged ends for smaller sizes.

1. The plugs and shafts shall be of cast iron or ductile iron conforming to ASTM A 536 - Ductile Iron Castings, and the plugs shall be lined with a resilient coating, best suited for the specific service.

2. The body shall be lined with a suitable elastomer, where required for a special service, or it shall be epoxy-lined in accordance with Section 09 90 00 – Painting and Coating.

3. The seats shall be of nickel or stainless steel welded to the body.

4. All top and bottom shaft bearings shall be of permanently lubricated stainless steel or Teflon coated stainless steel.

5. Grit seals of Teflon, Nylatron, or similar suitable material shall be at the top and bottom plug journals.

6. Valves shall have an unobstructed port area of 100 percent of full pipe area.

7. All eccentric plug valves shall have a pressure rating of not less than 150 psi WOG, for bubble-tight shut-off in the standard flow direction, and 25 psi WOG in the reverse flow direction.

8. When equipped with worm gear actuator, the pressure rating shall be 150 psi WOG in both directions.

9. The stem seal shall consist of field adjustable packing, replaceable without removal of the actuator, or of self-adjusting U-cup packing.

2.2 ACTUATORS

A. Unless otherwise indicated, eccentric plug valves 3-inch and smaller shall have operating levers; larger valves shall have worm-gear actuators. Valve actuators shall be in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.

B. Contractor shall coordinate actuator position for ease of operation by Owner and to ensure plug shall swing upward when installed in horizontal piping.

2.3 MANUFACTURERS, OR EQUAL

A. DeZurik Corporation

B. Clow Valve Company

C. Pratt Valve

D. Val-Matic

PART 3 - EXECUTION

3.1 INSTALLATION

A. Plug valves shall be installed in strict accordance with the manufacturer's published recommendations and the applicable provisions of Section 40 05 51 – Valves, General.

B. Unless otherwise directed, the following rules shall be observed for the installation of eccentric plug valves on sewage, sludge, or other liquid systems containing solids, silt, or fine sand:

1. The valves shall be positioned with the stem in the horizontal direction.

2. In horizontal pipelines, the plug shall swing upwards when opening, to permit flushing out of solids. Coordinate location of valve actuator so plug swings upward prior to ordering valves.

3. The orientation of the valve shall prevent the valve body from filling up with solids when closed; however, where the pressure differential through the valve exceeds 25 psi, the higher pressure for valves without worm gear, electric, or air operators shall be through the valve to force the plug against the seat.

4. Valves which may be closed for extended periods (stand-by, bypass, or drain lines) and valves with reversed flow (higher pressure on downstream side, forcing the plug away from its seat), shall be equipped with worm gear operators for all sizes.

5. For special applications or when in doubt, consult with the manufacturer prior to installation.

END OF SECTION 40 05 62

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SECTION 40 05 63 - BALL VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide ball valves and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. The Contractor shall furnish submittals in accordance with Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 METAL BALL VALVES (4-INCH AND SMALLER)

A. Unless otherwise indicated, general purpose metal ball valves in sizes up to 4-inch shall have actuators in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.

B. Body: Ball valves up to 1-1/2-inch (incl.) in size shall have bronze or carbon steel 2-or 3-piece bodies with screwed ends for a pressure rating of not less than 600 psi WOG. Valves 2-inch to 4-inch in size shall have bronze or carbon steel 2-or 3-piece bodies with flanged ends for a pressure rating of ANSI 125 psi or 250 psi unless otherwise indicated.

C. Balls: The balls shall be solid chrome plated brass or bronze, or stainless steel, with standard port (single reduction) or full port openings.

D. Stems: The valve stems shall be of the blow-out proof design, of bronze, stainless steel, or other acceptable construction, with reinforced Teflon seal.

E. Seats: The valve seats shall be of Teflon or Buna-N, for bi-directional service and easy replacement.

F. Manufacturers, or equal

1. Conbraco Industries, Inc. (Apollo)

2. ITT Engineered Valves

3. Neles-Jamesbury, Inc.

4. Watts Regulator

5. Worcester Controls

2.2 STAINLESS STEEL BALL VALVES (1/4" – 3")

A. Stainless steel ball valves shall be 2-piece, full port with blowout proof stem to be installed as indicated on the drawings.

B. Valves shall have an adjustable stem packing, reinforced PTFE seals, PTFE stem packing, thrust washer and body seal.

C. Valves shall be rated for 1000 psi WOG, non-shock and shall conform to MSS-SP-110.

D. Provide latch lock handle to lock in open or close position. Provide vinyl insulator on heavy duty 304 SS handles.

E. Stem, threaded pack gland, body, and ball shall be constructed of Type 316 SS.

F. Ball valves shall be Watts, Nibco, Milwaukee Valve or equal.

2.3 PLASTIC BALL VALVES

A. Plastic ball valves for corrosive fluids shall be made of polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), polypropylene (PP), or polyvinylidene fluoride (PVDF), as recommended by the Manufacturer for the specific application. Valves shall have manual actuators in accordance with Section 40 05 57 – Actuators for Process Valves and Gates, unless otherwise indicated.

B. Construction: Plastic ball valves shall have union ends or flanged ends to mate with ANSI B 16.5, class 150 flanges, for easy removal. The balls shall have full size ports and Teflon seats. Body seals, union o-ring seals, and stem seals shall be in accordance with the corrosion resistance requirements of respective valve manufacturer. External (without entering into the wetted area) seat packing adjustment is preferred. Metal reinforced stems to prevent accidental breakage are preferred. The valves shall be suitable for a maximum Working non-shock pressure of 150 psi at 73 degrees F for PVC and CPVC, with decreasing ratings for higher temperatures and other plastics.

C. Manufacturers, or equal

1. ASAHI-America
2. George Fischer, Inc.
3. Plast-O-Matic Valves, Inc.
4. Spears Mfg. Co.

PART 3 - EXECUTION

3.1 GENERAL

A. Valves shall be installed in accordance with Section 40 05 51 – Valves, General. Care shall be taken that valves in plastic lines are well supported at each end of the valve.

END OF SECTION 40 05 63

SECTION 40 05 64 - BUTTERFLY VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials, and equipment as required to furnish and install butterfly valves with manual, electric or pneumatic actuators as indicated on the Plans and in accordance with these specifications.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

1.	ANSI/AWWA C504	Rubber-Seated Butterfly Valves.
2.	ANSI/AWWA C540	Power Actuating Devices for Valves and Sluice Gates
3.	ANSI/AWWA C550	Protective Epoxy Interior Coatings for Valves and Hydrants
4.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
5.	ANSI B16.5	Pipe Flanges and Flanged Fittings
6.	ASTM A48	Specifications for Gray Iron Castings
7.	ASTM A126	Gray Iron Castings for Valves, Flanges and Pipe Fittings
8.	STM A276	Specifications for Stainless and Heat-Resisting Steel Bars and Shapes
9.	ASTM A436	Austenitic, Gray Iron Castings
10.	ASTM A536	Ductile Iron Castings
11.	MSS SP67	Butterfly Valves

1.3 SUBMITTALS

A. Provide shop drawings per Section 01 33 00 – Submittal Procedures and Section 40 05 51 – Valves, General including:

1. Complete Shop Drawings of butterfly valves and actuators.

2. Drawings showing valve port diameter complete with dimensions, part numbers and materials of construction.

3. Certification of proof-of-design test form the valve manufacturer.

4. If automatically actuated, provide actuator information in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.

5. For above grade installations, provide literature regarding valve position indicators and installation information to indicate if valves must be installed in the upright position. If valve must be installed in upright position, provide modified valve position indicator that can be seen from the floor when opening or closing the valve.

1.4 QUALITY ASSURANCE

A. Valves shall be subjected to performance, leakage, and hydrostatic test in accordance with procedures and acceptance criteria established by AWWA C504.

PART 2 - PRODUCTS

2.1 GENERAL

A. Butterfly valves shall comply with the requirements of Section 40 05 51 – Valves, General.

2.2 BUTTERFLY VALVES FOR GENERAL PURPOSE SERVICE

A. Valves shall be certified to NSF Standard 61.

B. Butterfly valves shall be rubber seated butterfly valves that conform to AWWA C504, rated for water working pressures up to 150 psig, subject to the following requirements. Butterfly valves for general purpose service shall be rubber seated butterfly valves that conform to AWWA C504, rated for water working pressures up to 150 psig, subject to the following requirements. Valves shall be of the size and class indicated, suitable for bubble tight shut-off service as well as throttling service at rated pressure at ambient temperatures of 33 to 125 degrees F.

C. Body: The valve body shall be of cast iron conforming to ASTM A126 - Specifications for Gray Iron Castings for Valves, Flanges and Pipe Fittings, Class B, with either wafer, lug, or flanged design as indicated in drawings, drilled to ANSI B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 125. The entire body shall be factory coated with an epoxy coating system in accordance with AWWA C550.

D. Disc: The disc shall be a ductile iron conforming to ASTM A536, with factory applied epoxy coating in accordance with AWWA C550. The disc shall have no holes drilled into it for securing the disc to the stem with pins, screws, or any other such hardware. If the disc design is such that securing hardware is required then the disc and securing hardware shall both be Type 316 stainless steel.

E. Seat: The valve seat shall be Ethylene-Propylene-Diene Monomer (EPDM) or Buna N and shall be bonded or vulcanized to the valve body.

F. Stem: The valve stem shall be a Type 316 stainless steel ASTM A276, with keyed slots on the stem to make with receiving slots on the inner part of the disc requiring no disc screws or pins for connection of the stem to the disc. If connecting pins or screws are required for a particular manufacturer's design, then the disc as well as the connecting hardware shall be type 316 stainless steel.

G. Stem Bushing: The stem bushing shall be a non-corrosive, heavy duty acetal bushing.

H. Stem Seal: The stem shall be a double "U" cup seal or O-ring designed which is self-adjusting and provides positive sealing in both directions, and is suitable for the service condition.

I. Flange/Style: Unless otherwise specified or noted on the drawings, the style of each butterfly valve shall be flanged in above grade applications and mechanical joint in buried applications. The Contractor shall not use any type of raised face type PVC flange on either side of any butterfly valve. Contractor shall be responsible to ensure that the selected butterfly valve will fully open and close without any physical interference at all.

J. Testing: Valves shall be factory leak tested in accordance with AWWA C504.

K. Manufacturers or equal:

1. DeZurik Water Controls

2. Henry Pratt Company

3. Val-matic

2.3 BUTTERFLY VALVES FOR AIR SERVICE

A. General: Butterfly valves for air service shall be specifically designed for this service and meet or exceed the design, strength, performance, and testing standards of AWWA C504. They shall be suitable for pressures from vacuum to 125 psi and temperatures from minus 40 degrees F to 300 degrees F.

B. Body: The valve body shall be of cast iron conforming to ASTM A126, Class B, with lug or flanged design as indicated, drilled to ANSI B16.1, Class 25, 125, 250, and 800, Class 125.

C. Disc: The disc shall be cast iron conforming to ASTM A126 with a nylon coating, bronze, or Type 316 stainless steel. The disc shall be designed with the air- profile or other suitable shape. Sprayed or plated disc edges are not acceptable.

D. Seat: The elastomer seat shall be in the body. It shall be field-replaceable without special tools. The seat material shall be EPDM to provide a tight shut-off at the temperatures above.

E. Shaft: The valve shaft shall be of Type 316 or 304 stainless steel, with sufficient strength to allow for the increased torque for air service.

F. Bearings: Shaft bearings shall be of the self-lubricating corrosion resistant sleeve type.

G. Packing: The packing shall be of the adjustable or self-adjustable (a-ring) type, suitable for the temperature and service conditions.

H. Manufacturers, or Equal:

1. DeZurik water Controls

2. Henry Pratt Company

3. Bray

2.4 ACTUATORS

A. Manual Actuators: Actuators shall conform to Section 40 05 57 – Actuators for Process Valves and Gates and to ANSI / AWWA C540 - Power Actuating Devices for Valves and Sluice Gates, subject to the following requirements. Unless otherwise indicated, all manually-actuated butterfly valves of 6 inch diameter and larger shall be equipped with a handwheel and 2-inch square actuating nut and position indicator. Manual lever type actuators shall allow for positive throttling and have at minimum 10 stop positions from open to close for positive locking of the valve. The manual lever type actuators as well as handwheel actuators shall have an epoxy coating per Section 09 90 00 – Painting and Coating.

B. Electric Actuators: Where indicated on Plans, provide electric actuators that meet the requirements of AWWA C 540 and are in accordance with Section 40 05 57 – Actuators for Process Valves and Gates. The maximum torque for the valve shall be input into the actuator program to be the maximum torque applied by the actuator.

2.5 PAINTING AND COATINGS

A. All valves inside of hydraulic structures shall be provided with a high build epoxy coating system, per specifications Section 09 90 00 – Painting and Coating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation, inspect interconnecting piping and end connections to ensure compatibility.

B. Prior to installation, inspect and verify condition of valve and appurtenances.

C. Ensure exposed piping is sufficiently supported to bear weight of valve when it is installed.

3.2 PRODUCT HANDLING

A. Protect valves and components against dirt and damage during shipment and storage.

B. Handle valves to prevent damage or contamination.

3.3 INSTALLATION

A. Install all valves in accordance with manufacturer's recommendations and with Section 40 05 51 – Valves, General.

END OF SECTION 40 05 64

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SECTION 40 05 65.23 – CHECK VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide swing check valves and ball check valves and appurtenances, complete and operable, in accordance with the Contract Documents where required.

1.2 REFERENCE STANDARDS

A.	ANSI/AWWA C 508	Swing-Check Valves for Waterworks Service, 2 in. through 24 in.
B.	ASTM A 126	Gray Iron Casting for Valves, Flanges, and Pipe Fittings;
C.	ANSI/ASME B 16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 300;
D.	ASTM B 584	Copper Alloy Sand Castings for General Applications
E.	ASTM B 584 or B 148	Aluminum-Bronze Castings, or of Buna-N;
F.	ASTM B 763	Copper Alloy Sand Castings for Valve Application, or
G.	ANSI/ASME B1.20.1	Pipe Threads, General Purpose (inch);
H.	ASTM B 16	Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines.

1.3 SUBMITTALS

A. The Contractor shall furnish submittals in accordance with Section 40 05 51 – Valves, General and Section 01 33 00 – Submittal Procedures.

PART 2 - PRODUCTS

2.1 SWING CHECK VALVES (3-INCH AND LARGER)

A. Valves shall be certified to NSF Standard 61 if used in potable water

B. General: If not specified otherwise, swing check valves for water, sewage, sludge, and general service shall be of the outside lever and spring or weight type, in accordance with ANSI/AWWA C 508 - Swing-Check Valves for Waterworks Service, 2 in. through 24 in. NPS. Valves shall have full-opening passages, designed for a water-working pressure of 150 psi. They shall have a flanged cover piece to provide access to the disc.

C. Body: The valve body and cover shall be of ductile iron conforming to ASTM A 536 – Ductile Iron Castings for Valves, Flanges, and Pipe Fittings, with flanged ends conforming to ANSI/ASME B 16.1 - Ductile Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800, or mechanical joint ends, as indicated.

D. Disc: The valve disc shall be of ductile iron, or bronze conforming to ASTM B 584 - Copper Alloy Sand Castings for General Applications.

E. Seat and Rings: The valve seat and rings shall be of stainless steel T304 or T316 Type.

F. Lining & Coating: The valve shall be lined and coated with NSF 61 Fusion Bonded Epoxy.

G. Hinge Pin: The hinge pin shall be of bronze or stainless steel.

H. Manufacturers, or equal

1. Val-Matic, 7800LW Series

2. American Flow Control (Darling)

3. APCO (Valve and Primer Corp.)

4. Kennedy Valve

5. Mueller Company

6. Crane Valves and Fittings

2.2 SWING CHECK VALVES (2-1/2-INCH AND SMALLER)

A. Swing check valves for steam, water, oil, or gas in sizes 2-1/2 inch and smaller shall be suitable for a steam pressure of 150 psi and a cold-water pressure of 300 psi. They shall have screwed ends unless otherwise indicated, and screwed caps.

B. Body: The valve body and cap shall be of bronze conforming to ASTM B 763 - Copper Alloy Sand Castings for Valve Application, or ASTM B 584 with threaded ends conforming to ANSI/ASME B1.20.1 - Pipe Threads, General Purpose (inch).

C. Disc: Valves for steam service shall have bronze or brass discs conforming to ASTM B 16 - Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines, and for cold water, oil, and gas service replaceable composition discs.

D. Hinge Pin: The hinge pins shall be of bronze or stainless steel.

E. Manufacturers, or equal

1. Crane Company

2. Milwaukee Valve Company

3. Stockham Valves and Fittings

4. Wm. Powell Company

2.3 BALL CHECK VALVES

A. Provide ball check valve where called out on drawings in vertical piping only.

B. Body, cover, and hardware shall be Type 316 stainless steel. Ball shall be phenolic material with Buna N o-ring and seal or equivalent.

C. Provide Flomatic Ball Check Valve or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Valves shall be installed in accordance with provisions of Section 40 05 51 – Valves, General.

END OF SECTION 40 05 65.23

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SECTION 40 05 65.29 – DOUBLE-DISK CHECK VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide double-disk check valves and appurtenances, complete and operable, for process air piping in accordance with the Contract Documents..

1.2 REFERENCE STANDARDS

A.	ANSI/AWWA C 508	Swing-Check Valves for Waterworks Service, 2 in. through 24 in.
B.	ASTM A 126	Gray Iron Casting for Valves, Flanges, and Pipe Fittings;
C.	ANSI/ASME B 16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 300;
D.	ASTM B 584	Copper Alloy Sand Castings for General Applications
E.	ASTM B 584 or B 148	Aluminum-Bronze Castings, or of Buna-N;
F.	ASTM B 763	Copper Alloy Sand Castings for Valve Application, or
G.	ANSI/ASME B1.20.1	Pipe Threads, General Purpose (inch);
H.	ASTM B 16	Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines.

1.3 SUBMITTALS

A. The Contractor shall furnish submittals in accordance with Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 DOUBLE-DISK CHECK VALVES

A. Double-disk check valves for air and gas service and where indicated, shall be of the wafer-type designed to fit between ANSI B16.1 flanges for 125-lb rating. The check valve leaves shall be spring-loaded. Flow from one direction shall cause the valve to open, and upon valve shutoff, the spring shall shut the valve leaves before reverse flow starts, acting at a point of zero velocity, for non-slam closure. The spring-tension of each valve shall be designed for the individual operating condition.

B. Body: The valve body shall be of cast iron conforming to ASTM A 126 with integrally-cast seat, rated for minimum 150-lb. working pressure at up to 250 degrees F.

C. Leaves: The leaves shall be of bronze, aluminum bronze, or ductile iron, revolving on stainless steel or Monel hinge pins with retainers.

D. Seat: The valves shall have resilient seats for bubble-tight shut-off, suitable for temperatures up to 300 degrees F without sticking. The seats shall be Viton or other suitable material for the intended purpose. The seat rings shall be firmly attached to a shoulder cast in the body or to the disc by compression-molding or similar acceptable method.

E. Springs: The springs shall be of Type 316 stainless steel or Inconel, as best suited for the service condition.

F. Manufacturers, or equal:

1. APCO (Valve and Primer Corporation)

2. Proquip International

3. VAL-MATIC (Valve and Manufacturing Corporation)

PART 3 - EXECUTION

3.1 GENERAL

A. Valves shall be installed in accordance with provisions of Section 40 05 51 – Valves, General.

END OF SECTION 40 05 65.29

SECTION 40 05 71.13 – DUCKBILL CHECK VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide duckbill check valves and appurtenances, complete and operable, in accordance with the Contract Documents where required.

1.2 SUBMITTALS

A. The Contractor shall furnish submittals in accordance with Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 DUCKBILL ELASTOMERIC CHECK VALVES

A. Check valves shall be an all rubber flow operated check type with a flanged connection. The port area shall contour down to a duckbill, which shall allow passage of flow in one direction while preventing reverse flow. The valve shall be one piece rubber construction with nylon reinforcement. Rubber shall be Buna-N or EPDM. Provide Type 316 stainless steel hardware.

B. Check valve shall prevent backflow into the valve vault and shall open with minimal headloss to drain the valve vault.

C. Manufacturer name, plant location, valve size and serial number shall be bonded to the check valve. A single manufacturer shall provide all elastomer duckbill check valves.

2.2 FUNCTION

A. When line pressure inside the valve exceeds the backpressure outside the valve, the line pressure forces the bill of the valve open, allowing flow to pass. When backpressure exceeds the line pressure, the bill of the valve shall be forced closed.

2.3 MANUFACTURER OR EQUAL

A. Tideflex Technologies (Series 35)

B. General Rubber Corporation (Flex-Valve)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Valves shall be installed in accordance with provisions of Section 40 05 51 – Valves, General.

B. Installation of check valve shall be in accordance with Manufacturer's written Installation and Operation Manual and approved submittals.

3.2 MANUFACTURER'S CUSTOMER SERVICE

A. Manufacturer's authorized representative shall be available for customer service during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valve.

END OF SECTION 40 05 71.13

SECTION 40 05 78.11 – AIR RELEASE VALVES FOR WATER AND WASTEWATER SERVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide air-release, air/vacuum, combination air valves, and appurtenances, complete and operable in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

1. AWWA C512 Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures and Section 40 05 51 – Valves, General.

B. Technical Manual: Furnish operation and maintenance information in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

A. Comply with quality assurance requirements listed in Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 GENERAL

A. All valves specified in this Section shall meet the applicable requirements of Section 40 05 51 – Valves, General.

2.2 AIR-VACUUM AND AIR RELEASE VALVES

A. Air Vacuum Valves: Air/vacuum valves shall be designed to allow large quantities of air to escape out the orifice when filling a pipeline and to close when the liquid enters the valve. The Air/Vacuum Valve shall also permit large quantities of air to enter through the orifice when the pipeline is being drained to break the vacuum. The discharge orifice area shall be equal or greater than the inlet of the valve. The baffle will be designed to protect the float from direct contact of the rushing air and water to prevent the float from closing prematurely. The seat shall be fastened into the valve cover without distortion and shall be easily removed. The float shall be center guided into the seat. The valves shall be of the size indicated, with flanged or screwed ends to match piping. Bodies shall be of high-strength cast iron. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel.

Seat washers and gaskets shall be of a material insuring water tightness with a minimum of maintenance. Valves shall be designed for minimum 150 psi water-working pressure, unless otherwise indicated. The valves shall be suitable for operation with wastewater.

B. Air Release Valves: Air release valves shall be hydro-mechanical devices that automatically vent small pockets of air as they accumulate at high points in a system while the system is operating and pressurized. Valves shall be installed at high points within pressurized mechanical and yard piping systems. Valves shall be designed for a minimum water-working pressure of 150 psi, unless otherwise indicated. The valves shall be suitable for operation with wastewater.

C. Combination Air Valves: Combination air valves (Air/vacuum and Air Release Valves (AVAR)) shall combine the characteristics of air and vacuum valves and air release valves by exhausting accumulated air in systems being filled; or re-admitting large quantities of air while a system is being drained; and venting accumulating, small pockets of air while the system is in service and under pressure.

D. Sewage Air Valves: The same general requirements shall apply as specified for air and vacuum valves. They shall have long float stems and bodies to minimize clogging. Each sewage air valve shall be furnished with the following backwash accessories, fully assembled on the valve:

1. Inlet shut-off valve.

2. Blow-off valve.

3. Clear water inlet valve.

4. Rubber supply hose.

5. Quick connect couplings.

E. Materials of Construction: Air vacuum and air release valves shall be constructed of the following materials:

No.	Item	Material
1	Body & Cover	Cast Iron, ASTM A126, Ductile Iron, ASTM A536 or Stainless Steel Type 316
2	Float	316 Stainless Steel, ASTM A240
3	Seat	Buna-N or EPDM
4	Baffle	316 Stainless Steel
5	Hardware	316 Stainless Steel

F. Manufacturers, or equal:

1. APCO

2. Val-Matic, Model 301A, 801A

3. Crispin

4. ARI

G. Size: Air vacuum and air release valves are to have a 2-inch inlet size unless called out otherwise in the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Valves shall be installed in accordance with the manufacturer's printed recommendations, and with provisions of Section 40 05 51 – Valves, General.

B. Air and vacuum release valves, shall have piped outlets to the nearest acceptable drain, firmly supported, and installed in such a way as to avoid splashing and wetting of floors and obstruction of traffic.

END OF SECTION 40 05 78.11

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SECTION 40 05 81.13 - FIRE HYDRANTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide fire hydrants, complete and operable, including all appurtenances and accessories, in accordance with the Contract Documents.

B. The requirements of Section 40 05 51 – Valves, General and Section 40 05 57 – Actuators for Process Valves and Gates apply to this section.

1.2 COMMERCIAL STANDARDS

A.	ANSI/AWWA C 502	Standard for Dry-Barrel Fire Hydrants
B.	ANSI/AWWA C 550	Protective Epoxy Interior Coatings for Valves and Hydrants

1.3 SUBMITTALS

A. The Contractor shall submit Manufacturer information for Engineer review in accordance with Section 01 33 00 – Submittal Procedures and Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 DRY-BARREL FIRE HYDRANTS

A. Construction: Unless otherwise shown, all hydrants shall be of the dry-barrel type according to ANSI/AWWA C 502, with a minimum of one 4-inch or 4-1/2-inch steamer connection, one 2-1/2-inch hose connection, and a 6-inch diameter inlet, except where otherwise required by the local fire department. The hose and steamer connections shall be provided with cast iron caps and metal chains. The barrel shall have a cast iron breakaway section above ground and a lower barrel of ductile iron, with an elbow or tee-section at the base. The stem shall have a breakaway coupling, or there shall be some other safety device in case of a fracture. Each hydrant shall be isolated by an individual, buried gate valve, with cast iron box and cover. All bolts, nuts, and washers shall be of Type 316 stainless steel, except where otherwise required for structural reasons. The hydrants shall be tested to 300 psig and they shall be suitable for a working pressure of 150 psig. All interior and exterior surfaces shall be coated in accordance with AWWA C 550 and Section 09 90 00 – Painting and Coating.

B. Manufacturers, or Equal

1. American Flow Control (Darling)

2. American Valve and Hydrant

3. Mueller

4. Clow – Medallion

PART 3 - EXECUTION

3.1 GENERAL

A. All fire hydrants shall be installed in strict accordance with the manufacturer's published recommendations, AWWA Standards, and all applicable codes, and the applicable provisions of Section 40 05 51 – Valves, General. All installations shall be to the satisfaction of the local fire and building department.

B. All hydrant isolating valves with slip joints, friction type, or caulked joint connections shall be harnessed to the main pipe by means: of welded steel harness sets, or clamps and steel rods, designed for this purpose. All hydrants with other than flanged inlets shall be installed with a concrete thrust block, calculated for the maximum expected water pressure. Dry-Barrel fire hydrants shall be set on a bed of pea gravel not less than 18-inches deep and 3-feet square, for drainage, or as required by local regulations and conditions. Provide geotextile around drain rock and overlap a minimum of 18-inches.

C. Place fire hydrants so that sidewalk flange is at least 2-inches above finished grade, but no more than 4-inches above finished grade.

D. Apply poly-fm grease to all buried metal surfaces and wrap with 8 mil thick polyethylene sheet and tape wrap prior to pouring concrete thrust blocks.

E. Paint the fire hydrants to meet the City Fire Department paint standards.

END OF SECTION 40 05 81.13

SECTION 40 05 82 – SOLENOID VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide miscellaneous valves, and appurtenances, complete and operable in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

1.	AWWA C511	Reduced-Pressure Principle Backflow Prevention Assembly
2.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
3.	C-510-97	Double Check Valve Backflow Prevention Assembly
4.	C-511-97	Reduced Pressure Principle Backflow Prevention Assembly
5.	NPFA 820	Standard for Fire Protection in Wastewater Treatment and Collection Facilities

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures and Section 40 05 51 – Valves, General.

B. Technical Manual: Furnish operation and maintenance information in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

A. Comply with quality assurance requirements listed in Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 GENERAL

A. All valves specified in this Section shall meet the applicable requirements of Section 40 05 51 – Valves, General.

B. All components that are in contact with potable water shall be certified to NSF Standard 61.

2.2 SOLENOID VALVES

A. All coil ratings shall be for continuous duty. For electrical characteristics see electrical drawings or specifications.

B. Explosion-proof valves shall be provided in Class 1, Division 1 or Class 1, Div 2 areas as required under NPFA 820 guidelines.

C. Solenoid valves shall be of the size, type, and class indicated and shall be designed for not less than 150 psi water-working pressure. Valves for water, air, or gas service shall have brass or bronze body with screwed ends, stainless steel trim and spring, Teflon or other resilient seals with material best suited for the temperature and fluid handled. Unless otherwise indicated, for chemicals and all corrosive fluids, solenoid valves with PVC, CPVC, polypropylene (PP), polyvinylidene fluoride (PVDF), or Teflon materials of construction, suitable for the specific application shall be provided. Enclosures shall be NEMA rated in accordance with the area designations.

D. Solenoid valves shall be pilot controlled and shall be water hammer free.

E. Solenoid valves shall fail in the closed position unless otherwise indicated on the project drawings.

F. Where solenoid valves are a part of a packaged equipment system, those solenoids valves shall be specified and provided by the equipment manufacturer.

G. Manufacturers, or Equal:

1. For general duty
    a. Automatic Switch Co. (ASCO), Model "RED HAT"
    b. Skinner Valve (Parker Hannifin Corporation)
    c. Magnatrol Valve Corporation
    d. J. D. Gould Co.
2. Metallic valves for corrosive fluids
    a. Valcor Engineering Corporation
3. Plastic valves for corrosive fluids
    a. GF Plastic Systems, Inc.
    b. Spears Mfg. Co.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Valves shall be installed in accordance with the manufacturer's printed recommendations, and with provisions of Section 40 05 51 – Valves, General.

B. After installation is complete, the solenoid valve shall be tested for proper operation.

END OF SECTION 40 05 82

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SECTION 40 05 93 – COMMON MOTOR REQUIREMENTS FOR PROCESS EQUIPMENT

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall provide electrical motors, accessories, and appurtenances complete and operable, in conformance with the individual driven equipment specifications and the Contract Documents.

B. The provision in this Section apply to all low voltage AC squirrel cage induction motors except as indicated otherwise.

C. All motors shown on the Drawings or specified in other divisions of the specifications shall in general, be furnished with the driven equipment and connected under Division 26 of the Specification.

D. If motors are specified in other divisions of the Specification, then in the event of conflicts, the more restrictive specification shall apply.

E. The Contractor shall assign to the equipment supplier the responsibility to select suitable electric motors for the equipment. The choice of motor manufacturer shall be subject to review by the Engineer. Such review will consider future availability of replacement parts and compatibility with driven equipment.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Motors shall be designed, built, and tested in accordance with the latest revision of the following standard documents. In the case of conflict between the requirements of this Section and those of the standard documents, the requirements of this Section shall prevail.

1.	NEMA MG 1	Motors and Generators
2.	ANSI/IEEE 112	Test Procedures for Polyphase Induction Motors and Generators
3.	UL l004	Motors, Electric

1.3 CONTRACTOR SUBMITTALS

A. Refer to Section 01 33 00 – Submittal Procedures and individual equipment specification requirements.

B. Submit the motor manufacturer's certification of bearing life on motors where application conditions suggest significant belt drive or thrust loads.

C. A Motor Data form (sample Form follows section) shall be submitted for each and every motor furnished under this Contract.

D. Motor outline, dimensions, and weight.

E. Manufacturer's descriptive information relative to specified features.

F. Motor Performance Characteristics:

1. Guaranteed minimum efficiency at rated load at rated voltage.

2. Guaranteed minimum power factor at rated load at rated voltage.

3. Expected efficiency at 1/2, 3/4, and full load at rated voltage.

4. Expected power factor at 1/2, 3/4, and full load at rated voltage.

5. Motor no-load current at rated voltage.

6. Full load current at rated voltage.

7. Full load current at 110 percent voltage.

8. Starting current at rated voltage.

9. Full load speed.

10. Certified copy of test report for identical motor tested in accordance with NEMA MG 1-12.53a and IEEE Standard 112, Test Method B, showing full load efficiency and power factor not less than specified value. Motors not as specified will be rejected.

G. Vertical Motor Data:

1. Thrust bearing life

2. Type of thrust bearing lubrication.

3. Type of guide bearing lubrication.

H. Operation and Maintenance Manuals in accordance with Section 01 78 23 (provided before or during training of treatment plant staff), including:

1. Complete information for storage and installation.

2. Complete operating and maintenance instructions.

3. Bill of Materials.

1.4 EQUIPMENT GUARANTEE

A. Guarantees shall cover:

1. Faulty or inadequate design.

2. Improper assembly or erection.

3. Breakage, or other failure.

4. Defective workmanship or materials

1.5 FACTORY TESTS

A. Provide factory test and test reports as listed below for all polyphase motors. For motors 7 1/2 hp and above, provide test reports for the actual motor being supplied. For motors under 7 1/2 hp, test reports of an identical motor may be provided. Perform all tests in accordance with the Procedures for Polyphase Induction Motors and Generators No. 112A and NEMA MG 1.

B. Measurements of no-load current and speed at nominal voltage and frequency

1. Measurement of locked rotor current at rated frequency.

2. Results of high-potential test.

3. Determination of efficiency and power factor at 1/2 load, 3/4 load, full-load, and service factor load.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide squirrel-cage induction motors unless otherwise noted.

B. Electric motors driving identical machines shall be identical.

C. Coordination: Provide motors especially suitable both electrically and mechanically to drive the loads specified. The speed, horsepower, torque base, bearing, shaft, insulation and enclosure shall be closely coordinated with this specification so as to provide a satisfactory, efficient drive without overloading, overheating, abnormal noise or vibration. The BHP required of the driven equipment under the most severe operating conditions for the equipment served shall not exceed the rated nameplate horsepower of the motor when operating at its rated service factor, nor shall it exceed the rated nameplate horsepower of the motor when operated at specified conditions at a service factor of 1.0. The "most severe operating conditions" shall include the full possible range of normal operating conditions but shall not include unusual conditions such as equipment failure.

D. Standards: All motors shall be in accordance with NEMA-MG 1 "T" Line, IEEE and ANSI latest revision insofar as they are applicable.

E. Service Conditions: Provide motors designed and built for long, trouble-free life in industrial service capable of operating successfully under the following application conditions:

1. 40°C maximum ambient temperature to -20 degrees Celsius minimum ambient temperature.

2. Altitude at the facility site shall be verified.

3. Voltage variations to + 10 percent of nameplate rating.

4. Frequency variations to + 5 percent of nameplate rating.

5. Multiple speed motors suitable for use with multiple speed starter furnished.

6. Inverter duty motors suitable for use with variable frequency drives, if furnished.

F. Operating Characteristics: All motors shall be rated for full-voltage starting, NEMA Design B, normal torque, normal starting current, unless otherwise required by the driven equipment or specified.

G. Installation Environment: Provide motors suitable for the environment in which they are to be installed. Where the installation environment is specified, provide motors suitable for the environment indicated and in conformance with the specification.

H. Exempt Motors: Motors for valve operators, submersible pumps, or motors which are integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven element, or part of domestic or commercial uses apparatus may be exempted from these specifications to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

2.2 ENCLOSURES

A. Horizontal: Drip proof NEMA Standard MG 1, unless otherwise specified. Provide screen over all air openings.

B. Vertical: Motors shall be weather protected Type 1 (WP-l) NEMA Standard MG 1, with inlet and outlet openings screened unless otherwise specified.

C. TEFC and TENV: Totally enclosed fan cooled (TEFC) where specified. Provide horizontal TEFC motors with condensate drain holes. Totally enclosed non- ventilated (TENV) may be substituted for TEFC at Contractor's option.

D. Cast iron or extruded aluminum or die cast aluminum stator frames and end shields, rigid construction.

E. Heavy fabricated steel, cast iron or aluminum frames for single phase motors.

2.3 ACCESSORY REQUIREMENTS

A. Motor Assembly: Provide NEMA conduit entrance box. Provide conduit entrance box size and drilling to conform to the conduit or wiring requirements indicated on the electrical drawings. Include motor leads and all accessory leads in a common conduit entrance box.

B. Motor Leads: Provide motor leads compatible with motor insulation systems, permanently identified.

C. Eyebolts: Provide drilling and tapping for eyebolts on all motors weighing more than 83 pounds.

D. Nameplates: Provide one or more engraved stainless steel stamped metal nameplates with the information required by NEMA-MGI-IO.38 and the following additional information:

1. Maximum ambient temperature for which motor is rated.

2. Class of insulation.

3. Service factor.

4. Bearing number.

5. Motor connection diagram if more than three leads.

6. Power rating in KW if driven equipment ratings are given in metric units.

E. Oil Lubricated Polyphase Motors: Provide lubricating oil reservoirs and sight gauges.

F. Painting: As specified in Section 43 05 01 – Equipment General Provisions.

G. Provide motor grounding lug suitable to terminate ground wire, sized as indicated.

2.4 INSULATION CLASS

A. Provide NEMA Class B insulation for all polyphase squirrel-cage induction motors, unless otherwise specified.

1. Provide additional anti-abrasion protection for non-enclosed motors, per NEMA MGl-l.27.

2. Provide additional moisture protection for enclosed motors, per NEMA MGl-20.48a.

B. Class F insulation with additional nonhygroscopic moisture protection as specified in paragraph 2.03A above may be utilized at the Contractor's option, however, the temperature rise as measured by resistance when operating at rated service factor and load shall conform to the limiting observable temperatures in NEMA-MGl, for class of insulation used.

C. Class A insulating materials shall not be utilized except in single-phase fractional horsepower motors or used in dry locations, with a standard reduction in rated temperature rise.

D. Encapsulation: Where specified. Provide insulating resin encapsulation by a molded or equivalent process in which the resin completely surrounds the conductors in the slots and end turns, leaving no voids between the conductors or adjacent stator steel. Allowable temperature rise shall not exceed the limits of NEMA-MGl.

E. Motors to be operated from adjustable frequency drives shall be provided with insulation systems to withstand 1600 volt spikes, with dV/dt as defined in NEMA MG 1-31 and shall be labeled as “Inverter Duty”.

2.5 SERVICE FACTOR

A. Provide the service factor indicated, or NEMA standard for the specified insulation and enclosure, whichever is greater. Minimum service factor shall be 1.15.

2.6 NEMA TYPE

A. Provide motors in accordance with standard NEMA type classifications as specified. The use of industry standard subclassifications such as "mill and Chemical" motors and similar" standard" heavy-duty designs are encouraged where they meet or exceed the specified minimum requirements.

2.7 POWER RATINGS

A. Motor horsepower or kw ratings, if indicated in the detailed equipment specifications, are minimum size acceptable.

B. Ratings indicated on the electrical drawings are for guidance only and do not limit the equipment size.

C. Frame/hp relationships shall conform to the latest NEMA standards for "T" or "U" frames and all dimensions shall meet NEMA standards.

2.8 STANDARD RATED VOLTAGE PHASE AND FREQUENCY

A. Provide motors nameplate-rated for 60 Hertz power supply as follows unless otherwise specified or shown on the drawings:

1. Motor less than 1/6 hp, single-phase, 115 volts.

2. Motors 1/6 hp through 1 hp, single phase, 115/230 volts.

3. Motors 1 hp and greater, three phase, 460 volts.

4. Multi-speed motors may have single voltage rating if manufacturer's standard.

B. Conform to the specified service conditions and the equipment specifications without reduction in the service factor.

2.9 BEARINGS AND SHAFTS

A. Motors greater than 2 HP shall have bearings designed for 17,500 hours (belted) or 100,000 hours (coupled) L-10 life.

B. Fractional Horsepower: Motors with fractional horsepower through 2 HP shall be provided with Lubricated-for-Life ball bearings.

C. Horizontal Motors Over 2 HP: Motors larger than 2 HP shall be provided with relubricatable ball bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

D. Vertical Motors Over 2 HP: Vertical motors larger than 2 HP shall be provided with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

E. Shafts: Shafts shall be in accordance with NEMA "T" or "TS" dimensions. Long shafts shall be suitable for belt, chain or gear drive within limits established by good industrial practice and documented by NEMA. Short shafts shall be used for direct connection. Vertical motors shall be the solid-shaft type except where application requires a hollow-shaft design.

F. Inverter Duty Motors: Motors to be used in VFD applications must have bearing protection from shaft currents. Provide AEGIS shaft grounding ring, ceramic bearings or equivalent means to prevent premature bearing failure due to shaft current discharge.

2.10 DUTY CYCLE

A. Provide motors rated for continuous duty unless otherwise specified. Short time rated motors may be provided where the application is well documented by NEMA, is usual industrial practice and the driven equipment and motor is a tested combination under the specified performance conditions.

2.11 LUBRICATION

A. Horizontal polyphase motors shall be grease lubricated. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent relubrication, but facilities shall be provided for adding new grease and draining out old grease without major motor disassembly. Motors 180T frame and smaller may utilize grease release fitting in lieu of grease drain plug. The bearing housing shall have long, tight, running fits or rotating seals to protect against the entrance of foreign matter into the bearings or leakage of grease out of the bearing cavity.

B. Vertical polyphase motor lubrication shall conform to the motor manufacturer's recommendations. Except as otherwise recommended, guide bearings shall be ball bearings, grease lubricated; thrust bearings shall be grease lubricated through frame 28OT, oil lubricated in larger frame sizes.

2.12 MOTOR THERMAL PROTECTION

A. Provide one heat-sensing detector per phase, embedded in the windings to provide even temperature protection on motors 75 hp or larger. Coordinate over-temperature protection system with motor starter overload relays.

B. Single Phase Motor: Single phase 120, 208, or 230 volt motor shall have integral thermal overload protection or shall be inherently current limited.

C. Thermostats: Winding thermostats shall be snap action, bi-metallic, temperature-actuated switch, and shall be factory mounted integral to the motors. Thermostats shall be provided with one normally closed contact. The thermostat switch point shall be precalibrated by the manufacturer.

2.13 HIGH EFFICIENCY MOTORS

A. All motors provided shall be high efficiency as specified below.

B. High efficiency motors shall have minimum and nominal efficiencies which meet or exceed the efficiencies specified below when tested in accordance with the latest version of IEEE Test Procedure 112A. Method B. using accuracy improvement by segregated loss determination including stray load loss improvement as specified in NEMA Standard MGl-12.S3A. latest revision. Minimum efficiencies shall be guaranteed in writing.

C. Single speed induction high efficiency motors, three-phase, NEMA Design B, 460V, continuous duty, 40°C ambient shall meet or exceed the efficiencies specified in the following table.

Energy Efficiency Horizontal					
		Percent Guaranteed Minimum Rated Load Efficiencies		Percent Guaranteed Minimum Rated Load Power Factor	
HP	Nominal Speed RPM	DP	TEFC	DP	TEFC
1	1,800	80.0	81.5	85.0	85.0
	1,200	78.5	79.3	74.0	74.0
1.5	3,600	79.3	81.5	86.0	86.0
	1,800	79.3	82.0	88.0	88.0
	1,200	82.5	84.0	69.5	69.5
2	3,600	82.0	84.0	88.0	88.0
	1,800	81.5	83.7	84.0	84.0
	1,200	85.5	85.5	69.0	69.0
	900	82.9	82.5	54.0	54.0
3	3,600	82.0	84.0	91.0	88.0
	1,800	84.8	86.5	79.0	79.5
	1,200	87.5	88.1	71.0	71.5
	900	84.1	82.9	62.0	62.5
5	3,600	84.8	86.5	87.0	91.5
	1,800	86.5	86.5	81.0	81.0
	1,200	87.5	88.1	75.5	75.5
	900	87.5	86.5	70.0	70.5
7.5	3,600	86.5	88.1	90.0	90.0
	1,800	89.3	89.5	86.5	86.5
	1,200	88.5	88.5	80.0	80.0
	900	87.5	86.5	72.0	72.0
10	3,600	89.3	89.5	90.0	90.0
	1,800	89.3	89.5	86.0	86.0
	1,200	89.5	89.5	80.5	81.0
	900	89.3	88.5	77.5	78.0

2.14 ACCEPTABLE MANUFACTURER

A. U.S. Motors

B. General Electric

C. Equal

PART 3 - EXECUTION

3.1 ERECTION

A. Motors shall be factory installed on common bases, stands, etc., with the driven equipment. Provide suitable couplings and guards between motor and driven equipment.

B. Align and connect to driven equipment.

C. Connect motors to power supply and controllers and verify correct rotation of equipment.

3.2 INSTALLATION CHECK

A. Provide services of an experienced, competent, and authorized representative of the manufacturer to visit site of work and inspect, check, adjust if necessary, and approve equipment installation for motors 25 hp and larger.

B. Assure that equipment manufacturer's representative is present when equipment is placed in operation.

C. Verify that equipment representative revisits jobsite as often as necessary until all trouble is corrected and equipment installation and operation are satisfactory, in the opinion of the Owner.

D. The Installing Contractor shall perform the following field checks:

1. Inspect each motor installation for any deviation from rated voltage, phase, or frequency and improper installation.

2. Visually check for proper phase and ground connections. Verify that multi-voltage motors are connected for proper voltage.

3. Check winding and bearing temperature detectors and space heaters for functional operation.

4. Test for proper rotation prior to connection to the driven equipment.

5. Test insulation (megger test) of all new and re-used motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

END OF SECTION 40 05 93

MOTOR DATA FORM

Equipment Name: _____ Equipment Number(s): _____

Site Location: _____

Nameplate Markings

Mfr: _____ Mfr Model: _____ Frame: _____ HP: _____

Volts: _____ Phase: _____ RPM: _____ Service Factor: _____

FLA: _____ LRA: _____ Freq: _____ Ambient Temp Rating: _____°C

Time Rating: _____ (NEMA MG-10.35) Design Letter _____ (NEMA MG-1.16)

KVA Code Letter: _____ Insulation Class: _____

The following information is required for high efficiency motors only:

A. Guaranteed minimum efficiency at full load at NEMA efficiency index:

_____
(NEMA MG1-12.53B)

B. Nameplate or nominal efficiency: _____

Data Not Necessarily Marked on Name Plate

Type of enclosure: _____ Enclosure Material: _____

Temp rise: _____ °C (NEMA MG1-12.41, 42)

Space heater included: _____ Yes _____ No;

If yes, _____ Watts _____ Volts

Type of Rotor winding over-temperature protection, if specified:

Use the space below to provide additional information on other motor modifications, if specified:

_____

_____

SECTION 40 05 97 - PIPING IDENTIFICATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide identification for exposed piping and valves, complete and in place, in accordance with the Contract Documents.

B. All mechanical pipe systems shall have protective coatings applied in accordance with Section 09 99 00 – Painting and Coating.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

1. ANSI A13.1 Scheme for the Identification of Piping Systems

1.3 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: A list of suggested labels for each valve tag and pipe system prior to fabrication.

C. The Contractor shall submit one sample of all types of identification devices to be used in the work.

PART 2 - PRODUCTS

2.1 IDENTIFICATION OF PIPING

A. Except as indicated below for very short pipe lengths, identify exposed piping larger than 2-inches nominal size (except that all chemical pipes shall be identified) for the pipe contents and direction of flow. Pipe identification shall be as manufactured by Brady, Seton, or equal.

B. Marker Type: Adhesive – Vinyl or polyester sheet with UV–resistant ink, shaped similar to pipe curvature and coated with pressure sensitive adhesive.

C. Marker Area: Sized per pipe size according to ANSI A13.1; color from the table below.

D. Lettering: Sized per pipe size according to ANSI A13.1; color from the table below.

E. Arrows: At least 2 arrows at each marker area, showing direction of flow.

F. Pipe 2-inches and smaller shall be identified by plastic plates made from laminated 3-layer plastic with engraved black letters on white background.

G. Standard Piping Colors: Paint piping to be in accordance with Table 1 - Color Schedule and in accordance with the requirements of the Specifications for type and quality of paint as hereafter specified. This schedule is to be used only for color and identification purposes.

H. In installations where existing piping identification systems have been established, the Contractor shall follow the existing system. Where existing identification systems are incomplete, utilize the existing system as far as practical and supplement with the indicated system.

Mechanical Piping Color Schedule Piping Color Code			
ANSI Classification	Typical Project Piping	Pipe Color	Letter Color
Flammable or Explosive Liquid (Dangerous)	Chlorine	Safety Yellow	Black
Flammable or Explosive Gas (Dangerous)	Chlorine Natural Gas Hydrogen Dilution Vent	Safety Green Safety Orange	Black White
Liquid or Liquid Mixture	Utility Water Potable Water, Cold Potable Water Hot Raw Waste Water Drains Vents Finish Water Backwash Water RAS/WAS Overflow Alum Sample Polymer Solution Citric Acid Permanganate Sodium Hydroxide Tertiary Effluent (Reuse)	Light Blue Dark Blue Med. Blue Dark Green Gray Gray Light Blue Gray Brown Gray Gray Gray Gray Red Yellow Dark Grey Purple	Black Black Black Black Black Black Black Black Black Black Black Black Black Black Black White Black
Wastes	Residual Analyzed Residual Control	Gray Gray	Black Black

2.2 IDENTIFICATION OF VALVES AND SHORT PIPE LENGTHS

A. Identifying devices for valves and the sections of pipe that are too short to be identified with markers and arrows shall be identified with metal or plastic tags.

B. Metal tags shall be stainless steel with embossed lettering. Plastic tags shall be solid black plastic laminate with white embossed letters. Tags shall be designed to be firmly attached to the valves or short pipes or to the structure immediately adjacent to such valves or short pipes.

PART 3 - EXECUTION

3.1 GENERAL

A. All markers and identification tags shall be installed in accordance with the manufacturer's printed instructions, and shall be neat and uniform in appearance. Tags and markers shall be readily visible from all normal working locations.

3.2 VALVE TAGS

A. Valve tags shall be permanently attached to the valve or structure by means of two (2) stainless steel bolts or screws.

B. Wording on the valve tags shall describe the exact function of each valve, e.g., “HWR-BALANCING,” “CLS THROTTLING”, “PUMP SHUT-OFF,” etc.

3.3 MARKER LOCATIONS

A. Each pipe shall be marked at:

1. Intervals of 20-feet in straight runs.

2. At least one in every room.

3. Within 2-feet of turns, elbows, and valves.

4. On the upstream side of tees, branches, and other distribution points.

5. On both sides of walls and floors through which the piping passes.

END OF SECTION 40 05 97

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SECTION 40 41 00 - ELECTRIC HEAT TRACING SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This section includes electric heat tracing systems.

1.2 SUBMITTALS

A. Shop Drawings: Provide shop drawings information in accordance with Section 01 33 00 – Submittal Procedures. Include performance data for all components of the heat tracing system.

B. Operation and Maintenance Data:

1. Provide operations and maintenance data per Section 01 78 23 – Operation and Maintenance Data.

1.3 STANDARDS

A. ANSI American National Standards Institute

B. FM FM Approvals

C. IEEE Institute Of Electrical and Electronics Engineers

D. NEC U.S. National Electrical Code (NFPA 70)

E. NEMA National Electrical Manufacturers Association

F. UL Underwriters' Laboratories, Inc.

PART 2 - PRODUCTS

2.1 HEATING CABLES

A. Heat-tracing applications in nonhazardous locations shall use self-regulating cables with a continuous maintain temperature of 150°F and an intermittent exposure temperature of 185°F. Heat-tracing applications in Division 1 hazardous locations shall use self-regulating cables with a continuous maintain temperature of 250°F and an intermittent exposure temperature of 420°F.

B. Self-regulating heating cable shall vary its power output relative to the temperature of the surface of the pipe or valve. The cable shall be designed such that it can be crossed over itself and cut to length in the field.

C. Self-regulating heating cable shall be designed for a useful life of 20 years or more with "power on" continuously, based on the following useful life criteria:

1. Retention of at least 75 percent of nominal rated power after 20 years of operation at the

2. Maximum published continuous exposure temperature.

3. Retention of at least 90 percent of nominal rated power after 1000 hours of operation at the maximum published intermittent exposure temperature. The testing shall conform to UL 746B, IEC 216-1 Part 1.

D. A warranty against manufacturing defects for a period of 10 years shall be available.

E. The heating cable shall consist of two 16 AWG or larger nickel-plated copper bus wires, embedded in a self-regulating polymeric core that controls power output so that the cable can be used directly on metallic pipes. Cables shall have a temperature identification number (T-rating) of T6 (185°F) without use of thermostats. Cables used in Division 1 hazardous locations shall have a T rating as required by FM hazardous location requirements.

F. A ground-fault protection device set at 30A, with a nominal 100-ms response time, shall be used to protect each circuit.

G. The heating cable shall have a tinned copper braid with a resistance less than the heating cable bus wire resistance as determined in type test (ASTM, B193, Sec. 5). The braid shall be protected from chemical attack and mechanical abuse by a fluoropolymer outer jacket.

H. In order to provide rapid heat-up, to conserve energy, and to prevent overheating of fluids in the pipe, the heating cable shall have the following minimum self-regulating index:

Heating cable	S.R. index (W/°F)
5 W/ft	0.060
10 W/ft	0.100

1. The self-regulating index is the rate of change of power output in watts per degree Fahrenheit, as measured between the temperatures of 50°F and 100°F, and confirmed by the type test and published data sheets.

I. In order to ensure that the self-regulating heating cable does not increase power output when accidentally exposed to high temperatures, resulting in thermal runaway and self-ignition, the cable shall produce less than 0.5 watts per foot when energized and heated to 350°F for 30 minutes. After this test, if the cable is re-energized, it must not have an increasing power output leading to thermal runaway.

J. The self-regulating heating cable shall retain at least 90 percent of its original power output after having been cycled 300 times between 50°F and 210°F, allowing at least six minutes of dwell time at each temperature.

K. Heat trace cable used in non-hazardous locations shall be Raychem® BTV self-regulating cable, Chromalox SRL self-regulating Cable, Tempco SL self-regulating cable, Thermon D1-HTSX self-regulating heating cable or equal.

L. Heat trace cable used in Division 1 hazardous locations shall conform to the above requirements and have FM approval for use in Division 1 hazardous locations and shall have connections supplied as part of the cable and FM approved for use in Division 1 hazardous locations.

M. Heat trace cable used in hazardous locations shall be Raychem® HXTV-CT self-regulating cable, Chromalox HSRM self-regulating Cable, Thermon D1-HTSX self-regulating heating cable or equal.

2.2 HEAT TRACE PANELS

A. Heat trace distribution panels shall consist of an enclosure, including a panelboard with ground-fault protection devices (30A trip level) capable of individual control of each heat trace circuit.

B. The panels shall provide ground-fault alarm capabilities.

C. Circuits shall be switched by individual contactors operated by a remote thermostat.

D. The panels shall be capable of remote temperature monitoring and alarming of individual heat-tracing circuits.

E. The panels shall be NEMA 4X enclosures for installations in non-hazardous locations. In hazardous locations use Class 1, Division 1 approved for hazardous locations with Z-purge.

F. The panels shall be capable of providing audible and visible alarms.

2.3 MONITORING SYSTEMS

A. Monitoring systems shall be capable of communicating with a host PC for central programming, status review, and alarm annunciation. The monitoring systems shall have a may be network-ready option to provide communication to a host PC running Windows based supervisor software for central programming, status review, and alarm annunciation. The system shall include, but not be limited to, the following:

1. Alarm limits and setpoint temperatures shall be programmable from the central monitoring and control panel in °F. The system shall include an alphanumeric display with multilingual support and password protection or lockable cabinet to prevent unauthorized access to the system.

2. The system shall be switched by a solid-state relay with a minimum rating of 30 Amperes.

3. The system shall be capable of assigning RTDs to a circuit to monitor temperature.

4. The system shall monitor temperature, voltage, and line current to the systems.

5. The system shall monitor ground-fault current and offer the option of alarm only or alarm and trip if the ground fault exceeds the selectable level.

6. The system shall be field-mounted and shall have FM or CSA approval for Class I, Division 1 when using a solid-state switching device.

7. The system shall provide the user with the option of line-sensing control with a user selectable dead band ambient sensing.

8. The system shall provide an isolated solid-state alarm relay for alarm annunciation back to a Distributed Control System (DCS).

9. Electrical code-approved ground-fault detection equipment shall be integral to the controller.

10. Enclosure type shall be NEMA 4X stainless steel for corrosion resistance and protection from moisture. Enclosures installed in hazardous locations shall have FM or CSA approval for Class I, Division 1 approved enclosures

2.4 THERMOSTATS

A. Thermostats shall be ambient sensing thermostats for use in control of heat tracing system used in freeze protection systems. The thermostat shall respond to ambient temperature changes and have an adjustable set point. The set point range of temperature shall be 15°F to 140°F. Temperature sensor shall be silicone filled stainless steel bulb.

B. Thermostat enclosures for installation in non-hazardous locations hall be NEMA 4X cast aluminum with stainless hardware. Thermostats installed in hazardous locations shall have NEMA 7 enclosures approved for use in hazardous locations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Complete installation shall conform to appropriate local codes.

B. Install cable heaters in accordance with detailed layout drawings and manufacturer's instructions.

C. Band heating cable to pipe with tape wraps approximately every 12 inches. Only use fiberglass tape approved by the manufacturer of the heat tape for attaching the cable.

D. Locate heating cable on pipe per manufacturer's instructions.

E. Where heating cable is scheduled to heat plastic pipe, attach aluminum tape length of pipe and band heating cable on aluminum tape to evenly distribute heat.

F. Self-Regulating (SR) Cable Installation

1. Terminate non-power end of cable per termination kit instructions.

2. Do not pinch or make sharp bends in cable.

3. At power termination mount power connection standoff and junction box per power termination kit instructions. The electrical connection shall be made per the termination kit instruction and all local codes.

4. All splice connections shall be made per the kit instruction and all local codes.

5. Install monitor lights per manufacturer's instruction and all local codes.

3.2 TESTING AND TRAINING

A. Contractor shall test heat tracing system and certify that the installation is complete and operating per the Drawings and Specifications.

B. Contractor shall provide training to the Owner's plant operator on the heat tracing system at each installation at the plant.

END OF SECTION 40 41 00

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SECTION 40 42 00 – PROCESS PIPING INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install insulation on piping mains, branches, risers, fittings, and valves for all cold and hot domestic water supply and return piping (CW, HW, ICW, IHW, HWR). Cold water and Industrial cold water to be insulated in attic area and along exterior walls. Other items requiring insulation include:

1. Duct work
2. Thermal Storage Equipment (water heater).
3. Emergency Generator Exhaust System
4. Blower Discharge Piping

1.2 REFERENCE STANDARDS

A.	HH-1-558B	Insulation Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering, Thermal (Mineral Fiber, Industrial Type)
B.	ASTM C 547	Mineral Fiber Pipe Insulation
C.	ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials
D.	ASTM C 553	Type I, class B-2, jacketed flexible blankets. Thermal conductivity

1.3 SUBMITTALS

A. The Contractor shall submit complete Shop Drawings of all thermal insulation K-Value, with manufacturer’s data on materials, covering, jackets, and finish, in accordance with Section 01 33 00 – Submittal Procedures.

PART 2 - PRODUCTS

2.1 GENERAL

A. Components of the insulation, including covering, mastics, and adhesives, shall have a flame-spread rating of not over 25 and a smoke development rating of not over 50. Ratings shall be as established by tests in accordance with ASTM E 84 and Federal Specification standards. The integrated insulation assemblies shall also conform to the above specifications. Insulation shall be applied in strict accordance with the manufacturer's instructions.

2.2 STANDARD TEMPERATURE INSULATION

A. This type of insulation shall be employed for process, cold and hot water, and equipment with surface temperatures up to 850 degrees F. Pipe insulation and jacketing shall be applied to piping where indicated, including associated fittings, flanges, and valves. Pipe insulation shall be molded-type pipe covering, made of fibrous glass with a minimum k-factor of 0.23 at 75 degrees F mean temperature.

B. The insulation shall be oversized for installation over electric heating cable. Insulation shall have a factory-applied white fire-retardant vapor-barrier jacket of kraft paper and aluminum foil laminated together and reinforced with fiberglass yarn.

C. Fittings and valves shall be covered with the same material as the pipe, cut in segments to fit snugly without open spaces, held in place with copper wire or cement, and then be covered with the same jacketing material as the pipe.

D. Insulated fittings adjacent to vapor-barrier insulation shall be sealed with acceptable vapor-barrier cement before installation of the finish jacket. Pipe insulation and vapor-barrier shall be continuous through hangers and supports.

E. Insulation shall be coordinated with the pipe hangers and supports. Where insulation protection shields are provided the top half section of pipe insulation, support locations shall be of the same density. The bottom half insulation segments provided between the pipe and the insulation protection shields shall have a density of not less than 6.0 lb./Ft^3.

F. Insulation shall be covered with smooth aluminum weatherproof metal or plastic preformed jacketing with a factory-attached moisture barrier. Jackets for fittings shall consist of precision-formed smooth-sided sections and shall be sized to cover and protect the insulated fitting.

G. Each section shall be manufactured from aluminum or PVC, and joints shall be sealed with silicone mastic or solvent welding to provide a continuous air and weathertight joint.

H. Strapping shall be 1/2-inch wide, Type 3003 aluminum or stainless steel.

2.3 CELLULAR GLASS INSULATION FOR AIR PIPING

A. This type of insulation shall be employed for process, cold and hot water, and equipment with surface temperatures up to 400 degrees F. Pipe insulation and jacketing shall be applied to piping where indicated, including associated fittings, flanges, and valves. Pipe insulation shall be cellular glass insulation manufactured in accordance with ASTM C552 and shall be certified to meet the requirements of ISO 9001:2000. Cellular glass insulation shall have a minimum k-factor of 0.23 at 75 degrees F mean temperature.

B. Pipe insulation shall be fabricated in half sections.

C. The insulation shall be oversized for installation over electric heating cable.

D. Fittings and valves shall be covered with the same material as the pipe, cut in segments to fit snugly without open spaces, banded in place, and then be covered with the same jacketing material as the pipe.

E. Insulated fittings adjacent to vapor-barrier insulation shall be sealed with acceptable vapor-barrier cement before installation of the finish jacket. Pipe insulation and vapor-barrier shall be continuous through hangers and supports.

F. Insulation shall be coordinated with the pipe hangers and supports. Where insulation protection shields are provided the top half section of pipe insulation, support locations shall be of the same density. The bottom half insulation segments provided between the pipe and the insulation protection shields shall have a density of not less than 6.0 lb./ft^3.

G. Insulation shall be covered with smooth stainless steel weatherproof metal jacketing with a factory-attached moisture barrier if required. Jackets for fittings shall consist of precision-formed smooth-sided sections and shall be sized to cover and protect the insulated fitting.

H. Each section shall be manufactured from stainless steel and joints shall be sealed with silicone mastic to provide a continuous air and weathertight joint.

I. Strapping shall be 1/2-inch wide, stainless steel.

2.4 HIGH TEMPERATURE INSULATION

A. This type of insulation shall be employed for engine exhaust pipes, flues, and similar pipes and equipment with surface temperatures up to 1,200 degrees F. The high temperature insulation shall consist of 4-inch thick calcium silicate or similar pre-molded blocks in two layers of 2-inch thickness, each with staggered joints, all applied over a 3/4-inch high metal rib lath. The inner layer shall be suitable for 1,200 degrees F, and the second layer for 1,000 degrees F. Bends, voids, joints, fittings and other parts of the piping system shall be filled with insulating cement. Aluminum lagging with preformed aluminum fittings shall be banded to the insulation in a similar fashion as required for standard insulation. Allowance shall be made for thermal expansion.

2.5 SCHEDULE

A. Unless otherwise indicated, the following shall be provided:

Application	Nominal Pipe Size	Insulation Material	Thickness (Inches)	Inserts Or Shields	Vapor Barrier	Field Applied Jacket
Domestic Cold Water, ICW	ALL	GF	1	NO	YES	PVC
Domestic Hot Water, Domestic Hw Recirc., IHW	ALL	GF	1	NO	NO	PVC
Diesel Engine Exhaust Muffler/ Silencer	1 TO 10	CS	4	NO	YES	A, SS
Plumbing Vents Within 6 ft of Roof Outlet	ALL	GF	1	NO	NO	NONE
Process Air Blower Discharge Piping	ALL – Above Grade	CG	1 ½”	NO	NO	SS

1. CS – Calcium Silicate; GF – Glass Fiber; CG – Cellular Glass

2. A – Aluminum; SS – Stainless Steel;

2.6 MANUFACTURERS, OR EQUAL FOR STANDARD AND HIGH TEMPERATURE INSULATION

A. Armstrong Contracting and Supply Corp.

B. Certain-Teed Corporation

C. Johns Manville

D. Owens-Corning Fiber Glass Corp.

E. P.P.G. Industries, Inc.

2.7 MANUFACTURERS OR EQUAL FOR CELLULAR GLASS INSULATION

A. Owens Corning FOAMGLAS®

B. Johns Manville

PART 3 - EXECUTION

3.1 INSTALLATION

A. Pipes: Install in accordance with manufacturer's directions on clean dry pipes. Butt joints firmly together and seal vapor barrier longitudinal seam overlap with vapor barrier adhesive. Wrap butt joints with four inch strip of vapor barrier jacket material cemented with vapor barrier adhesive. Finish with bands applied at mid-section and at each end of insulation and encase exterior and buried piping insulation with aluminum jacket with weatherproof construction.

B. Valves & Fittings: Insulate and finish by one of the following methods:

1. With hydraulic setting insulating cement, or equal, to thickness equal to adjoining pipe insulation.

2. With segments of molded insulation securely wired in place.

3. With prefabricated covers made from molded pipe insulation finished with vapor barrier adhesive.

4. Finish fittings and valves with four ounce canvas and coat with vapor barrier adhesive or Zeston covers.

C. Duct Insulation: Install block and board insulation as follows:

1. Adhesive and Band Attachment: Secure block and board insulation tight and smooth with at least 50 percent coverage of adhesive. Install bands spaced 12 inches apart. Protect insulation under bands and at exterior corners with metal corner angles. Fill joints, seams, and chipped edges with vapor barrier compound. Install metal corner angles on all outside corners to provide a neat, finished appearance.

2. Speed Washers or Weld Pins Attachment: Secure insulation tight and smooth with speed washers or welded pin attachments. Space anchor pins 18 inches apart each way and 3 inches from insulation joints. Apply mastic to insulation in contact, open joints, breaks, punctures, and voids in insulation.

3. Blanket Insulation: Install tight and smooth. Secure to ducts having long sides or diameters as follows:

a. 24 Inches and Larger: Anchor pins spaced 12 inches apart each way.

b. Overlap joints 3 inches.

c. Seal joints, breaks, and punctures with vapor barrier tape, matching jacket material.

D. Calcium Silicate Insulation Installation:

1. Insulation Installation on Generator Exhaust Pipe:

a. Secure single-layer insulation with stainless-steel bands at 12 inch intervals and tighten bands without deforming insulation material.

b. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12 inch intervals. Secure outer layer with stainless-steel bands at 12 inch intervals.

2. Insulation Installation on Straight Pipes and Tubes:

a. Secure single-layer insulation with stainless-steel bands at 12 inch intervals and tighten bands without deforming insulation materials.

b. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12 inch intervals. Secure outer layer with stainless-steel bands at 12 inch intervals.

E. Cellular Glass Insulation

1. Install insulation and jacket materials in accordance with manufacturer's written instructions on clean dry pipes.

2. Apply insulation in smooth, clean manner with tight and finished smooth joints. Fit insulation tightly against surfaces. Insulate each continuous run of pipe with full-length sections of insulation with a single piece cut to length to complete the run of pipe. Do not use cut pieces or scraps to complete the installation.

3. Butt longitudinal and circumferential insulation joints firmly together. Insulation may be applied in a single layer application. Insulation should be fabricated in half sections or curved sidewall segments wherever possible. Beveled lags or flat block insulation may be acceptable for large diameter surfaces as shown in Table 1.

4. Insulation shall be banded in place.

5. Apply sealant or cement when previous applications of adhesives and cement have thoroughly dried.

6. Apply insulation to permit expansion or contraction of pipelines without damage to insulation or jacketing.

7. Fittings and valves shall be covered with the same material as the pipe, cut in segments to fit snugly without open spaces, banded in place, and then be covered with the same jacketing material as the pipe.

8. Fittings:

a. Insulate fittings by covering with mitered sections of insulation or utilize factory-made prefabricated fitting shapes.

b. Terminate preformed pipe jackets or covering at sufficient distance from flanges to permit removal of bolts.

c. Overlap flange and flanged fitting insulation on adjacent pipe covering by at least 2 inches.

9. Provide continuous insulation through and over pipe supports and provide protection saddles at supports.

10. Extend insulation against insulation end protection shields or covers so that insulation voids do not exist and provide watertight end seals and covers where insulation terminates.

11. Provide continuous pipe insulation and covering through sleeves or openings in walls and floors. When buried pipe enters a building through a below grade wall or slab penetration, begin insulation system on interior side of penetration.

12. Insulated fittings adjacent to vapor-barrier insulation shall be sealed with acceptable vapor-barrier cement before installation of the finish jacket. Pipe insulation and vapor-barrier shall be continuous through hangers and supports.

13. Insulation shall be coordinated with the pipe hangers and supports. Where insulation protection shields are provided the top half section of pipe insulation, support locations shall be of the same density. The bottom half insulation segments provided between the pipe and the insulation protection shields shall have a density of not less than 6.0 lb./ft^3.

END OF SECTION 40 42 00

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SECTION 40 61 96 – CONTROL STRATEGIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide all instrumentation and programming required to implement the control strategies described in this Section, the functions shown on the drawings complete and operable in accordance with the Contract Documents.

B. The following equipment is included in the control strategies:

1. Influent Sampler
2. Influent Fine Screen (new screen)
3. IFAS Process
4. Tertiary Filter Lift Station
5. Tertiary Filter Process
6. Coagulant and pH Adjustment System
7. Effluent Sampler
8. Digester Blowers
9. Decant Pump Station
10. Sludge Feed Pumps
11. Screw Press Dewatering System

1.2 DEFINITIONS

A. The following terms are used in the descriptions of PLC functions:

1. Operator Settings: Operator set or entered values shall be constants that are adjustable or set from operator displays. Examples of operator set or entered values are controller set points, batch set points, etc. Specific values that are required to be operator set are noted in the process control strategy descriptions.

2. Tunable Values: Tunable values are constants that are adjustable at engineer level displays without requiring any software reconfiguration. These values are not adjustable from operator level displays.

B. The following abbreviations are used throughout this Section:

1.	SS	Selector Switch
2.	F/R	Forward or Reverse
3.	HOR	Hand/Off/Remote
4.	RVS	Reduced Voltage Starter
5.	VFD	Variable Frequency Drive
6.	LR	Local Remote
7.	HOA	Hand/Off/Auto
8.	MOV	Motor Operated Valve
9.	LOS	Lock-Out Stop
10.	LCS	Local Control Station
11.	LCP	Local Control Panel

1.3 SUBMITTALS

A. Provide submittals describing SCADA system screen development in accordance with Section 01 33 00 – Submittal Procedures and Section 40 70 00 – Instrumentation and Control, General.

B. Develop detailed loop descriptions based on the information in the Contract Documents, including the Process and Instrumentation drawings (P&ID) and Division 40 specifications.

1. For each control loop, provide a detailed functional description of the operation of the equipment, signals, and controls shown on the P&IDs:

a. Include all functions depicted or described in the Contract Documents.

b. Include the following within each loop description:

1) All requirements specific to that loop.

2) Common control requirements applicable to that loop.

3) List of all ranges, setpoints, timers, values, counters, etc.

2. Where there are similar loops with identical control, such as multiple loops for individual pumps, only 1 loop description need be developed and the remaining loops may reference that loop description.

C. Loop description format:

1. Loop number and title.

2. References:

a. List P&IDs that are specifically referenced.

3. Abstract:

a. General description of how the loop works, what devices are involved, and how the process shall be controlled.

b. Process values, setpoints, and limits, including units and ranges:

1) Show span and range values for analog inputs and outputs, and operating point and deadband for discrete inputs.

4. Hardwired control:

a. Detailed description of the control functions at the local level.

b. Function of local operator interfaces.

c. Operation of hardwired field pilot controls:

1) Pushbuttons.

2) Selector switches.

3) Potentiometers.

4) Pilot lights, indicators, and other displays.

5. Hardwired interlocks:

a. Explanation of the operation of system interlocks and hardwired permissive conditions.

6. PLC control:

a. Detailed description of the control functions that are under control of the PLC.

b. Operator controls and automatic controls.

c. Setpoints, alarms, etc.:

1) Include units and ranges for analog values.

2) Include span and range for analog inputs and outputs.

3) Include operating point and deadband for discrete inputs, and identify conditions where contacts are open, and when they close.

d. Control sequences.

7. Software interlocks:

a. Operation of system software interlocks.

8. HMI control:

a. Detailed description of the operator controls.

9. SCADA control:

a. Detailed description of the operator controls.

b. Setpoints, alarms, etc.

10. Indicators and alarms:

a. List any indicators and alarms specific to the loop that are not covered in the common control strategies.

11. Failure modes:

a. List any failure modes specific to the loop that are not covered in the common control strategies.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 COMMON FUNCTIONS

A. Common functions that are generally applicable to all loops or to many similar loops are described under the heading "General Control Loop Functions." These functions are not repeated in the descriptions for each individual control strategy.

B. General Control Loop Functions: The following general control system functions shall be provided:

1. All analog and discrete inputs to the dialers shall be displayed. Both RUNNING and OFF input states shall be displayed.

2. All analog inputs shall have instrument failure alarms when the input is below 0 percent or above 100 percent for a tunable time initially set at 10 seconds.

3. All discrete FAIL inputs shall be alarmed for a tunable time initially set at 10 seconds. Other discrete inputs shall be alarmed as noted in the control strategy descriptions.

4. Operational Readiness Testing (ORT) should include all discrete and analog alarms as well as status alarms. This should also include all operations (e.g. lift station pump controls for lead, lag alarms, etc.). All alarm should be tested through voice or text notification as needed.

5. Where alarms are specified in the control strategy descriptions, alarms shall be initiated from the applicable inputs. If discrete inputs are not available, the specified alarms shall be initiated from the applicable analog input; alarm setpoints shall be operator adjustable.

6. All flow inputs and equipment run times shall be totalized and recorded. All totalized values shall be displayed. Runtime shall be displayed in tenths of an hour and be based on real-time accumulation.

7. When a level is less than 10 (e.g. ft, psi, mg/L, etc.) the precision shall be recorded in hundredths.

8. Displays shall be grouped functionally for ease of operation. Both analog and discrete functions associated with an item of equipment or a group of equipment shall be provided on the same display.

9. All PID control functions shall be provided with standard analog controller functions and operator interfaces including, but not limited to, the following:

    a. AUTO/MANUAL mode selection: In AUTO, the output of controller shall be based on the PID control calculation. In MANUAL, the output of the controller shall be operator adjustable. Transfer between operational modes shall be bumpless.

    b. LOCAL/REMOTE set point selection: In LOCAL, the set point shall be operator adjustable from the equipment, if applicable. In REMOTE, the set point shall be adjustable from a REMOTE set point input.

    c. Set point, process variable, and controller output shall be displayed.

    d. Provisions shall be included to prevent reset windup.

10. When equipment is tagged OUT OF SERVICE, by the operator all associated equipment shall have their alarms inhibited until the tagged equipment is re-tagged IN SERVICE.

11. Speed indications and speed control setpoints shall be displayed in Hz.

12. Wherever two or more pieces of equipment are provided for the same functions, for example submersible lift station pumps, the MCC shall alternate the equipment after each use.

3.2 INFLUENT AUTOMATIC SAMPLER

A. Reference Drawings: EI-701-A

B. Description: An influent composite sampler will be located outside the Headworks building as shown on the drawings. The sampler is paced based on the total influent flow rate as measured by the total flow through the existing influent flow meter. The influent flow meter is located in a vault near the Headworks building.

C. Local Controls: The controller consists of a microprocessor linked to Programmable Read Only Memory (PROM) and supporting electronics. Sampling programs can be entered via a keypad. The controller shall display the status of the sampler and shall prompt the user through the programming sequence. The sampler is to be programmed to take a sample when a flow input pulse from the PLC controller is received.

D. Local Manual Control Mode: As provided by the equipment manufacturer.

E. Local Automatic Control Mode: The Automatic Influent Sampler is provided with an internal timer capable of initiating the sampling sequence after a preset time has elapsed. This preset time is variable from 4 minutes to 12 hours.

F. SCADA Automatic Control Mode: The sampler will provide a signal from the SCADA system which monitors the influent flow meter and totalizes the flow. When the total reaches the operator set sample size, a pulse is generated which activates the sampler.

G. Local Indicators: On the controller per manufacturer.

H. SCADA Indicators: The SCADA system shall include:

1. Instantaneous influent flow in gallons per day (gpd each meter and total)

2. Influent flow for previous and current day from midnight to midnight in gallons (gal. each meter and total).

3. Sample size (gal)

4. Gallons since last sample

I. SCADA Alarms: The SCADA system shall send alarms for:

1. High raw influent flow (greater than 1.74 MGD).

3.3 INFLUENT SCREENING

A. Reference Drawing(s): EI-701-A

B. Reference Section 46 21 35 – Rotary Drum Fine Screen.

C. Description: The screening area in the Headworks is comprised of two screening channels with various manual isolation gates. One of the channels contains the existing coarse screen and the other channel contains a new fine screen. The existing coarse screen will be kept offline and brought online only when the new screen needs maintenance. Screenings from each screen is washed, compacted, and then fall into a dumpster. The screen has a level detection system using the water level to signal the fine screen to run. The screen control panel is located in the electrical room of the Headworks building. Adjacent to each screen is a local control station which includes HOA switches for the screen and washwater system, an FOR switch for the screen, and an emergency stop push button.

D. Local Manual Control Mode: When HAND mode is selected, both coarse and fine screens will run in the appropriate direction determined by the forward or reverse selector switch. When in HAND, the spray wash button activates the wash solenoid.

E. Automatic Control Mode: When the HOA selector switch is in the AUTO position, both coarse and fine screen units will be energized based upon one of the options as follows:

1. The fine screen is equipped with a level setting accessible for adjustment, and a detection system to determine the need for screen operation based upon the upstream channel fluid levels compared to this setting. When the LEVEL/TIME (in SCADA) is in the LEVEL position, the unit will be energized when the level exceeds the operator setpoint. The cleaning cycle will run for an operator adjustable period of time.

2. The fine screen is equipped with a timer (30 seconds to 15 minutes) that is accessible for adjustment from the front of the LCP enclosure. The operator may set the timer as desired. When the LEVEL/TIME (in SCADA) is in the TIME position, the cycle timer will count down and the unit will be energized to when the cycle timer expires or when the upstream level exceeds the operator setpoint. The unit will continue to run for the operator adjusted time period. After each run cycle, the cycle timer is automatically reset and repeats the countdown cycle once again.

3. All automatic control mode functions and setpoints are accessible from the SCADA system.

F. Interlocks: The following interlocks and/or permissives shall be provided in addition to the standard motor protection by overload detection:

1. As provided by the manufacturer of the screening equipment, an output signal from the screen is used to START/STOP the internal dewatering press.

G. SCADA Indicators:

1. Fine Screen (New) and Coarse Screen (Existing):

a. Screens Status (on = green).

b. HOA selector switches AUTO position status.

c. High level.

d. Fail.

e. E-stop.

f. Elapsed run time for screen in tenths of an hour.

H. SCADA Control:

1. Fine Screen:

a. Auto

2. Coarse Screen:

a. Auto

I. SCADA Alarms: As a minimum, the following alarms shall be provided to the SCADA system:

1. Fault alarm for the screens.

2. High level for the screens.

3.4 IFAS TREATMENT

A. Reference Drawing(s): EI-701-B, EI-701-B2

B. Description:

1. The IFAS treatment basins shall be refurbished to consist of two trains with two basins in each train. The IFAS process equipment has been prepurchased from Veolia and information is contained in the Appendices for reference. Each basin includes three cylindrical screens with an air sparge system to periodically scour each screen. The air sparge system is controlled by solenoid valves, with four solenoid valves in total. Each basin shall contain two diffuser assemblies. Air is manually throttled with air butterfly valves to balance air flow between the tanks and to provide for adequate mixing. IFAS Basin #1 in each process train shall be equipped with a DO/Temperature sensor, submersible level transducer, and a high level float switch. IFAS Basin #2 shall have a high level float switch.

2. The IFAS Blower Building B2 contains three pre-purchased blower packages. Each blower package includes a high temperature switch, temperature gauge and pressure gauge. Each process train has a dedicated blower with a swing blower available as a backup. There is separate air piping conveying air from the blowers to each process train. Insertion-type air flow meters shall be installed in the blower discharge piping to each process train inside the Blower Building.

C. Local Controls: From VCP-100-B2 located in the IFAS blower building.

D. Local Manual Controls: From the local VCP-100-B2 there shall be an HMI. There shall be a programmed OPEN/CLOSED/REMOTE switch for each solenoid valve. The operator shall be able to manually open and close each solenoid valve. Programmed on the HMI shall be a MANUAL/AUTO switch. When in MANUAL the operator shall be able to turn each blower on and off. The operator shall also be able to modulate the speed of each VFD.

E. Automatic Control Mode: While in Automatic Control Mode, the operators shall be able to set the dissolved oxygen level, the PLC shall then modulate the blowers to reach the setpoint. The solenoid valves for the air sparge system shall open on a periodic basis as set by the operator.

F. SCADA control: The operator shall be able to control the system from SCADA the same as if he were operating it from the HMI.

G. Interlocks:

1. Each VFD shall shut down if the blower high temperature switch has tripped.

2. VFD Fault.

3. Loss of communication.

4. Additional as provided by the manufacturer.

H. Local Indication:

1. VFD Current

2. VFD Speed Feedback

3. VFD Running

4. VFD Fault

5. High Discharge Temperature for each Blower

6. IFAS Process Train #1 air flow

7. IFAS Process Train #2 air flow

8. Dissolved Oxygen for IFAS Basin #1 each train

9. Temperature for IFAS Basin #1 each train

10. High Level for each basin

11. Water level for IFAS Basin #1 each train.

I. SCADA Indication:

1. Same as local indication.

3.5 TERTIARY LIFT STATION

A. Reference Drawing(s): EI-701-D1

B. Reference Specifications: Section 43 25 00 - Submersible Non-Clog Pumps

C. Description: The Tertiary Lift Station is comprised of a wet well, level controls, and three submersible non-clog pumps with variable frequency drives. The lift station receives secondary effluent from Clarifiers and discharges to the Tertiary Filtration system. Level Controls consist of one pressure transducer suspended in the wet well as primary level control and two backup mechanical float switches as secondary level control and alarm. There is one float switch for a HIGH HIGH level alarm and one float for switch for LOW level alarm. Normal operation requires the pumps to alternate after each start. The level controller shall control the operation of the pumps to maintain a constant water level in the wet well by matching influent flows.

C. Local Controls: From MCP-4300 located in Tertiary Building and the VFDs for each pump.

D. Local Manual Control Mode: The operator may run each submersible pump in manual mode by placing the programmed HOA selector switch in the HAND position. While in the HAND position, the pump shall run continuously. The pump speed can be modulated via the VFD. Any pump may be stopped by placing the respective selector switch in the OFF position.

E. Automatic Control Selection: Automatic control mode for each submersible pump is provided by placing the HOA selector switch in the AUTO position. When in AUTO, the level controller controls the operation of the pumps.

F. Level Sensor Selection: Select floats or level sensor to control pumps.

G. Automatic Control Mode: When the pump HOA selector switch is in the AUTO position, the pump shall be controlled by the selected level sensor. While in the AUTO mode, the pump is controlled using wet well level as the primary control variable. The controller shall alternate the pumps after each start.

1. LEAD/LAG1/LAG2 Selection: This setting defines which pump is the LEAD pump, LAG1 pump, and LAG2 pump.

2. The level settings can be changed by the operator. The following pump control strategies are available while in the AUTO control mode:

a. When the fluid level in the wet well rises to the LEAD pump start level, the LEAD pump is energized. The pump remains energized until the fluid level in the wet well falls to the pump shutoff level.

b. If the fluid level in the wet well continues to rise until it reaches the LAG1 pump start level, the LAG1 pump is energized. The pump remains energized until the fluid level in the wet well falls to the pump shutoff level.

c. If the fluid level in the wet well rises to the HIGH level, the LAG2 pump is energized, and a high-water level alarm shall be sent to the SCADA system. The pump remains energized until the fluid level in the wet well falls to the pump shutoff level. Once the water level falls back below the HIGH level, a notice of normal water level shall be sent to the SCADA system. The high-water alarm must be cleared manually in the SCADA system.

d. If the "high-high" float switch is activated and no pumps are on, then the selected level sensor may have failed, and the other level sensor should be activated, and all pumps turned on. If all of the pumps are already running when the "high-high" float switch is activated, then nothing additional needs to be done besides sending a "high-high" level alarm. If the fluid level in the wet well falls to the LOW alarm level, a low water alarm shall be sent to the SCADA system, and all of the pumps shall shut off.

e. If a pump fails anytime it is running or commanded to run, a FAIL alarm is annunciated at the HMI for that pump. If the pump that failed was in the LEAD position, then the LAG1 pump is promoted to LEAD position and the LAG2 pump becomes the LAG1 pump. A pump failure alarm is also sent to the SCADA system.

H. SCADA Control:

1. Same as Automatic Control. The LEAD, LAG, HIGH, Pump Off and LOW water levels shall be adjustable from SCADA.

2. The lag delay times shall be adjustable from SCADA, including pump, water level, and alarm lag delay times.

I. Interlocks: A pump that is running shall be interlocked to stop on any of the following conditions:

1. VFD fault.

2. Failure of any of the safety shutdown functions of the pumps.

3. Additional as provided by the manufacturer.

4. Sand filters offline.

5. High level interlock at sand filter.

J. Local Indicators: As a minimum, the following indicators shall be provided at the VFD:

1. HOA switch.

2. Pump running.

3. Pump stopped.

4. Pump fail.

5. As a minimum, the following indicators shall be indicated on the level controller:

a. Wet well levels in hundredths of a foot.

K. SCADA Indicators: As a minimum, the following indicators shall be provided:

1. Run status for each pump.

2. HOA switch in the AUTO position.

3. VFD speed reference.

4. VFD speed feedback.

5. Elapsed run time for each pump in tenths of an hour.

6. Wet well level in hundredths of a foot.

7. Lift station flow rate in gallons per minute and totalized flow shall be in gallons per day from midnight to midnight.

8. Motor Amps

L. SCADA Alarms: As a minimum, the following alarms shall be provided to the SCADA system:

1. Pump fail for each pump.

2. Moisture alarm for each pump. Moisture detection switches located in the seal oil chamber detect moisture leakage through the outer shaft seal. The moisture sensor shall be wired to the pump control system to provide seal failure protection indication for the pump. A moisture detection relay for each pump shall be provided to provide alarm signal to SCADA system upon moisture detection.

3. High temperature alarm for each pump. Thermal sensors used to monitor stator temperatures by the use of three thermal switches embedded in the coils of the stator winding shall be wired to the pump control system to provide overheat protection for the motors. These sensors shall be connected to the SCADA network similar to moisture sensors to provide an alarm signal upon detection of preset HIGH temperature.

4. VFD fault.

5. High and low water level alarms.

6. High-High water level alarm from float switch.

M. System Bypass

1. When HIGH HIGH level alarm is triggered, the Tertiary Lift Station can be bypassed by manually controlling associated plug valves, as shown in O&M manual.

2. Tertiary Lift Station can also be bypassed manually when SCADA alarms indicate high level alarms on all (or the majority) of the Tertiary Filters.

3. When Tertiary Lift Station is bypassed, the existing UV system shall be switched to "HAND" mode since the flow meter will no longer be providing a signal to modulate the UV. All UV bulbs in the channel that water flows shall be turned on to provide effluent disinfection. The effluent sampler shall also be switched manually through the sampler to collect based on time rather than the flow meter measurement.

3.6 TERTIARY FILTRATION

A. Reference Drawing(s): EI-701-D

B. Other References: Pre-purchase documentation in Appendices.

C. Description: The tertiary filter system is a vendor provided package. The filter equipment has been prepurchased from Nexom and information is contained in the Appendices for reference. The system includes four filters on duty and one filter as standby. Each filter has a filtration area of 64 sf. The designed hydraulic loading was 1.0 and 4.7 gpm/sf at ADF and PHF, respectively. The SCADA system shall control the number of filters online based on plant influent flow, shown in Table 1. See vendor documentation included in the appendices for control strategies related to the equipment.

ID	Flow, MGD	Number of Filters on Duty	Hydraulic Loading Rate, gpm/sf
Design Flow			
Average Daily Flow	0.36	2	1.95
Max Month Flow	0.50	2	2.71
Peak Day Flow	0.67	3	2.42
Peak Hour Flow	1.73	4	4.69
Plant Influent Flow			
Real time flow, 1	<0.49	2	<2.66
Real time flow, 2	0.50-0.67	3	1.81-2.42
Real time flow, 3	0.68-1.73	4	1.84-4.69

Note: The design calculation from Nexom suggested 1 - 2 filters are required at ADF of 0.36 MGD, 2-3 filters are required at PDF of 0.67 MGD, and 4-5 filters are required at PHF of 1.73 MGD.

D. Local Indicators: See vendor documentation.

E. SCADA Indicators: At a minimum, the SCADA system shall include for the filter system:

1. Filter influent flow
2. Filter effluent flow
3. Headloss pressure

F. SCADA Alarms: At a minimum, the SCADA system shall provide alarms for:

1. Low air pressure alarm

G. System Bypass

1. When the Tertiary Lift Station is bypassed by manually controlling associated plug valves, as shown in O&M manual, the Tertiary Filters are also bypassed.
2. Tertiary Lift Station can also be bypassed manually when SCADA alarms indicate high level alarms on all (or the majority) of the Tertiary Filters.

3. When Tertiary Lift Station is bypassed, the existing UV system shall be switched to "HAND" mode since the flow meter will no longer be providing a signal to modulate the UV. All UV bulbs in the channel that water flows shall be turned on to provide effluent disinfection. The effluent sampler shall also be switched manually through the sampler to collect based on time rather than the flow meter measurement.

3.7 CHEMICAL FEED SYSTEM

A. Reference Drawing(s): EI-701/2-D

B. Other Reference: Specifications for Chemical Feed Equipment and Pumps

C. Description: The chemical feed system is divided into two distinct components – the Phosphorus coagulant system (typically using alum) and the pH adjustment system (typically employing caustic soda). The ALUM system includes a chemical tank equipped with a level sensor. For pH adjustment, a 300-gallon 50% NaOH tote is utilized. A duplex NaOH dosing pump skid is specifically assigned to filter effluent, with one pump serving as a redundancy. In the case of the ALUM system, one duplex pump skid functions as the supply source for IFAS basins, with both pumps actively serving one basin each. Another duplex ALUM pump skid is assigned as the supply source for tertiary filters, with one pump offline. Notably, all pumps in both ALUM duplex pump skids are identical, with the offline pump serving as redundancy for both skids. The PLC shall allow for designation of an assigned pump to a give process after manual valving has been adjusted. The following describes the control for each process:

1. Filter System (coagulation pumps): Pump shall be paced based on a calculated phosphorus influent loading to the filters. This loading shall be calculated as the product of the flow (in MGD) and the phosphorus concentration (in mg/L) and multiply by 8.34 to provide a lbs/day value. The base pump speed shall be manually set by the operator and the speed proportionally varied by SCADA based on the loading.

2. Filter System (pH pumps): Pump shall be paced based on influent flow to the filters. The base pump speed shall be set manually by the operator and the speed proportionally varied by SCADA based on the flow.

3. IFAS basins (coagulation pump): Pump shall operate based on a run signal from the IFAS PLC for each basin.

D. Interlocks:

1. Tank level (alum)

2. Fault (each pump)

E. Local Indicators: Reference Section 46 33 44.

F. SCADA Control:

1. Low tank alarm level setpoint (alum)

2. HOA (each pump)

3. Hand pump speed (each pump)

G. SCADA Indicators: At a minimum, the SCADA system shall include for each (2) chemical system:

1. Tank level (alum)

2. Pump running (each pump)

3. Pump speed (each pump)

H. SCADA Alarms: At a minimum, the SCADA system shall provide alarms for:

1. Low tank level alarm (alum tank)

2. Pump fault (each pump)

3. Leak detect (each chemical system)

4. High Phosphorus concentration

3.8 EFFLUENT AUTOMATIC SAMPLER

A. Reference Drawing(s): EI-701-K

B. Description: An effluent composite sampler will be located outside the UV building as shown on the drawings. The sampler is paced based on the total effluent flowrate as measured by the total flow through the tertiary filter effluent flow meter. The effluent flow meter is located in Structure D.

C. Local Controls: The controller consists of a microprocessor linked to Programmable Read Only Memory (PROM) and supporting electronics. Sampling programs can be entered via a keypad. The controller shall display the status of the sampler and shall prompt the user through the programming sequence. The sampler is to be programmed to take a sample when a flow input pulse from the PLC controller is received.

D. Local Manual Control Mode: As provided by the equipment manufacturer.

E. Local Automatic Control Mode: The Automatic Effluent Sampler is provided with an internal timer capable of initiating the sampling sequence after a preset time has elapsed. This preset time is variable from 4 minutes to 12 hours.

F. SCADA Automatic Control Mode: The sampler will be provided a signal from RCP-4000 which is run by PLC-100-E which monitors the effluent flow meter and totalizes the flow. When the total reaches the operator set sample size, a pulse is generated which activates the sampler.

G. Local Indicators: On the controller per manufacturer.

H. SCADA Indicators: The SCADA system shall include:

1. Instantaneous effluent flow in gallons per day (gpd each meter and total)

2. Effluent flow for previous and current day from midnight to midnight in gallons (gal. each meter and total).

I. SCADA Alarms: The SCADA system shall send alarms for:

1. High effluent flow (greater than 1.74 MGD).

3.9 DIGESTER BLOWERS

A. Reference Drawing(s): EI-701-G1

B. Reference: 43 11 33 – Positive Displacement Lobe Blowers

C. Description: These facilities consist of two existing 25 HP positive displacement blowers and one new blower package of the same size as the existing. These blowers are part of the aeration system for the aerobic digesters and run at a constant speed.

D. Local Controls: Each blower has a local control station with a Hand-Off-Auto switch and a reset button. The blower will run when placed in HAND position. The blowers run at a constant speed. The blowers can be manually turned off by placing the switch in the OFF position.

E. Automatic Control Mode: The blower can be placed in AUTO mode at the local control station. In AUTO mode, the Operator can turn the blowers on and off remotely through the SCADA system.

F. SCADA Indicators/control:

1. Start

2. Running

3. Manual/Automatic

G. SCADA Alarms:

1. Blower Fault

3.10 DECANT LIFT STATION

A. Reference Drawing(s): EI-701-G2

B. Other Reference 43 25 00 - Submersible Non-Clog Pumps.

C. Description: The Decant Lift Station is comprised of a wet well, level controls, and two submersible non-clog pumps. The wet well receives backwash from the tertiary filters, drains from Structure D, and supernatant from the aerobic digesters, and discharges to the headworks lift station. Level controls consist of one pressure transducer suspended in the wet well as primary level control and two backup mechanical float switches as secondary level control and alarm. There is one float switch for a HIGH HIGH level alarm and one float for switch for LOW level alarm. Normal operation requires the pumps to alternate after each start. The level controller shall control the operation of the pumps based on the water level in the wet well.

D. Local Controls: From LCP-7000 located in Dewatering Building.

E. Local Manual Control Mode: The operator may run each submersible pump in manual mode by placing the programmed HOA selector switch in the HAND position. While in the HAND position, the pump shall run continuously. Any pump may be stopped by placing the respective selector switch in the OFF position.

F. Automatic Control Selection: Automatic control mode for each submersible pump is provided by placing the HOA selector switch in the AUTO position. When in AUTO, the level controller controls the operation of the pumps.

G. Level Sensor Selection: Selects the sensor to be used by the level controller.

H. Automatic Control Mode: When the pump HOA selector switch is in the AUTO position, the pump shall be controlled by the selected level sensor. While in the AUTO mode, the pump is controlled using wet well level as the primary control variable. The controller shall alternate the pumps after each start.

1. LEAD/LAG Selection: This setting defines which pump is the LEAD pump and the LAG pump.

2. The level settings can be changed by the operator. The following pump control strategies are available while in the AUTO control mode:

a. When the fluid level in the wet well rises to the LEAD pump start level, the LEAD pump is energized. The pump remains energized until the fluid level in the wet well falls to the pump shutoff level.

b. If the fluid level in the wet well continues to rise until it reaches the LAG pump start level, the LAG pump is energized. The pump remains energized until the fluid level in the wet well falls to the pump shutoff level.

c. If the fluid level in the wet well rises to the HIGH level, the high-water level alarm shall be sent to the SCADA system. Once the water level falls back below the HIGH level, a notice of normal water level shall be sent to the SCADA system. The high-water alarm must be cleared manually in the SCADA system.

d. If the “high-high” float switch is activated and no pumps are on, then the selected level sensor may have failed, and the other level sensor should be activated, and all pumps turned on. If all of the pumps are already running when the “high-high” float switch is activated, then nothing additional needs to be done besides sending a “high-high” level alarm. If the fluid level in the wet well falls to the LOW alarm level, a low water alarm shall be sent to the SCADA system, and all of the pumps shall shut off.

e. If a pump fails anytime it is running or commanded to run, a FAIL alarm is annunciated at the HMI for that pump. If the pump that failed was in the LEAD position, then the LAG pump is promoted to LEAD position. A pump failure alarm is also sent to the SCADA system.

I. SCADA Control:

1. Same as Automatic Control. The LEAD, LAG, HIGH, Pump Off and LOW water levels shall be adjustable from SCADA.

2. The lag delay times shall be adjustable from SCADA, including pump, water level, and alarm lag delay times.

J. Interlocks: A pump that is running shall be interlocked to stop on any of the following conditions:

1. Failure of any of the safety shutdown functions of the pumps.

2. Additional as provided by the manufacturer.

K. Local Indicators: As a minimum, the following indicators shall be provided at the local control panel:

1. HOA switch.

2. Pump running.

3. Pump stopped.

4. Pump fail.

5. As a minimum, the following indicators shall be indicated on the level controller:

a. Wet well level in hundredths of a foot.

b. The controlling level sensor.

L. SCADA Indicators: As a minimum, the following indicators shall be provided:

1. Run status for each pump.

2. HOA switch in the AUTO position.

3. Elapsed run time for each pump in tenths of an hour.

4. Wet well level in hundredths of a foot.

M. SCADA Alarms: As a minimum, the following alarms shall be provided to the SCADA system:

1. Pump Fail for each pump.

2. Moisture alarm for each pump. Moisture detection switches located in the seal oil chamber detect moisture leakage through the outer shaft seal. The moisture sensor shall be wired to the pump control system to provide seal failure protection indication for the pump. A moisture detection relay for each pump shall be provided to provide alarm signal to SCADA system upon moisture detection.

3. High temperature alarm for each pump. Thermal sensors used to monitor stator temperatures by the use of three thermal switches embedded in the coils of the stator winding shall be wired to the pump control system to provide overheat protection for the motors. These sensors shall be connected to the SCADA network similar to moisture sensors to provide an alarm signal upon detection of preset HIGH temperature.

4. High and low water level alarms.

5. High-High water level alarm from float switch.

3.11 SLUDGE FEED PUMPS

A. Reference Drawing: EI-701-E.

B. Description: These facilities shall include two progressing cavity sludge feed pumps to be used as part of the screw press dewatering system or they can be used to pump from the aerobic digesters, through the polymer injection equipment, to the sludge drying beds to geobags for dewatering.

C. Local Controls: The Operator needs to open the plug valve to the bypass line and close the plug valve to the screw press in the sludge pump area in the dewatering building. The selected sludge feed pump can be placed in HAND at the screw press main control panel and the speed adjusted manually at the variable frequency drive until the desired pumping rate is achieved. The polymer feed system can be placed in HAND at the screw press main control panel and the polymer dose adjusted at the polymer feed local control panel.

D. Automatic Control: Controlled by the vendor provided screw press control panel. The speed of the pumps shall be modulated to meet the needs of the screw press.

E. Local Indicators: The screw press panel shall at a minimum have indicators or be available in the HMI for:

1. Run Status of sludge feed pump.

2. Failure alarm(s) for sludge feed pump.

3. Local indicators for the polymer feed system shall be at the polymer feed system local control panel.

F. SCADA Indicators: As a minimum, the following indicators shall be provided at the SCADA screen.

1. HOA selector status for each dewatering feed pump and polymer feed system.

2. Run status for each sludge pump and polymer feed system (red for off, green for on).

3. Pump speed for each sludge pump.

4. Elapsed run time meter for each dewatering feed pump and polymer system in tenths of an hour.

5. Digested sludge flow in gpm.

6. Totalized 24-hour digested sludge flow in gallons for previous day and the current day from midnight to midnight.

G. SCADA Alarms: As a minimum, the following alarms shall be provided to the SCADA system:

1. Pump Failure.

2. Polymer system common alarm.

3.12 SCREW PRESS DEWATERING SYSTEM

A. Reference Drawing(s): EI-701-E.

B. Other Reference: Appendices for prepurchase documents.

C. Description: These facilities shall include two progressing cavity sludge feed pumps, a liquid polymer feed system, sludge flow meter, dewatering screw press, and dewatered solids screw conveyors. The screw press has been prepurchased from HUBER and information is contained in the Appendices for reference. The screw press manufacturer shall provide a local control panel. The local control panel shall control the operation of the screw press, dewatering feed pumps, polymer system, and dewatered sludge loading conveyor.

D. Local Controls: Local controls for the sludge feed pumps shall be comprised of the variable frequency drives and screw press main control panel. The pump flow rate shall be controlled manually by adjusting the VFD. Local controls for the screw press system shall be comprised of the screw press main control panel. Local controls for the polymer mix systems shall be comprised of the polymer system panels. Local controls for the dewatered sludge conveyor system shall consist of the conveyor local control panel.

E. Local Manual Control Mode: The operator may control a dewatering feed pump on or off by switching the HOA switch from HAND to OFF. In the HAND mode, the pump speed for each pump shall be controlled manually by adjusting the VFD speed for each pump. The flow meter shall be used to manually adjust the pump to a flow rate. The operator shall control the polymer system manually at the polymer control panel. The operator shall control the screw press system manually at the screw press panel. The operator may control the dewatered sludge conveyor on and off by switching the HOA switch from HAND to OFF.

F. Automatic Control Mode: In the automatic mode, the screw press is controlled by the main control panel which is provided by the screw press Manufacturer. The screw press local control panel shall communicate via Ethernet to control the dewatering feed pumps, polymer mix system, and the dewatered sludge conveyor system.

A dewatering feed pump is set in the automatic mode by setting the HOA switch for that pump to AUTO. In the automatic mode, the lead dewatering feed pump shall turn on from a signal from the screw press control panel. The screw press system shall be put into the automatic mode by placing the HOA switch in the AUTO position on the control panel. The polymer mix system and the dewatered sludge conveyor are set in the automatic mode by setting the HOA switch to AUTO. In the AUTO mode the operation shall be:

1. The screw press turns on and after a 15-second delay (adjustable) the dewatering feed pump (the correct pump is set at the screw press main control panel), polymer feed system, and dewatered sludge conveyor system all turn on. The system shall continue to operate until the pre-set number of gallons to be processed is met, the timer expires, or the operator turns the system to OFF.

2. When the system shuts down, the sludge feed pump and the polymer mix system are shut off immediately. The screw press continues to run for 5 minutes (adjustable) to allow the sludge to clear the press, then run the self-clean cycle. After the cleaning cycle is complete, the press is shut off. The dewatered sludge conveyors will continue to run for 20 minutes (operator adjustable) to allow the sludge to clear the conveyor and then shut off.

G. SCADA Control:

1. The number of gallons to be dewatered shall be set in SCADA.

2. The delay time for starting the dewatering feed pump, polymer system, and dewatering sludge conveyor shall be set in SCADA.

3. The additional run times for the screw press and dewatered sludge conveyor after shut down shall be set in SCADA.

H. Interlocks: The dewatering feed pumps, polymer mix system, and screw conveyors shall be interlocked with the screw press so that all of the equipment operates when the screw press is operating. The entire system shall shut down on failure of/alarms from the sludge feed pump, polymer system, screw press, or solids loading conveyor system.

I. Local Indicators: The screw press panel shall at a minimum have indicators or be available in the HMI for:

1. Run Status.

2. HOA switch for the screw press system, the spray drive, the polymer feed system, and the sludge feed pumps.

3. Failure alarm(s).

J. SCADA Indicators: As a minimum, the following indicators shall be provided at the SCADA screen.

1. HOA selector status for each dewatering feed pump, screw press, polymer mix system, and dewatered sludge conveyor system.

2. Screw press Forward-Off-Reverse switch.

3. Run status for each pump, polymer system, screw press and solids loading conveyor (red for off, green for on).

4. Pump speed for each pump.

5. Elapsed run time meter for each dewatering feed pump, dewatered sludge conveyor motor, polymer system, and screw press in tenths of an hour.

6. Digested sludge flow in gpm.

7. Totalized 24-hour digested sludge flow in gallons for previous day and the current day from midnight to midnight.

K. SCADA Alarms: As a minimum, the following alarms shall be provided to the SCADA system:

1. Pump Failure.

2. Polymer system common alarm.

3. Screw press failure.

4. Dewatered sludge conveyor failure.

5. Low air pressure.

6. Low water pressure.

END OF SECTION 40 61 96

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SECTION 40 62 00 – SCADA COMPUTERS AND SOFTWARE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide and install a PC-based Supervisory Control And Data Acquisition (SCADA) software system complete and operable, in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Submittals shall be in accordance with the applicable requirements of Sections 40 70 00 – Instrumentation and Control, General.

B. Shop Drawings: At a minimum, the following information shall be submitted for SCADA Computer and Software.

1. Data sheets and technical specifications for PC hardware and associated operating systems.

2. Data sheets and technical specification for SCADA software. Clearly identify version numbers, licensing information, point counts, and minimum hardware/OS requirements.

3. Contractor shall submit screen prints of SCADA overview displays and equipment control pop-ups for Owner review and approval.

C. Operation and Maintenance Manuals: The following items shall also be included in with the SCADA Operations and Maintenance Manuals:

1. A file containing a full backup of the SCADA application and instructions for a full restoration. Backup shall be the newest version of what is running on the system.

2. A tabular listing of all operating system and SCADA software version numbers, product keys, serial numbers, license numbers. Include source vendor name and contact information, support agreement numbers, and support plan expiration dates.

1.3 QUALITY ASSURANCE

A. Warranty: The Contractor shall provide a warranty for materials and labor on all installed equipment for a minimum period of one year from date of acceptance.

B. PC hardware shall be provided with a minimum 3-year manufacturer’s warranty.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and all equipment furnished under this Contract shall be new, free from defects, of first quality, and produced by manufacturers regularly engaged in the manufacture of these products.

B. Hardware Commonality: Where there is more than one item of similar equipment being furnished all such similar equipment shall be the product of a singular manufacturer.

C. All computer hardware software and other accessories required to form a complete system shall be provided. Parts may be required to complete the system that are not shown on the drawings but are the responsibility of the contractor to furnish in order to provide a complete, operable system.

D. All materials shall be UL listed.

2.2 SCADA COMPUTERS

A. SCADA Server. Located in Control building.

1. Minimum requirements:

Item	Specification
Operating System	Microsoft® Windows® Server 2022 Standard 64-Bit
CPU Processor	Intel® Xeon® E5, 20MB Cache, 8 cores
Memory	16GB
Hard Drives	2 x 2TB SATA 6Gb/s (7200rpm), Integrated RAID 0
Optical Drive	16X DVD+/-RW
Video	Dual Monitor support
Audio	Integrated
LAN	Integrated
2nd LAN Card	PCIe GbE
Keyboard	HP USB
Mouse	HP USB optical scroll mouse
Antivirus	Kapersky or Equal
Support / Warranty	3/3/3 (parts/labor/next business day on-site) limited warranty
Monitors	Two (2) 24-inch Flat Panel Displays – DisplayPort, built-in speakers.
UPS	Provide appropriately sized UPS by APC or equal.

2. Manufacturer, or equal:

a. Hewlett Packard Z440 Series Workstation

2.3 SCADA SOFTWARE

A. Existing licenses. Proficy oFIX

B. Provide the following on the SCADA Server:

1. Core Ignition System Platform with the perspective module unlimited.

a. Include Alarm Notification module with SMS notification module.

2. Microsoft SQL server.

a. Include reporting module.

3. Remote Desktop to support up to two simultaneous terminal sessions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to specification 40 70 00 – Instrumentation & Control, General for a general description of the work to be performed.

B. Configure up to eight existing Windows PCs for remote desktop access to SCADA Server. Pre-configure shortcuts for Owners use.

C. The SCADA server shall also be utilized as a runtime station.

3.2 SCADA DISPLAYS

A. All equipment status, alarms and other displays outlined in Specification 40 61 96 – Control Strategies shall be included in the integration of the SCADA system.

B. TAG Licensing: The Contractor and/or Programmer shall be responsible to provide software with sufficient number of TAGs to accommodate the Work outlined in the Contract Documents, with an additional 50% spare (minimum).

C. SCADA displays converted from existing applications shall retain the same look and operational function except as approved by owner/engineer.

D. Individual Display Navigational Buttons and Features: Provide updates to each and every existing window navigational feature for all existing display screens to provide access to any new or modified windows. Provide navigational features on all new displays that are logically needed to link or jump to connected or associated displays.

E. General Display Requirements: The Contractor shall configure the SCADA software to implement all functions specified in the Contract Documents. This includes providing new PLC and SCADA/OIT programming for all processes shown on the P&IDs and other modifications as included as part of this project. The Contractor will coordinate this Work with all Equipment Manufacturer Control Panels. This Work includes such configuration and programming as is required to perform data transfer and communication between local equipment control panels, PLCs and SCADA system.

1. SCADA/OIT displays shall be configured to maximize user friendliness for the operators. Each display shall include navigational devices to directly go to related displays and to the main menu display. The various required displays shall use text of all capital letters with the exception of certain engineering units. All text shall be horizontal. Screens showing equipment shall include the equipment number and name as used in the Contract Drawings. Each display shall show the current time and date which shall appear in the same place on each display.

2. SCADA displays refer to PC-Based SCADA computers.

3. OIT displays refer to local touchscreens to be installed in the door of PLC enclosures. OITs shall contain all functions and features associated with equipment and instruments in the local PLC.

4. The Contractor shall provide SCADA interface to vendor package systems as described in the associated Division 43 to 46 specifications. SCADA/OIT displays associated with vendor package systems that have a vendor provided OIT shall have a layout similar to the vendor OIT but follow graphic standard of the primary SCADA system.

F. Base Displays: The Contractor shall configure displays to show all status and analog data contained in the SCADA/OIT system database. Some status and analog points shall be displayed on more than one display, especially where it relates to more than one process or is significant to operation. Every analog and status value shall appear on at least one display. All scaling values, timers, setpoint (alarm and operational) shall appear on a display. All values that may possibly be changed in the future shall appear on a display. Analog values shall be displayed with appropriate engineering units, and shall use techniques such as variable fill and/or color changes to provide clarity to operators. Status points shall incorporate symbol and/or color changes along with labels (Open/Close, On/Off, etc.) to inform operators of the current status.

G. Control Pop-Ups: The Programmer shall configure Control Pop-ups to allow operators to access and modify control parameters as described in Section 40 61 96 - Control Strategies.

1. Control functions shall in general be accessible from a point and click target within the related display(s) and by name. Control functions may be incorporated into the appropriate display. Control functions shall not be possible directly from a base display.

2. The entry of setpoints for analog scaling, alarming, etc. shall be in a fashion similar to the existing displays. The Programmer shall confirm the setpoint entry method with the Owner prior to the first display submittal, and shall use the Owner's preferred setpoint entry method for all SCADA displays developed under this Contract.

H. Trend Displays: The Programmer shall provide trend displays to include all processes and sub processes provided or modified as part of this project. In general, each trend display shall show real time and historical process data in an X- Y plot with time on the horizontal axis. Trend displays shall be configured as listed below with from one to six process variables displayed. Each variable shall be drawn in a separate color with its vertical axis, scale, units, tag number, and description shown in the same color. All variables on a trend display shall be shown on a single full display X- Y plot with a vertical axis and scale for each variable, and a common horizontal time axis.

1. All analog values shall be trended.

2. Some trends shall be displayed on more than one display. Logically group analog values to provide informative display of process operation.

I. Alarm System Displays: The system shall provide Alarm display and acknowledge capabilities. Alarms, along with detailed configuration requirements, are described in Section 40 61 96 – Control Strategies.

1. Only those alarms identified in the Contract Documents shall have setpoints entered by the Programmer. All setpoints shall be able to be easily entered, by personnel with the required security level.

J. Reports: The Programmer shall configure reports as defined in sections 40 70 00 which shall be processed as required by the Owner. Operator shall be able to toggle a pushbutton at the SCADA/OMI to enable/disable printing of each of the reports. Each report shall be able to be displayed on the SCADA/OMI terminal and shall also be logged to the SCADA/OMI's hard disk, in the same manner as the existing reports.

1. Each report shall include a report title, header and footer information, and other applicable features as found on reports currently generated by the system. Reports which require multiple pages to print shall include page numbers and suitable column(s) printed at the top of each page. Said columns shall include at least the date and day of the week for monthly reports. Reports which include calculations shall automatically display N/A if required data to perform that calculation is not available rather than performing the calculation with an implied zero.

2. All reports shall include variable tag names, if applicable, and descriptions. Engineering units for all values shall be displayed. Numerical formats shall be included. Column headings shall be clear and concise and any abbreviations shall be commonly accepted.

3. Reports shall include minimum, maximum, and average hourly or daily values for trended variables or other numerically significant variables such as equipment run times, out of service times, etc. as currently generated by the SCADA system or as determined by the Engineer. Where applicable, existing reports shall be modified to incorporate changes made to the plant as part of this project. The following reports shall be included as a minimum:

    a. Daily Report

    b. Weekly Report

    c. Monthly Report

4. The Programmer shall test the report at least twice during startup using real process data. The resultant reports shall be submitted to the Engineer for checking and approval. The Programmer shall repeat the tests at no additional cost to the Owner until the spreadsheet calculations are correct and the reports conform to the Contract Document requirements.

K. Security: The use of security levels and entry of security passwords shall be in a fashion similar to the existing SCADA displays. Security levels within the current system shall be incorporated into all new displays and appropriate SCADA/OIT components. Security levels for viewing, changing operator settings, and tunable values as defined in the control strategies shall equal existing security levels for similar displays or components. The Programmer shall confirm the security methods and levels with the Owner prior to the first SCADA/OIT display submittal and shall use the Owner's preferred security methods for all displays developed under this Contract.

END OF SECTION 40 62 00

SECTION 40 63 43 – PLC-BASED CONTROL SYSTEM HARDWARE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor, through the use of the Instrumentation and Control System Contractor (ICSC), shall provide a PLC-based control system (PLCS) complete and operable, in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Submittals shall be in accordance with the applicable requirements of Section 40 70 00 – Instrumentation and Control, General and Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: The PLC hardware submittal shall be included with the control panel submittals per Section 40 67 00 – Control Panels. PLC hardware submittals shall include but are not limited to the following:

1. Data sheets shall be included for each PLCS component together with a technical product brochure or bulletin. These data sheets shall show the component name as used within the Contract Documents, the manufacturer's model number or other identifying product designation, the project tag number, the project system of which it is a part, the input and output characteristics, the requirements for electric power, the ambient operating condition requirements, and details on materials of construction.

2. Complete and detailed bills of materials: A bill of material list, including quantity, description, manufacturer, and part number, shall be submitted for each component of the PLC system. Bills of material shall include all items within an enclosure.

3. Proposed version of PLC firmware.

C. UPS and battery load calculations to show that the backup capacity and time meet the specified requirements. Operation and Maintenance Manuals: The following items shall also be included in with the SCADA Operations and Maintenance Manuals:

1. All PLC control panel drawings.

2. All control panel and PLC submittal information.

3. A CD or DVD containing a pdf of documented PLC program and copy of the downloadable source code.

1.3 QUALITY ASSURANCE

A. Special warranty requirements shall be in accordance with the applicable requirements of Section 40 70 00 – Instrumentation and Control, General.

B. Equipment, software, and materials which do not achieve design requirements after installation shall be replaced or modified by the Contractor to attain compliance. The cost for doing so shall be the Contractor's responsibility. Following replacement or modification, the Contractor shall retest the system and perform any additional procedures needed to place the complete PLC in satisfactory operation and attain design compliance approval from the Engineer.

C. The Contractor warrants the materials and workmanship used for the PLCS equipment and materials and further guarantees the materials and workmanship used for any equipment and materials produced and furnished hereunder as a part of the Work to be as required and agreed upon, free from injurious defects, and in all respects satisfactory for the service required.

D. The Contractor warrants/guarantees the satisfactory performance of the equipment and materials under operating conditions for a period of two years after the date of final acceptance. In the event that tests and inspections disclose latent defects or failure to meet the specified requirements, the Contractor upon notification by the Owner shall proceed at once to correct or repair any such defects or non-conformance or to furnish, at the delivery point named in the Contract Documents, such new equipment or parts as may be necessary for conformity to the requirements, and shall receive no additional compensation therefore. In case of any required repairs or other corrective or remedial work covered under warranty, the warranties on all such corrections, repairs, new equipment, or parts shall be extended for an additional 24 months from the date of final acceptance or 12 months from the date of completion of any such corrections, repairs, new equipment, or parts, whichever date is later. If the Owner performs repair, the Contractor shall reimburse the Owner for all costs incurred in the removal of the defective material and installation of the replacement.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and all equipment furnished under this Contract shall be new, free from defects, of first quality, and produced by manufacturers regularly engaged in the manufacture of these products.

B. Hardware Commonality: Where there is more than one item of similar equipment being furnished all such similar equipment shall be the product of a singular manufacturer.

C. All PLCs, I/O modules, power supplies and other accessories required to form a complete system shall be provided. Parts may be required to complete the system that are not shown on the drawings but are the responsibility of the Contractor to furnish in order to provide a complete, operable system.

D. All materials shall be UL listed.

2.2 PLC ENCLOSURES

A. Each PLC and its corresponding I/O modules, power supply module(s), communication interface device(s), and peripheral equipment shall be mounted inside suitable enclosures. All I/O wiring from the field to the I/O modules shall be terminated on terminal blocks in the enclosure.

B. PLC enclosures shall be provided in accordance with Section 40 67 00 - Control Panels.

2.3 PROGRAMMABLE LOGIC CONTROLLER (PLC)

A. PLCs shall be provided for locations listed in Section 40 70 00 – Instrumentation and Control, General.

B. Each PLC shall be of solid-state design. All CPU operating logic shall be contained on plug-in modules for quick replacement. Chassis wired logic is not acceptable. The controller shall be capable of operating in a hostile industrial environment and designed to provide high reliability specifically in this process application. The internal wiring of the controller is to be fixed, with the logic functions it must perform in a given application to be programmed into its memory. The controller shall be supplied with the CPU, input/output scanner, inputs, outputs, memory, power supply, and all power and interface cables necessary to function as a complete and operable PLC system. Each PLC shall be furnished with multiple onboard communication ports to support all communication functions as outlined by Drawings and other Contract Documents.

C. Central Processors (CPU): Each CPU shall contain all the relays, timers, counters, number storage registers, shift registers, sequencer, arithmetic capability, and comparators necessary to perform the indicated control functions. It shall be capable of interfacing sufficient discrete inputs, analog inputs, discrete outputs, and analog outputs to meet requirements plus excess capacity as described above. Specifically, the PLCs shall have the following features and capabilities:

1. The CPU within the system shall perform internal diagnostic checking and give visual indication to the user by illuminating a "green" indicator when no fault is detected and a "red" indicator when a fault is detected.

2. Non-volatile memory shall store the operating system information to protect against loss in the case of power loss or system shut-down. Only at the time of a hardware change shall this configuration status be altered or reentered.

3. PLC firmware shall be the most currently available from the manufacturer at the time of hardware procurement.

D. Program Creation and Storage (Memory): Memory capacity shall be configurable to allow for the most efficient match to the intended application. It shall be possible to upgrade to a processor with a larger memory size simply by saving a program, replacing the processor, and downloading the program to the new system without having to make any program changes.

1. The operator shall be able to backup volatile memory, including data and program logic onto either CD-Rom or external hard disk, at their option.

2. Each unit shall be supplied with sufficient memory to implement the indicated control functions plus a reserve capacity. This reserve capacity shall be totally free from any system use. The memory shall be programmed in a multi-mode configuration with multiple series or parallel contacts, counters, timers, and arithmetic functions.

E. PLC Power Supply: The PLC shall operate in compliance with an electrical service of either 120 VAC, single phase; in the frequency range from 47 to 63 Hz, or 24 VDC. The power supply shall be mounted in the PLC housing and be sized to power all modules mounted in that housing and an "average module load" for any empty housing slots plus 25 percent above that total. Power supply shall be by the same manufacturer as the PLC and shall be of the same product line. A single main power supply shall have the capability of supplying power to the CPU and local input/output modules. Auxiliary power supplies shall provide power to remotely located racks.

1. Design features of the PLC power supply shall include diagnostic indicators mounted in a position to be easily viewed by the user.

2. The power supply shall offer fuse protection.

F. PLC Input/Output (I/O) Modules: All I/O housings and modules shall be suitable for hostile industrial environments as described above. All I/O modules shall be isolated and conform to IEEE Surge Withstand Standards and NEMA Noise Immunity Standards.

1. Modules shall be removable without having to disconnect wiring from the module's terminals by means of a swing-arm or plug-in wiring connector.

2. Each PLC I/O location shall contain the I/O modules required to provide all of the I/O points contained in the I/O Lists.

3. 20% Spare I/O capacity shall be provided.

G. Manufacturer, without exception: PLCs shall be Allen Bradley CompactLogix 5380 Series. All Processors, Power Supplies, Ethernet Modules, Chassis, and IO cards will be of the same CompactLogix 5380 family.

2.4 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Provide and install UPSs to power each PLC per requirements listed in Section 40 67 00 – Control Panels.

2.5 OPERATOR INTERFACE TERMINAL (OIT)

A. The PLC panels as indicated on the Drawings shall be provided with a panel mounted industrial Operator Interface Terminal.

1. Provide 512 MB memory and 512 MB Flash/RAM.

2. Provide with Ethernet/IP communications.

B. Manufacturer, or similar.

1. Inductive Automation Ignition EDGE Panel

2. Allen Bradley Panelview Plus 7 Performance Terminal, 12 inches

2.6 SOFTWARE

A. The Contractor shall provide one copy of PLC programming software licensed in the name of the Owner. Programming software shall be installed on the SCADA Server.

B. Manufacturer, without exception:

1. Rockwell Studio 5000 Full Edition.

2.7 REDUNDANCY

A. PLC redundancy not required.

2.8 SPARE PARTS

A. Spare parts shall be provided in original manufacturer packaging with unbroken seals.

B. Provide the following spare parts:

1. Quantity one (1) spare PLC Power supply.

2. Quantity one (1) spare PLC Processor.

3. Quantity one (1) spare PLC Ethernet Bridge Module.

4. Quantity one (1) spare PLC I/O module for each type required in each PLC.

5. Provide all other manufacturer recommended PLC system spare parts.

PART 3 - EXECUTION

3.1 STORAGE AND HANDLING

A. All equipment and materials delivered to the Site shall be stored in a location which shall not interfere with the operations of the Owner's personnel or interfere with construction. Storage and handling shall be performed in a manner which shall afford maximum protection to the equipment and materials. It is the Contractor's responsibility to assure proper handling and on-site storage.

3.2 INSTALLATION

A. The Contractor shall utilize personnel to accomplish, or supervise the physical installation of all elements, components, accessories, or assemblies which it provides. The Contractor shall employ installers who are skilled and experienced in the installation and connection of all elements, components, accessories, and assemblies it provides.

3.3 CALIBRATION, TESTING, AND COMMISSIONING

A. Provide calibration, testing, and commissioning as specified in Section 40 79 23 – Testing, Calibration, and Commissioning.

END OF SECTION 40 63 43

DEVICE	TAG	I/O TAGNAME	P&ID	CONTROLLER	TYPE	DESCRIPTION	ANALOG SIGNAL LEVEL	DISCRETE SIGNAL LEVEL	OFF/4 mA	ON/20 mA	POWER	NOTES
FIT-1020	FI	FIT_1020_FI	EI-701-A	A-PLC-01	AI	INFLUENT FLOW	4-20 mA		0GPM	4000GPM	EXISTING	
FIT-1020	FQI	FIT_1020_FQ	EI-701-A	A-PLC-01	DI	INFLUENT TOTAL FLOW		120V	EXISTING	EXISTING		WIRED TO SIGNAL SPLITTER
LIT-1001	LI	LIT_1001_LI	EI-701-A	A-PLC-01	AI	FINE SCREEN #1 LEVEL	ETHERNET		EXISTING	EXISTING	EXISTING	
SCR-1	YA	SCR_1_YA	EI-701-A	A-PLC-01	DI	FINE SCREEN #1 FAIL	ETHERNET		GOOD	FAILED		
LT-1008	LAH	LT_1008_LAH	EI-701-A	A-PLC-01	DI	FINE SCREEN #2 HIGH LEVEL ALARM	ETHERNET		NO ALARM	ALARM	120V	
SCR-2	YI	SCR_2_YI	EI-701-A	A-PLC-01	DI	FINE SCREEN #2 RUNNING	ETHERNET		NOT RUNNING	RUNNING	EXTERNAL	
SCR-2	YA	SCR_2_YA	EI-701-A	A-PLC-01	DI	FINE SCREEN #2 OVERLOAD	ETHERNET		NO ALARM	OVERLOAD		
GP-1	YA	GP_1_YA	EI-701-A	A-PLC-01	DI	GRIT CLASSIFIER PUMP 60-110A FAIL		120V	GOOD	FAILED	EXISTING	
GP-1	YI	GP_1_YI	EI-701-A	A-PLC-01	DI	GRIT CLASSIFIER PUMP 60-110A E-STOP		120V	STOP	GOOD		
GC-1	YA	GC_1_YA	EI-701-A	A-PLC-01	DI	GRIT CLASSIFIER GRIT 60-110B FAIL		120V	GOOD	FAILED	EXISTING	
GC-1	YI	GC_1_YI	EI-701-A	A-PLC-01	DI	GRIT CLASSIFIER GRIT 60-110B E-STOP		120V	STOP	GOOD		
ASH-1001-1	AAH	ASH_1001-1 _AAH	EI-701-A	A-PLC-01	DI	1001-1 LEL LEVEL DETECTED HIGH		120V	GOOD	LEVEL HIGH	EXISTING	
ASH-1001-2	AAH	ASH_1001-2_AAH	EI-701-A	A-PLC-01	DI	1001-2 H2S LEVEL DETECTED HIGH		120V	GOOD	LEVEL HIGH	EXISTING	

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DEVICE	TAG	I/O TAGNAME	P&ID	CONTROLLER	TYPE	DESCRIPTION	ANALOG SIGNAL LEVEL	DISCRETE SIGNAL LEVEL	OFF/4 mA	ON/20 mA	POWER	NOTES
PMP-0101	YI.AM	PMP_0101_YI.AM	EI-702-A	A-PLC-01	DI	PMP-0101 AUTO/MANUAL	ETHERNET		OFF	ON		
PMP-0101	SC	PMP_0101_SC	EI-702-A	A-PLC-01	AO	PMP-0101 SPEED CONTROL	ETHERNET		0	60HZ		
PMP-0101	YI.LR	PMP_0101_YI.LR	EI-702-A	A-PLC-01	DI	PMP-0101 LOCAL/REMOTE	ETHERNET		IN LOCAL	IN REMOTE		
PMP-0101	SI	PMP_0101_SI	EI-702-A	A-PLC-01	AI	PMP-0101 SPEED INDICATE	ETHERNET		0	60HZ		
PMP-0101	KI.ACC	PMP_0101_KI.ACC	EI-702-A	A-PLC-01	AI	PMP-0101 ETM	ETHERNET				EXTERNAL	
PMP-0101	YA	PMP_0101_YA	EI-702-A	A-PLC-01	DI	PMP-0101 FAIL	ETHERNET		GOOD	FAILED		
PMP-0101	YA.ES	PMP_0101_YA.ES	EI-702-A	A-PLC-01	DI	PMP-0101 ESTOP	ETHERNET		STOP	GOOD		
PMP-0101	II	PMP_0101_II	EI-702-A	A-PLC-01	AI	PMP-0101 MOTOR CURRENT	ETHERNET		0			
PMP-0101	TAH	PMP_0101_TAH	EI-702-A	A-PLC-01	AI	PMP-0101 TEMPERATURE ALARM HIGH	ETHERNET		NO ALARM	ALARM		
PMP-0102	YI.AM	PMP_0102_YI.AM	EI-702-A	A-PLC-01	DI	PMP-0102 HAND SWITCH	ETHERNET		OFF	ON		
PMP-0102	SC	PMP_0102_SC	EI-702-A	A-PLC-01	AO	PMP-0102 SPEED CONTROL	ETHERNET		0	60HZ		
PMP-0102	YI.LR	PMP_0102_YI.LR	EI-702-A	A-PLC-01	DI	PMP-0102 IN REMOTE	ETHERNET		IN LOCAL	IN REMOTE		
PMP-0102	SI	PMP_0102_SI	EI-702-A	A-PLC-01	AI	PMP-0102 SPEED INDICATE	ETHERNET		0	60HZ		
PMP-0102	KI.ACC	PMP_0102_KI.ACC	EI-702-A	A-PLC-01	AI	PMP-0102 ETM	ETHERNET				EXTERNAL	
PMP-0102	YA	PMP_0102_YA	EI-702-A	A-PLC-01	DI	PMP-0102 FAIL	ETHERNET		NO ALARM	ALARM		
PMP-0102	YA.ES	PMP_0102_YA.ES	EI-702-A	A-PLC-01	DI	PMP-0102 ESTOP	ETHERNET		STOP	GOOD		
PMP-0102	II	PMP_0102_II	EI-702-A	A-PLC-01	AI	PMP-0102 MOTOR CURRENT	ETHERNET		0			
PMP-0102	TAH	PMP_0102_TAH	EI-702-A	A-PLC-01	DI	PMP-0102 TEMPERATURE ALARM HIGH	ETHERNET		NO ALARM	ALARM		
PMP-0103	YI.AM	PMP_0103_YI.AM	EI-702-A	A-PLC-01	DI	PMP-0103 HAND SWITCH	ETHERNET		OFF	ON		
PMP-0103	SC	PMP_0103_SC	EI-702-A	A-PLC-01	AO	PMP-0103 SPEED CONTROL	ETHERNET		0	60HZ		
PMP-0103	YI.LR	PMP_0103_YI.LR	EI-702-A	A-PLC-01	DI	PMP-0103 IN REMOTE	ETHERNET		IN LOCAL	IN REMOTE		
PMP-0103	SI	PMP_0103_SI	EI-702-A	A-PLC-01	AI	PMP-0103 SPEED INDICATE	ETHERNET		0	60HZ		
PMP-0103	KI.ACC	PMP_0103_KI.ACC	EI-702-A	A-PLC-01	AI	PMP-0103 ETM	ETHERNET				EXTERNAL	
PMP-0103	YA	PMP_0103_YA	EI-702-A	A-PLC-01	DI	PMP-0103 FAIL	ETHERNET		GOOD	FAILED		
PMP-0103	YA.ES	PMP_0103_YA.ES	EI-702-A	A-PLC-01	DI	PMP-0103 ESTOP	ETHERNET		STOP	GOOD		
PMP-0103	II	PMP_0103_II	EI-702-A	A-PLC-01	AI	PMP-0103 MOTOR CURRENT	ETHERNET		0			
PMP-0103	TAH	PMP_0103_TAH	EI-702-A	A-PLC-01	DI	PMP-0103 TEMPERATURE ALARM HIGH	ETHERNET		GOOD	TEMPURATURE HIGH		
LT-60-140	LI	LT_60-140_LI	EI-702-A	A-PLC-01	AI	LEVEL	ETHERNET		EXISTING	EXISTING	EXISTING	
LSH-61-100	LAHH	LSH_61-100_LAHH	EI-702-A	A-PLC-01	DI	HIGH LEVEL	ETHERNET		NO ALARM	ALARM	EXISTING	
LSL61-100B	LALL	LSL61_100B_LALL	EI-702-A	A-PLC-01	DI	LOW LEVEL	ETHERNET		NO ALARM	ALARM	EXISTING	
LS-0101	SP.OFF	LS_0101_SP.OFF	EI-702-A	A-PLC-01	DI	LOW LEVEL PUMPS OFF	ETHERNET		OPEN	CLOSED	EXISTING	
LS-0102	SP.LG2	LS_0105_SP.LG2	EI-702-A	A-PLC-01	DI	PEAK FLOW LEVEL LAG PUMP ON	ETHERNET		OPEN	CLOSED	EXISTING	
LS-0103	SP.LD2	LS_0102_SP.LD2	EI-702-A	A-PLC-01	DI	NORMAL FLOW LEVEL LEAD PUMP ON	ETHERNET		OPEN	CLOSED	EXISTING	
LS-0104	SP.LG1	LS_0103_SP.LG1	EI-702-A	A-PLC-01	DI	NORMAL FLOW LEVEL LAG PUMP ON	ETHERNET		OPEN	CLOSED	EXISTING	
LS-0105	SP.LD1	LS_0104_SP.LD1	EI-702-A	A-PLC-01	DI	PEAK FLOW LEVEL LEAD PUMP ON	ETHERNET		OPEN	CLOSED	EXISTING	
A-ATS-01	ZI.UP	A_ATS-01_ZI.UP	EI-702-A	A-PLC-01	DI	A-ATS-01 UTILITY POWER		120V	STANDBY POWER	UTILITY POWER	EXTERNAL	
A-ATS-01	ZI.EP	A_ATS-01_ZI.EP	EI-702-A	A-PLC-01	DI	A-ATS-01 STANDBY POWER		120V	UTILITY POWER	STANDBY POWER		
A-ATS-01	YI	A_ATS-01_YI	EI-702-A	A-PLC-01	DI	A-ATS-01 SYSTEM STATUS		120V	NOT RUNNING	RUNNING		
GEN-02	YI.AM	GEN_02_YI.AM	EI-702-A	A-PLC-01	DI	SYSTEM IN AUTO		120V	MANUAL	IN AUTO	EXTERNAL	RE-USE EXISTING I/O POINT
GEN-02	YI	GEN_02_YI	EI-702-A	A-PLC-01	DI	GENERATOR RUNNING		120V	NOT RUNNING	RUNNING		RE-USE EXISTING I/O POINT
GEN-02	YA	GEN_02_YA	EI-702-A	A-PLC-01	DI	GENERATOR FAULT		120V	NO ALARM	ALARM		RE-USE EXISTING I/O POINT
ATS-02	ZI.UP	ATS_02_ZI.UP	EI-702-A	A-PLC-01	DI	ATS-02 UTILITY POWER		120V	STANDBY POWER	UTILITY POWER	EXTERNAL	
ATS-02	ZI.EP	ATS_02_ZI.EP	EI-702-A	A-PLC-01	DI	ATS-02 STANDBY POWER		120V	UTILITY POWER	STANDBY POWER		
ATS-02	YA	ATS_02_YA	EI-702-A	A-PLC-01	DI	ATS-02 SYSTEM STATUS (ON)		120V	NOT RUNNING	RUNNING		

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DEVICE	TAG	I/O TAGNAME	P&ID	CONTROLLER	TYPE	DESCRIPTION	ANALOG SIGNAL LEVEL	DISCRETE SIGNAL LEVEL	OFF/4 mA	ON/20 mA	POWER	NOTES
AIT-2002	AI	AIT_2002_AI	EI-701-B	PLC-100-B2	AI	IFAS DO CONCENTRATION TRAIN #2	4-20 mA		0%	100%	120V	VENDOR PLC
AIT-2002	TI	AIT_2002_TI	EI-701-B	PLC-100-B2	AI	IFAS TEMPERATURE TRAIN #2	4-20 mA		0°F	100°F		VENDOR PLC
LSH-2003	LAH	LSH_2003_LAH	EI-701-B	PLC-100-B2	DI	IFAS HIGH WATER ALARM BASIN #2A		24V	NO ALARM	HIGH WATER	N/A	VENDOR PLC
AIT-2004	AI	AIT_2004_AI	EI-701-B	PLC-100-B2	AI	IFAS DO CONCENTRATION TRAIN #1	4-20 mA		0%	100%	120V	VENDOR PLC
TIT-2004	TI	TIT_2004_TI	EI-701-B	PLC-100-B2	AI	IFAS TEMPERATURE TRAIN #1	4-20 mA		0°F	100°F		VENDOR PLC
LSH-2005	LAH	LSH_2005_LAH	EI-701-B	PLC-100-B2	DI	IFAS HIGH WATER ALARM BASIN #1A		24V	NO ALARM	HIGH WATER	N/A	VENDOR PLC
LSH-2006	LAH	LSH_2006_LAH	EI-701-B	PLC-100-B2	DI	IFAS HIGH WATER ALARM BASIN#2B		24V	NO ALARM	HIGH WATER	N/A	VENDOR PLC
LT-2007	LI	LT_2007_LI	EI-701-B	PLC-100-B2	AI	IFAS BASIN LEVEL TRAIN #2	4-20 mA		0'0"	13'6"	LOOP	VENDOR PLC
LT-2008	LI	LT_2008_LI	EI-701-B	PLC-100-B2	AI	IFAS BASIN LEVEL TRAIN #1	4-20 mA		0'0"	13'6"	LOOP	VENDOR PLC
SV-2009	ZCO	SV_2009_ZCO	EI-701-B	PLC-100-B2	DO	CYLINDRICAL SCREEN SCOUR COMMAND BASIN #1A		24V	CLOSE	OPEN	120V	VENDOR PLC
SV-2010	ZCO	SV_2010_ZCO	EI-701-B	PLC-100-B2	DO	CYLINDRICAL SCREEN SCOUR COMMAND BASIN #2A		24V	CLOSE	OPEN	120V	VENDOR PLC
SV-2013	ZCO	SV_2013_ZCO	EI-701-B	PLC-100-B2	DO	CYLINDRICAL SCREEN SCOUR COMMAND BASIN #2B		24V	CLOSE	OPEN	120V	VENDOR PLC
SV-2014	ZCO	SV_2014_ZCO	EI-701-B	PLC-100-B2	DO	CYLINDRICAL SCREEN SCOUR COMMAND BASIN #1B		24V	CLOSE	OPEN	120V	VENDOR PLC
LSH-2015	LAH	LSH_2015_LAH	EI-701-B	PLC-100-B2	DI	IFAS HIGH WATER ALARM BASIN #1B		24V	NO ALARM	HIGH WATER	N/A	VENDOR PLC

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DEVICE	TAG	I/O TAGNAME	P&ID	CONTROLLER	TYPE	DESCRIPTION	ANALOG SIGNAL LEVEL	DISCRETE SIGNAL LEVEL	OFF/4 mA	ON/20 mA	POWER	NOTES
TSH-2101	TAH	TSH_2101_TAH	EI-701-B2	PLC-100-B2	DI	BLOWER #1 HIGH TEMPERATURE	ETHERNET		NO ALARM	ALARM ON	N/A	
TSH-2102	TAH	TSH_2102_TAH	EI-701-B2	PLC-100-B2	DI	BLOWER #2 HIGH TEMPERATURE	ETHERNET		NO ALARM	ALARM	N/A	
TSH-2103	TAH	TSH_2103_TAH	EI-701-B2	PLC-100-B2	DI	BLOWER# 3 HIGH TEMPERATURE	ETHERNET		NO ALARM	ALARM	N/A	
FIT-2104	FI	FIT_2104_FI	EI-701-B2	PLC-100-B2	AI	IFAS TRAIN #1 AIR FLOW	ETHERNET		BY VENDOR	BY VENDOR	120V	VENDOR PLC
FIT-2105	FI	FIT_2105_FI	EI-701-B2	PLC-100-B2	AI	IFAS TRAIN #2 AIR FLOW	ETHERNET		BY VENDOR	BY VENDOR	120V	VENDOR PLC
VFD-B1	SI	VFD_B1_SI	EI-701-B2	PLC-100-B2	AI	SPEED FEEDBACK	ETHERNET		0HZ	60HZ	EXTERNAL	VENDOR PLC
VFD-B1	YC	VFD_B1_YC	EI-701-B2	PLC-100-B2	DO	START/RUN	ETHERNET		STANDBY	START		VENDOR PLC
VFD-B1	YI.AM	VFD_B1_YI.AM	EI-701-B2	PLC-100-B2	DI	AUTO/MANUAL	ETHERNET		MANUAL	AUTO		VENDOR PLC
VFD-B1	YI	VFD_B1_YI	EI-701-B2	PLC-100-B2	DI	RUNNING	ETHERNET		NOT RUNNING	RUNNING		VENDOR PLC
VFD-B1	YA	VFD_B1_YA	EI-701-B2	PLC-100-B2	DI	FAULT	ETHERNET		NO ALARM	ALARM		VENDOR PLC
VFD-B1	SC	VFD_B1_SC	EI-701-B2	PLC-100-B2	AO	SPEED COMMAND	ETHERNET		0HZ	60HZ		VENDOR PLC
VFD-B2	SI	VFD_B2_SI	EI-701-B2	PLC-100-B2	AI	SPEED FEEDBACK	ETHERNET		0HZ	60HZ	EXTERNAL	VENDOR PLC
VFD-B2	YC	VFD_B2_YC	EI-701-B2	PLC-100-B2	DO	START/RUN	ETHERNET		STANDBY	START		VENDOR PLC
VFD-B2	YI.AM	VFD_B2_YI.AM	EI-701-B2	PLC-100-B2	DI	AUTO/MANUAL	ETHERNET		MANUAL	AUTO		VENDOR PLC
VFD-B2	YI	VFD_B2_YI	EI-701-B2	PLC-100-B2	DI	RUNNING	ETHERNET		NOT RUNNING	RUNNING		VENDOR PLC
VFD-B2	YA	VFD_B2_YA	EI-701-B2	PLC-100-B2	DI	FAULT	ETHERNET		NO ALARM	ALARM		VENDOR PLC
VFD-B2	SC	VFD_B2_SC	EI-701-B2	PLC-100-B2	AO	SPEED COMMAND	ETHERNET		0HZ	60HZ		VENDOR PLC
VFD-B3	SI	VFD_B3_SI	EI-701-B2	PLC-100-B2	AI	SPEED FEEDBACK	ETHERNET		0HZ	60HZ	EXTERNAL	VENDOR PLC
VFD-B3	YC	VFD_B3_YC	EI-701-B2	PLC-100-B2	DO	START/RUN	ETHERNET		STANDBY	START		VENDOR PLC
VFD-B3	YI.AM	VFD_B3_YI.AM	EI-701-B2	PLC-100-B2	DI	AUTO/MANUAL	ETHERNET		MANUAL	AUTO		VENDOR PLC
VFD-B3	YI	VFD_B3_YI	EI-701-B2	PLC-100-B2	DI	RUNNING	ETHERNET		NOT RUNNING	RUNNING		VENDOR PLC
VFD-B3	YA	VFD_B3_YA	EI-701-B2	PLC-100-B2	DI	FAULT	ETHERNET		NO ALARM	ALARM		VENDOR PLC
VFD-B3	SC	VFD_B3_SC	EI-701-B2	PLC-100-B2	AO	SPEED COMMAND	ETHERNET		0HZ	60HZ		VENDOR PLC
FIT-1020	FI	FIT_1020_FI	EI-701-B2	PLC-100-B2	AO	INFLUENT FLOW	ETHERNET		0GPM	4000GPM	EXTERNAL	INPUT TO PLC REQUIRED BY VENDOR
FIT-3001	FI	FIT_3001_FI	EI-701-B2	PLC-100-B2	AO	RAS FLOW	ETHERNET		0GPM	4000GPM	EXTERNAL	INPUT TO PLC REQUIRED BY VENDOR
FIT-3002	FI	FIT_3002_FI	EI-701-B2	PLC-100-B2	AO	WAS FLOW	ETHERNET		0GPM	4000GPM	EXTERNAL	INPUT TO PLC REQUIRED BY VENDOR

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DEVICE	TAG	I/O TAGNAME	P&ID	CONTROLLER	TYPE	DESCRIPTION	ANALOG SIGNAL LEVEL	DISCRETE SIGNAL LEVEL	OFF/4 mA	ON/20 mA	POWER	NOTES
TS-3001	TAH	TS_3001_TAH	EI-701-C	PLC-RAS-1	DI	RAS PUMP #1 HIGH TEMPERATURE		24V	ALARM OFF	ALARM ON	EXISTING	
MS-3001	MAH	MS_3001_MAH	EI-701-C	PLC-RAS-1	DI	RAS PUMP #1 MOISTURE DETECTED		24V	ALARM OFF	ALARM ON		
PMP-3001	YA	PMP_3001_YA	EI-701-C	PLC-RAS-1	DI	RAS PUMP #1 COMMON FAULT		24V	ALARM OFF	ALARM ON		
TS-3002	TAH	TS_3002_TAH	EI-701-C	PLC-RAS-1	DI	RAS PUMP #2 HIGH TEMPERATURE		24V	ALARM OFF	ALARM ON	EXISTING	
MS-3002	MAH	MS_3002_MAH	EI-701-C	PLC-RAS-1	DI	RAS PUMP #2 MOISTURE DETECTED		24V	ALARM OFF	ALARM ON		
PMP-3002	YA	PMP_3002_YA	EI-701-C	PLC-RAS-1	DI	RAS PUMP #2 COMMON FAULT		24V	ALARM OFF	ALARM ON		
TS-3003	TAH	TS_3003_TAH	EI-701-C	PLC-RAS-2	DI	RAS PUMP #3 HIGH TEMPERATURE		24V	ALARM OFF	ALARM ON	EXISTING	
MS-3003	MAH	MS_3003_MAH	EI-701-C	PLC-RAS-2	DI	RAS PUMP #3 MOISTURE DETECTED		24V	ALARM OFF	ALARM ON		
PMP-3003	YA	PMP_3003_YA	EI-701-C	PLC-RAS-2	DI	RAS PUMP #3 COMMON FAULT		24V	ALARM OFF	ALARM ON		
TS-3004	TAH	TS_3004_TAH	EI-701-C	PLC-RAS-2	DI	RAS PUMP #4 HIGH TEMPURATURE		24V	ALARM OFF	ALARM ON	EXISTING	
MS-3004	MAH	MS_3004_MAH	EI-701-C	PLC-RAS-2	DI	RAS PUMP #4 MOISTURE DETECTED		24V	ALARM OFF	ALARM ON		
PMP-3004	YA	PMP_3004_YA	EI-701-C	PLC-RAS-2	DI	RAS PUMP #4 COMMON FAULT		24V	ALARM OFF	ALARM ON		
FIT-3001	FI	FIT_3001_FI	EI-701-C	PLC-100-E	AI	WAS FLOW TO DIGESTERS	4-20 mA		EXISTING	EXISTING	EXISTING	
FCV-3001	YA	FCV_3001_YA	EI-701-C	PLC-100-E	DI	MOTOR CONTROLLED WAS VALVE FAULT		24V	ALARM OFF	ALARM ON		
FIT-3002	FI	FIT_3002_FI	EI-701-C	PLC-100-E	AI	RAS FLOW TO IFAS	4-20 mA		EXISTING	EXISTING	EXISTING	
FCV-3002	YA	FCV_3002_YA	EI-701-C	PLC-100-E	DI	MOTOR CONTROLLED RAS VALVE FAULT		24V	ALARM OFF	ALARM ON		
CLA-1	YA	CLA_1_YA	EI-701-C	A-PLC-01	DI	CLA-1 CUTOUT DRIVE RAKE		24V	ALARM OFF	ALARM ON	EXISTING	
CLA-1	NAH	CLA_1_NAH	EI-701-C	A-PLC-01	DI	CLA-1 TORQUE ALARM HIGH		24V	ALARM OFF	ALARM ON		
CLA-2	YA	CLA_2_YA	EI-701-C	A-PLC-01	DI	CLA-2 CUTOUT DRIVE RAKE		24V	ALARM OFF	ALARM ON	EXISTING	
CLA-2	NAH	CLA_2_NAH	EI-701-C	A-PLC-01	DI	CLA-2 TORQUE ALARM HIGH		24V	ALARM OFF	ALARM ON		
CLA-3	YA	CLA_3_YA	EI-701-C	A-PLC-01	DI	CLA-3 CUTOUT DRIVE RAKE		24V	ALARM OFF	ALARM ON	EXISTING	
CLA-3	NAH	CLA_3_NAH	EI-701-C	A-PLC-01	DI	CLA-3 TORQUE ALARM HIGH		24V	ALARM OFF	ALARM ON		
CLA-4	YA	CLA_4_YA	EI-701-C	A-PLC-01	DI	CLA-4 CUTOUT DRIVE RAKE		24V	ALARM OFF	ALARM ON	EXISTING	
CLA-4	NAH	CLA_4_NAH	EI-701-C	A-PLC-01	DI	CLA-4 TORQUE ALARM HIGH		24V	ALARM OFF	ALARM ON		

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DEVICE	TAG	I/O TAGNAME	P&ID	CONTROLLER	TYPE	DESCRIPTION	ANALOG SIGNAL LEVEL	DISCRETE SIGNAL LEVEL	OFF/4 mA	ON/20 mA	POWER	NOTES
FIT-4001	FI	FIT_4001_FI	EI-701-D	RIO-4000	AI	FILTER INFLUENT FLOW	4-20 mA		0GPM	4000GPM	120V	
PSL-4014	PAL	PSL_4014_PAL	EI-701-D	RIO-4000	DI	HEADLOSS PRESSURE LOW		24V	NO ALARM	LOW PRESSURE	N/A	FROM VCP-4000
PSL-4013	PAL	PSL_4013_PAL	EI-701-D	RIO-4000	DI	LOW AIR PRESSURE		24V	NO ALARM	LOW PRESSURE	N/A	FROM VCP-4000
FIT-4002	FI	FIT_4002_FI	EI-701-D	RIO-4000	AI	FILTER EFFLUENT FLOW	4-20 mA		0GPM	4000GPM	120V	
FIL-4001	YC	FIL_4001_YC	EI-701-D	RIO-4000	DO	FIL-1 RUN COMMAND		24V	STANDBY	RUN COMMAND	N/A	
FIL-4001	YI	FIL_4001_YI	EI-701-D	RIO-4000	DI	FIL-1 RUNNING		24V	NOT RUNNING	RUNNING	N/A	
FIL-4002	YC	FIL_4002_YC	EI-701-D	RIO-4000	DO	FIL-2 RUN COMMAND		24V	STANDBY	RUN COMMAND	N/A	
FIL-4002	YI	FIL_4002_YI	EI-701-D	RIO-4000	DI	FIL-2 RUNNING		24V	NOT RUNNING	RUNNING	N/A	
FIL-4003	YC	FIL_4003_YC	EI-701-D	RIO-4000	DO	FIL-3 RUN COMMAND		24V	STANDBY	RUN COMMAND	N/A	
FIL-4003	YI	FIL_4003_YI	EI-701-D	RIO-4000	DI	FIL-3 RUNNING		24V	NOT RUNNING	RUNNING	N/A	
FIL-4004	YC	FIL_4004_YC	EI-701-D	RIO-4000	DO	FIL-4 RUN COMMAND		24V	STANDBY	RUN COMMAND	N/A	
FIL-4004	YI	FIL_4004_YI	EI-701-D	RIO-4000	DI	FIL-4 RUNNING		24V	NOT RUNNING	RUNNING	N/A	
FIL-4005	YC	FIL_4005_YC	EI-701-D	RIO-4000	DO	FIL-5 RUN COMMAND		24V	STANDBY	RUN COMMAND	N/A	
FIL-4005	YI	FIL_4005_YI	EI-701-D	RIO-4000	DI	FIL-5 RUNNING		24V	NOT RUNNING	RUNNING	N/A	

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DEVICE	TAG	I/O TAGNAME	P&ID	CONTROLLER	TYPE	DESCRIPTION	ANALOG SIGNAL LEVEL	DISCRETE SIGNAL LEVEL	OFF/4 mA	ON/20 mA	POWER	NOTES
LT-4101	LI	LT_4101_LI	EI-702-D	RIO-4000	AI	ALUM TANK LEVEL	4-20 mA		0	5'	LOOP	
YS-4102	YA	YS_4102_YA	EI-702-D	RIO-4000	DI	ALUM PIPING LEAK DETECTOR		24V	NO ALARM	LEAK DETECTED	120V	
PMP-4101	YI	PMP_4101_YI	EI-702-D	RIO-4000	DI	RUNNING		24V	LOCAL	REMOTE		
PMP-4101	YA	PMP_4101_YA	EI-702-D	RIO-4000	DI	FAULT		24V	ALARM OFF	ALARM ON		
PMP-4101	YC	PMP_4101_YC	EI-702-D	RIO-4000	DO	RUN/START		24V	OFF	RUN	EXTERNAL	
PMP-4101	SC	PMP_4101_SC	EI-702-D	RIO-4000	AO	SPEED REFERENCE	4-20 mA		0	60HZ		
PMP-4101	SI	PMP_4101_SI	EI-702-D	RIO-4000	AI	SPEED FEEDBACK	4-20 mA		0	60HZ		
PMP-4102	YI	PMP_4102_YI	EI-702-D	RIO-4000	DI	RUNNING		24V	LOCAL	REMOTE		
PMP-4102	YA	PMP_4102_YA	EI-702-D	RIO-4000	DI	FAULT		24V	ALARM OFF	ALARM ON		
PMP-4102	YC	PMP_4102_YC	EI-702-D	RIO-4000	DO	RUN/START		24V	OFF	RUN	EXTERNAL	
PMP-4102	SC	PMP_4102_SC	EI-702-D	RIO-4000	AO	SPEED REFERENCE		24V	0	60HZ		
PMP-4102	SI	PMP_4102_SI	EI-702-D	RIO-4000	AI	SPEED FEEDBACK		24V	0	60HZ		
PMP-4103	YI	PMP_4103_YI	EI-702-D	RIO-4000	DI	RUNNING		24V	LOCAL	REMOTE		
PMP-4103	YA	PMP_4103_YA	EI-702-D	RIO-4000	DI	FAULT		24V	ALARM OFF	ALARM ON		
PMP-4103	YC	PMP_4103_YC	EI-702-D	RIO-4000	DO	RUN/START		24V	OFF	RUN	EXTERNAL	
PMP-4103	SC	PMP_4103_SC	EI-702-D	RIO-4000	AO	SPEED REFERENCE	4-20 mA		0	60 HZ		
PMP-4103	SI	PMP_4103_SI	EI-702-D	RIO-4000	AI	SPEED FEEDBACK	4-20 mA		0	60 HZ		
PMP-4104	YI	PMP_4104_YI	EI-702-D	RIO-4000	DI	RUNNING		24V	LOCAL	REMOTE		
PMP-4104	YA	PMP_4104_YA	EI-702-D	RIO-4000	DI	FAULT		24V	ALARM OFF	ALARM ON		
PMP-4104	YC	PMP_4104_YC	EI-702-D	RIO-4000	DO	RUN/START		24V	OFF	RUN	EXTERNAL	
PMP-4104	SC	PMP_4104_SC	EI-702-D	RIO-4000	AO	SPEED REFERENCE	4-20 mA		0	60 HZ		
PMP-4104	SI	PMP_4104_SI	EI-702-D	RIO-4000	AI	SPEED FEEDBACK	4-20 mA		0	60 HZ		

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DEVICE	TAG	I/O TAGNAME	P&ID	CONTROLLER	TYPE	DESCRIPTION	ANALOG SIGNAL LEVEL	DISCRETE SIGNAL LEVEL	OFF/4 mA	ON/20 mA	POWER	NOTES
PMP-4201	YI	PMP_4201_YI	EI-703-D	RIO-4000	DI	RUNNING		24V	NOT RUNNING	RUNNING	EXTERNAL	
PMP-4201	YA	PMP_4201_YA	EI-703-D	RIO-4000	DI	FAULT		24V	LOCAL	REMOTE		
PMP-4201	YC	PMP_4201_YC	EI-703-D	RIO-4000	DO	RUN/START		24V	OFF	RUN		
PMP-4201	SC	PMP_4201_SC	EI-703-D	RIO-4000	AO	SPEED REFERENCE	4-20 mA		0	60HZ		
PMP-4201	SI	PMP_4201_SI	EI-703-D	RIO-4000	AI	SPEED FEEDBACK	4-20 mA		0	60HZ		
PMP-4201	YA	PMP_4201_YA	EI-703-D	RIO-4000	DI	FAULT		24V	NO ALARM	ALARM		
PMP-4202	YI	PMP_4202_YI	EI-703-D	RIO-4000	DI	RUNNING		24V	NOT RUNNING	RUNNING	EXTERNAL	
PMP-4202	YA	PMP_4202_YA	EI-703-D	RIO-4000	DI	FAULT		24V	LOCAL	REMOTE		
PMP-4202	YC	PMP_4202_YC	EI-703-D	RIO-4000	DO	RUN/START		24V	OFF	RUN		
PMP-4202	SC	PMP_4202_SC	EI-703-D	RIO-4000	AO	SPEED REFERENCE	4-20 mA		0	60HZ		
PMP-4202	SI	PMP_4202_SI	EI-703-D	RIO-4000	AI	SPEED FEEDBACK	4-20 mA		0	60HZ		
PMP-4202	YA	PMP_4202_YA	EI-703-D	RIO-4000	DI	FAULT		24V	NO ALARM	ALARM		

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DEVICE	TAG	I/O TAGNAME	P&ID	CONTROLLER	TYPE	DESCRIPTION	ANALOG SIGNAL LEVEL	DISCRETE SIGNAL LEVEL	OFF/4 mA	ON/20 mA	POWER	NOTES
VFD-4301	II	VFD_4301_II	EI-701-D1	RIO-4300	AI	MOTOR CURRENT	ETHERNET		0A	20A		
VFD-4301	YC	VFD_4301_YC	EI-701-D1	RIO-4300	DO	RUN COMMAND	ETHERNET		OFF	RUN		
VFD-4301	YC.RST	VFD_4301_YC.RST	EI-701-D1	RIO-4300	DO	RESET COMMAND	ETHERNET		OFF	RESET		
VFD-4301	YI.LR	VFD_4301_YI.LR	EI-701-D1	RIO-4300	DI	REMOTE	ETHERNET		LOCAL	REMOTE		
VFD-4301	YI	VFD_4301_YI	EI-701-D1	RIO-4300	DI	RUNNING	ETHERNET		NOT RUNNING	RUNNING		
VFD-4301	YA	VFD_4301_YA	EI-701-D1	RIO-4300	DI	FAULT	ETHERNET		ALARM OFF	ALARM ON	EXTERNAL	
VFD-4301	SI	VFD_4301_SI	EI-701-D1	RIO-4300	AI	SPEED FEEDBACK	ETHERNET		0	60HZ		
VFD-4301	SC	VFD_4301_SC	EI-701-D1	RIO-4300	AO	SPEED REFERENCE	ETHERNET		0	60HZ		
ME-4301	MAH	ME_4301_MAH	EI-701-D1	RIO-4300	DI	MOISTURE DETECTED	ETHERNET		ALARM OFF	ALARM ON		
TE-4301	TAH	TE_4301_TAH	EI-701-D1	RIO-4300	DI	HIGH TEMPERATURE	ETHERNET		ALARM OFF	HIGH TEMP		
VFD-4302	II	VFD_4302_II	EI-701-D1	RIO-4300	AI	MOTOR CURRENT	ETHERNET		0A	20A		
VFD-4302	YC	VFD_4302_YC	EI-701-D1	RIO-4300	DO	RUN COMMAND	ETHERNET		OFF	RUN		
VFD-4302	YC.RST	VFD_4302_YC.RST	EI-701-D1	RIO-4300	DO	RESET COMMAND	ETHERNET		OFF	RESET		
VFD-4302	YI.LR	VFD_4302_YI.LR	EI-701-D1	RIO-4300	DI	REMOTE	ETHERNET		LOCAL	REMOTE		
VFD-4302	YI	VFD_4302_YI	EI-701-D1	RIO-4300	DI	RUNNING	ETHERNET		NOT RUNNING	RUNNING		
VFD-4302	YA	VFD_4302_YA	EI-701-D1	RIO-4300	DI	FAULT	ETHERNET		ALARM OFF	ALARM ON	EXTERNAL	
VFD-4302	SI	VFD_4302_SI	EI-701-D1	RIO-4300	AI	SPEED FEEDBACK	ETHERNET		0	60HZ		
VFD-4302	SC	VFD_4302_SC	EI-701-D1	RIO-4300	AO	SPEED REFERENCE	ETHERNET		0	60HZ		
ME-4302	MAH	ME_4302_MAH	EI-701-D1	RIO-4300	DI	MOISTURE DETECTED	ETHERNET		ALARM OFF	ALARM ON		
TE-4302	TAH	TE_4302_TAH	EI-701-D1	RIO-4300	DI	HIGH TEMPERATURE	ETHERNET		ALARM OFF	HIGH TEMP		
VFD-4303	II	VFD_4303_II	EI-701-D1	RIO-4300	AI	MOTOR CURRENT	ETHERNET		0A	20A		
VFD-4303	YC	VFD_4303_YC	EI-701-D1	RIO-4300	DO	RUN COMMAND	ETHERNET		OFF	RUN		
VFD-4303	YC.RST	VFD_4303_YC.RST	EI-701-D1	RIO-4300	DO	RESET COMMAND	ETHERNET		OFF	RESET		
VFD-4303	YI.LR	VFD_4303_YI.LR	EI-701-D1	RIO-4300	DI	REMOTE	ETHERNET		LOCAL	REMOTE		
VFD-4303	YI	VFD_4303_YI	EI-701-D1	RIO-4300	DI	RUNNING	ETHERNET		NOT RUNNING	RUNNING		
VFD-4303	YA	VFD_4303_YA	EI-701-D1	RIO-4300	DI	FAULT	ETHERNET		ALARM OFF	ALARM ON	EXTERNAL	
VFD-4303	SI	VFD_4303_SI	EI-701-D1	RIO-4300	AI	SPEED FEEDBACK	ETHERNET		0	60HZ		
VFD-4303	SC	VFD_4303_SC	EI-701-D1	RIO-4300	AO	SPEED REFERENCE	ETHERNET		0	60HZ		
ME-4303	MAH	ME_4303_MAH	EI-701-D1	RIO-4300	DI	MOISTURE DETECTED	ETHERNET		ALARM OFF	ALARM ON		
TE-4303	TAH	TE_4303_TAH	EI-701-D1	RIO-4300	DI	HIGH TEMPERATURE	ETHERNET		ALARM OFF	HIGH TEMP		
LSHH-4307	LAHH	LSHH_4307_LAHH	EI-701-D1	RIO-4300	DI	WET WELL HIGH LEVEL		24V	ALARM OFF	HIGH LEVEL	N/A	
LSLL-4308	LALL	LSLL_4308_LALL	EI-701-D1	RIO-4300	DI	WET WELL LOW LEVEL		24V	ALARM OFF	LOW LEVEL	N/A	
LT-4309	LI	LT_4309_LI	EI-701-D1	RIO-4300	DI	WET WELL LEVEL	4-20 mA		0' 5"	9'	LOOP	

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DEVICE	TAG	I/O TAGNAME	P&ID	CONTROLLER	TYPE	DESCRIPTION	ANALOG SIGNAL LEVEL / DISCRETE SIGNAL LEVEL	OFF/4 mA	ON/20 mA	POWER	NOTES
LPF-1	YI	LPF_1_YI	EI-701-E	PLC-100-E	DI	POLYMER SYSTEM RUNNING	ETHERNET	NOT RUNNING	RUNNING		
LPF-1	YA	LPF_1_YA	EI-701-E	PLC-100-E	DI	POLYMER SYSTEM FAULT	ETHERNET	NO ALARM	FAULT		
LPF-1	SC	LPF_1_SC	EI-701-E	PLC-100-E	AO	POLYMER PUMP PACING	ETHERNET	0 HZ	60 HZ	EXTERNAL	
LPF-1	YI.LR	LPF_1_YI.LR	EI-701-E	PLC-100-E	DI	POLYMER SYSTEM LOCAL/REMOTE	ETHERNET	LOCAL	REMOTE		
LPF-1	YC	LPF_1_YC	EI-701-E	PLC-100-E	DO	POLYMER SYSTEM START/STOP	ETHERNET	STOP	START		
FIT-8005	FI	FIT_8005_FI	EI-701-E	PLC-100-E	AI	SCREW PRESS INLET SLUDGE FLOW	ETHERNET	0 GPM	15 GPM		
SCP-1A	YC	SCP_1A_YC	EI-701-E	PLC-100-E	DO	SCREW PRESS REMOTE START	ETHERNET	STANDBY	START		
SCP-1A	YA.ES	SCP_1A_YA.ES	EI-701-E	PLC-100-E	DI	SCREW PRESS E-STOP	ETHERNET	E-STOP HIT	NO ALARM		
SCP-1A	YI.AM	SCP_1A_YI.AM	EI-701-E	PLC-100-E	DI	SCREW PRESS AUTO	ETHERNET	MANUAL	AUTO		
SCP-1A	YI.FWD	SCP_1A_YI.FWD	EI-701-E	PLC-100-E	DI	SCREW PRESS FORWARD	ETHERNET	STANDBY	FORWARD		
SCP-1A	YI.REV	SCP_1A_YI.REV	EI-701-E	PLC-100-E	DI	SCREW PRESS REVERSE	ETHERNET	STANDBY	REVERSE		
SCP-1A	YI	SCP_1A_YI	EI-701-E	PLC-100-E	DI	SCREW PRESS RUNNING	ETHERNET	NOT RUNNING	RUNNING		
SCP-1A	YA	SCP_1A_YA	EI-701-E	PLC-100-E	DI	SCREW PRESS FAULT	ETHERNET	NO ALARM	FAULT		
SCP-1B	YI.FWD	SCP_1B_YI.FWD	EI-701-E	PLC-100-E	DI	SCREW PRESS SPRAY DRIVE FORWARD	ETHERNET	STANDBY	FORWARD	EXTERNAL	
SCP-1B	YI.REV	SCP_1B_YI.REV	EI-701-E	PLC-100-E	DI	SCREW PRESS SPRAY DRIVE REVERSE	ETHERNET	STANDBY	REVERSE		
SCP-1B	YI.AM	SCP_1B_YI.AM	EI-701-E	PLC-100-E	DI	SCREW PRESS SPRAY DRIVE AUTO	ETHERNET	MANUAL	AUTO		
SCP-1B	YI	SCP_1B_YI	EI-701-E	PLC-100-E	DI	SCREW PRESS SPRAY WASH RUNNING	ETHERNET	NOT RUNNING	RUNNING		
PT-8006	PI	PT_8006_PI	EI-701-E	PLC-100-E	AI	SCREW PRESS PRESSURE	ETHERNET	BY VENDOR	BY VENDOR		
PSL-8015	PAL	PSL_8015_PAL	EI-701-E	PLC-100-E	DI	SCREW PRESS LOW AIR PRESSURE	ETHERNET	NO ALARM	LOW PRESSURE		
PSL-8023	PAL	PSL_8023_PAL	EI-701-E	PLC-100-E	DI	SCREW PRESS WATER WASH LOW PRESSURE	ETHERNET	NO ALARM	LOW PRESSURE		
ZSC-8007	ZIC	ZSC_8007_ZIC	EI-701-E	PLC-100-E	DI	SCREW PRESS SPRAY DRIVE HOME	ETHERNET	STANDBY	HOME		
ZSC-8008	ZIC	ZSC_8008_ZIC	EI-701-E	PLC-100-E	DI	SCREW PRESS SPRAY DRIVE AWAY	ETHERNET	STANDBY	AWAY		
VFD-8001	YI.LR	VFD_8001_YI.LR	EI-701-E	PLC-100-E	DI	SLUDGE PUMP #1 AUTO/REMOTE	ETHERNET	AUTO	REMOTE		
VFD-8001	YI	VFD_8001_YI	EI-701-E	PLC-100-E	DI	SLUDGE PUMP #1 RUNNING	ETHERNET	NOT RUNNING	RUNNING		
VFD-8001	YA	VFD_8001_YA	EI-701-E	PLC-100-E	DI	SLUDGE PUMP #1 FAULT	ETHERNET	NO ALARM	FAULT		
VFD-8001	SC	VFD_8001_SC	EI-701-E	PLC-100-E	AO	SLUDGE PUMP #1 SPEED REFERENCE	ETHERNET	0 HZ	60 HZ		
VFD-8001	YC	VFD_8001_YC	EI-701-E	PLC-100-E	DO	SLUDGE PUMP #1 RUN/START	ETHERNET	OFF	RUN	EXTERNAL	
VFD-8001	TAH	VFD_8001_TAH	EI-701-E	PLC-100-E	DI	SLUDGE PUMP #1 DRY-RUN ALARM	ETHERNET	NO ALARM	DRY RUN		
VFD-8001	PAH	VFD_8001_PAH	EI-701-E	PLC-100-E	DI	SLUDGE PUMP #1 PRESS ALARM	ETHERNET	NO ALARM	HIGH PRESS		
VFD-8001	SI	VFD_8001_SI	EI-701-E	PLC-100-E	AI	SLUDGE PUMP #1 SPEED FEEDBACK	ETHERNET	0 HZ	60 HZ		
VFD-8002	YI.LR	VFD_8002_YI.LR	EI-701-E	PLC-100-E	DI	SLUDGE PUMP #2 AUTO/REMOTE	ETHERNET	AUTO	REMOTE		
VFD-8002	YI	VFD_8002_YI	EI-701-E	PLC-100-E	DI	SLUDGE PUMP #2 RUNNING	ETHERNET	NOT RUNNING	RUNNING		
VFD-8002	YA	VFD_8002_YA	EI-701-E	PLC-100-E	DI	SLUDGE PUMP #2 FAULT	ETHERNET	NO ALARM	FAULT		
VFD-8002	SC	VFD_8002_SC	EI-701-E	PLC-100-E	AO	SLUDGE PUMP #2 SPEED REFERENCE	ETHERNET	0 HZ	60 HZ		
VFD-8002	YC	VFD_8002_YC	EI-701-E	PLC-100-E	DO	SLUDGE PUMP #2 RUN/START	ETHERNET	OFF	RUN	EXTERNAL	
VFD-8002	TAH	VFD_8002_TAH	EI-701-E	PLC-100-E	DI	SLUDGE PUMP #2 DRY-RUN ALARM	ETHERNET	NO ALARM	DRY RUN		
VFD-8002	PAH	VFD_8002_PAH	EI-701-E	PLC-100-E	DI	SLUDGE PUMP #2 PRESS ALARM	ETHERNET	NO ALARM	HIGH PRESS		
VFD-8002	SI	VFD_8002_SI	EI-701-E	PLC-100-E	AI	SLUDGE PUMP #2 SPEED FEEDBACK	ETHERNET	0 HZ	60 HZ		
CONV-1	YI.LR	CONV_1_YI.LR	EI-701-E	PLC-100-E	DI	CONVEYOR #1 IN REMOTE	ETHERNET	LOCAL	REMOTE		
CONV-1	YI	CONV_1_YI	EI-701-E	PLC-100-E	DI	CONVEYOR #1 RUNNING	ETHERNET	NOT RUNNING	RUNNING		
CONV-1	YA	CONV_1_YA	EI-701-E	PLC-100-E	DI	CONVEYOR #1 FAULT	ETHERNET	NO ALARM	FAULT		
CONV-1	YC	CONV_1_YC	EI-701-E	PLC-100-E	DO	CONVEYOR #1 RUN COMMAND	ETHERNET	STANDBY	RUN	EXTERNAL	
HS-8016	YA.ES	HS_8016_YA.ES	EI-701-E	PLC-100-E	DI	CONVEYOR #1 E-STOP	ETHERNET	ESTOP PULLED	NO ALARM		
SSL-8014	SAL	SSL_8014_SAL	EI-701-E	PLC-100-E	DI	CONVEYOR #1 ZERO SPEED	ETHERNET	RUNNING	ZERO SPEED		
ISH-8015	IAH	ISH_8015_IAH	EI-701-E	PLC-100-E	DI	CONVEYOR #1 LOCKED ALARM	ETHERNET	NO ALARM	LOCKED		
CONV-2	YI.LR	CONV_2_YI.LR	EI-701-E	PLC-100-E	DI	CONVEYOR #2 IN REMOTE	ETHERNET	LOCAL	REMOTE		
CONV-2	YI	CONV_2_YI	EI-701-E	PLC-100-E	DI	CONVEYOR #2 RUNNING	ETHERNET	NOT RUNNING	RUNNING		
CONV-2	YA	CONV_2_YA	EI-701-E	PLC-100-E	DI	CONVEYOR #2 FAULT	ETHERNET	NO ALARM	FAULT		
CONV-2	YC	CONV_2_YC	EI-701-E	PLC-100-E	DO	CONVEYOR #2 RUN COMMAND	ETHERNET	STANDBY	RUN	EXTERNAL	

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HS-8017	YA.ES	HS_8017_YA.ES	EI-701-E	PLC-100-E	DI	CONVEYOR #2 E-STOP	ETHERNET	ESTOP PULLED	NO ALARM		
SSL-8020	SAL	SSL_8020_SAL	EI-701-E	PLC-100-E	DI	CONVEYOR #2 ZERO SPEED	ETHERNET	RUNNING	ZERO SPEED		
ISH-8019	IAH	ISH_8019_IAH	EI-701-E	PLC-100-E	DI	CONVEYOR #2 LOCKED ALARM	ETHERNET	NO ALARM	LOCKED		
CONV-3	YI.LR	CONV_3_YI.LR	EI-701-E	PLC-100-E	DI	CONVEYOR #3 IN REMOTE	ETHERNET	LOCAL	REMOTE		
CONV-3	YI	CONV_3_YI	EI-701-E	PLC-100-E	DI	CONVEYOR #3 RUNNING	ETHERNET	NOT RUNNING	RUNNING		
CONV-3	YA	CONV_3_YA	EI-701-E	PLC-100-E	DI	CONVEYOR #3 FAULT	ETHERNET	NO ALARM	FAULT		
CONV-3	YC	CONV_3_YC	EI-701-E	PLC-100-E	DO	CONVEYOR #3 RUN COMMAND	ETHERNET	STANDBY	RUN	EXTERNAL	
HS-8018	YA.ES	HS_8018_YA.ES	EI-701-E	PLC-100-E	DI	CONVEYOR #3 E-STOP	ETHERNET	ESTOP PULLED	NO ALARM		
SSL-8022	SAL	SSL_8022_SAL	EI-701-E	PLC-100-E	DI	CONVEYOR #3 ZERO SPEED	ETHERNET	RUNNING	ZERO SPEED		
ISH-8021	IAH	ISH_8021_IAH	EI-701-E	PLC-100-E	DI	CONVEYOR #3 LOCKED ALARM	ETHERNET	NO ALARM	LOCKED		

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DEVICE	TAG	I/O TAGNAME	P&ID	CONTROLLER	TYPE	DESCRIPTION	ANALOG SIGNAL LEVEL	DISCRETE SIGNAL LEVEL	OFF/4 mA	ON/20 mA	POWER	NOTES
LCP-100-E	YA	LCP_100-E_YA	EI-702-E	PLC-100-E	DO	EXTERNAL FAULT	ETHERNET		ALARM OFF	ALARM ON	EXTERNAL	
VCP-9000	YC	VCP_9000_YC	EI-702-E	PLC-100-E	DO	REMOTE RUN COMMAND	ETHERNET		OFF	ON		
VCP-9000	YA	VCP_9000_YA	EI-702-E	PLC-100-E	DI	SYSTEM FAULT	ETHERNET		ALAM OFF	ALARM ON		
VCP-9000	YI	VCP_9000_YI	EI-702-E	PLC-100-E	DI	SYSTEM RUNNING	ETHERNET		OFF	ON		
PIT-9004	PI	PIT_9004_PI	EI-702-E	PLC-100-E	AI	AIRGAP DISCHARGE PRESSURE	ETHERNET		0	150PSI		
FIT-9005	FI	FIT_9005_FI	EI-702-E	PLC-100-E	AI	AIRGAP DISCHARGE FLOW	ETHERNET		0	150GPM		
FSL-8102	FAL	FSL_8102_FAL	EI-702-E	PLC-100-E	DI	LOW SUPPLY AIRFLOW		24VDC	NO ALARM	LOW AIRFLOW	24VAC	
FSL-8103	FAL	FSL_8103_FAL	EI-702-E	PLC-100-E	DI	LOW EXHAUST AIRFLOW		24VDC	NO ALARM	LOW AIRFLOW	24VAC	

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STR-5001	YC	STR_5001_YC	EI-701-G1	RIO-5000	DO	ME-5001 START COMMAND		24V	STANDBY	START	EXTERNAL	
STR-5001	YI	STR_5001_YI	EI-701-G1	RIO-5000	DI	ME-5001 RUNNING		24V	NOT RUNNING	RUNNING		
STR-5001	YA	STR_5001_YA	EI-701-G1	RIO-5000	DI	ME-5001 FAULT		24V	NO ALARM	ALARM		
STR-5001	YI.AM	STR_5001_YI.AM	EI-701-G1	RIO-5000	DI	ME-5001 AUTO/MANUAL		24V	MANUAL	AUTO		
STR-5002	YC	STR_5002_YC	EI-701-G1	RIO-5000	DO	ME-5002 START COMMAND		24V	STANDBY	START	EXTERNAL	
STR-5002	YI	STR_5002_YI	EI-701-G1	RIO-5000	DI	ME-5002 RUNNING		24V	NOT RUNNING	RUNNING		
STR-5002	YA	STR_5002_YA	EI-701-G1	RIO-5000	DI	ME-5002 FAULT		24V	NO ALARM	ALARM		
STR-5002	YI.AM	STR_5002_YI.AM	EI-701-G1	RIO-5000	DI	ME-5002 AUTO/MANUAL		24V	MANUAL	AUTO		
STR-5003	YC	STR_5003_YC	EI-701-G1	RIO-5000	DO	ME-5003 START COMMAND		24V	STANDBY	START	EXTERNAL	
STR-5003	YI	STR_5003_YI	EI-701-G1	RIO-5000	DI	ME-5003 RUNNING		24V	NOT RUNNING	RUNNING		
STR-5003	YA	STR_5003_YA	EI-701-G1	RIO-5000	DI	ME-5003 FAULT		24V	NO ALARM	ALARM		
STR-5003	YI.AM	STR_5003_YI.AM	EI-701-G1	RIO-5000	DI	ME-5003 AUTO/MANUAL		24V	MANUAL	AUTO		
FIT-4002	FI	FIT_4002_FI	EI-701-G2	RIO-5001	DO	EFFLUENT FLOW TO SAMPLER		24V	0GPM	4000GPM	---	

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DEVICE	TAG	I/O TAGNAME	P&ID	CONTROLLER	TYPE	DESCRIPTION	ANALOG SIGNAL LEVEL	DISCRETE SIGNAL LEVEL	OFF/4 mA	ON/20 mA	POWER	NOTES
P-7010	YC	P_7010_YC	EI-701-G2	RIO-7000	DO	RUN COMMAND	ETHERNET		OFF	ON		
P-7010	YC.RST	P_7010_YC.RST	EI-701-G2	RIO-7000	DO	RESET COMMAND	ETHERNET		OFF	RESET		
P-7010	YI.LR	P_7010_YI.LR	EI-701-G2	RIO-7000	DI	REMOTE	ETHERNET		LOCAL	REMOTE		
P-7010	YI	P_7010_YI	EI-701-G2	RIO-7000	DI	RUNNING	ETHERNET		NOT RUNNING	RUNNING	EXTERNAL	
P-7010	YA	P_7010_YA	EI-701-G2	RIO-7000	DI	FAILED	ETHERNET		ALARM OFF	ALARM ON		
ME-7010	MAH	ME_7010_MAH	EI-701-G2	RIO-7000	DI	MOISTURE DETECTED	ETHERNET		ALARM OFF	MOISTURE		
TE-7010	TAH	TE_7010_TAH	EI-701-G2	RIO-7000	DI	HIGH TEMPERATURE	ETHERNET		ALARM OFF	HIGH TEMP		
P-7020	YC	P_7020_YC	EI-701-G2	RIO-7000	DO	RUN COMMAND	ETHERNET		OFF	ON		
P-7020	YC.RST	P_7020_YC.RST	EI-701-G2	RIO-7000	DO	RESET COMMAND	ETHERNET		OFF	RESET		
P-7020	YI.LR	P_7020_YI.LR	EI-701-G2	RIO-7000	DI	REMOTE	ETHERNET		LOCAL	REMOTE		
P-7020	YI	P_7020_YI	EI-701-G2	RIO-7000	DI	RUNNING	ETHERNET		NOT RUNNING	RUNNING	EXTERNAL	
P-7020	YA	P_7020_YA	EI-701-G2	RIO-7000	DI	FAILED	ETHERNET		ALARM OFF	ALARM ON		
ME-7020	MAH	ME_7020_MAH	EI-701-G2	RIO-7000	DI	MOISTURE DETECTED	ETHERNET		ALARM OFF	MOISTURE		
TE-7020	TAH	TE_7020_TAH	EI-701-G2	RIO-7000	DI	HIGH TEMPERATURE	ETHERNET		ALARM OFF	HIGH TEMP		
LSH-7005	LAH	LSH_7005_LAH	EI-701-G2	RIO-7000	DI	WET WELL HIGH LEVEL		24V	ALARM OFF	HIGH LEVEL	N/A	
LSL-7006	LAL	LSL_7006_LAL	EI-701-G2	RIO-7000	DI	WET WELL LOW LEVEL		24V	ALARM OFF	LOW LEVEL	N/A	
LT-7007	LI	LT_7007_LI	EI-701-G2	RIO-7000	AI	WET WELL LEVEL	4-20mA		1'	4'	LOOP	

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DEVICE	TAG	I/O TAGNAME	P&ID	CONTROLLER	TYPE	DESCRIPTION	ANALOG SIGNAL LEVEL	DISCRETE SIGNAL LEVEL	OFF/4 mA	ON/20 mA	POWER	NOTES
500	YA	500_YA	EI-701-K	PP-500	DI	ACTUATOR FAIL	ETHERNET		ALARM OFF	ALARM ON		
500	YA	500_YA	EI-701-K	PP-500	DI	MINOR ALARM	ETHERNET		ALARM OFF	ALARM ON		
500	YA	500_YA	EI-701-K	PP-500	DI	INCOMPLETE SEQUENCE	ETHERNET		ALARM OFF	ALARM ON		
500	YA	500_YA	EI-701-K	PP-500	DI	MODULE FAIL	ETHERNET		ALARM OFF	ALARM ON		
500	YA	500_YA	EI-701-K	PP-500	DI	COMMUNICATION FAIL	ETHERNET		ALARM OFF	ALARM ON		
500	ZI	500_ZI	EI-701-K	PP-500	DI	OPEN/CLOSE	ETHERNET		CLOSE	OPEN		
500	ZI	500_ZI	EI-701-K	PP-500	DI	OPEN/CLOSE	ETHERNET		CLOSE	OPEN		
500	YA	500_YA	EI-701-K	PP-500	DI	MULT LAMP FAIL	ETHERNET		ALARM OFF	ALARM ON		
500	YA	500_YA	EI-701-K	PP-500	DI	PLC FAIL	ETHERNET		ALARM OFF	ALARM ON		
500	YA	500_YA	EI-701-K	PP-500	DI	BANK FAIL	ETHERNET		ALARM OFF	ALARM ON		
500	YA	500_YA	EI-701-K	PP-500	DI	ADJ LAMP FAIL	ETHERNET		ALARM OFF	ALARM ON		
500	YA	500_YA	EI-701-K	PP-500	DI	LOW U/V FAIL	ETHERNET		ALARM OFF	ALARM ON		
500	YA	500_YA	EI-701-K	PP-500	DI	LEAD/LAG	ETHERNET		ALARM OFF	ALARM ON		
500	YA	500_YA	EI-701-K	PP-500	DI	OFFLINE	ETHERNET		ONLINE	OFFLINE		
500	YC	500_YC	EI-701-K	PP-500	DO	RUN	ETHERNET		OFF	ON		
500	YI	500_YI	EI-701-K	PP-500	DI	ON	ETHERNET		OFF	ON		
500	YI.AM	500_YI.AM	EI-701-K	PP-500	DI	AUTO	ETHERNET		MANUAL	AUTO		
500	YI.AM	500_YI.AM	EI-701-K	PP-500	DI	AUTO	ETHERNET		MANUAL	AUTO		
YA-6001	YC	YA_6001_YC	EI-701-K	PP-500	DI	YA-6001 OPEN/CLOSE	ETHERNET		CLOSE	OPEN	EXISTING	
YA-6003	YC	YA_6003_YC	EI-701-K	PP-500	DI	YA-6003 OPEN/CLOSE	ETHERNET		CLOSE	OPEN	EXISTING	
LT-K01	LI	LT_K01_LI	EI-701-K	PP-500	AI	UV SYSTEM #1 LEVEL	ETHERNET		EXISTING	EXISTING	EXISTING	
LT-502	LI	LT_502_LI	EI-701-K	PP-500	AI	UV SYSTEM #2 LEVEL	ETHERNET		EXISTING	EXISTING	EXISTING	
K-101	FI	K_101_FI	EI-701-K	PP-500	AI	EFF FLOW GPM	4-20mA		EXISTING	EXISTING	EXISTING	FLOW METER REMOVED, DEMO WIRING FROM PANEL AND REMOVE ASSOCIATED CONTROLS
K-101	FQI	K_101_FQI	EI-701-K	PP-500	AI	EFF FLOW TOTALIZED	4-20mA		EXISTING	EXISTING		FLOW METER REMOVED, DEMO WIRING FROM PANEL AND REMOVE ASSOCIATED CONTROLS
K-101	FI	K_101_FI	EI-701-K	PP-500	AI	EFF FLOW	4-20mA		EXISTING	EXISTING		FLOW METER REMOVED, DEMO WIRING FROM PANEL AND REMOVE ASSOCIATED CONTROLS

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SECTION 40 67 00 - CONTROL PANELS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide control panels, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section apply to local panels provided in equipment systems specified in other sections unless indicated otherwise in those sections.

1.2 REFERENCE STANDARDS

A. ASTM A 283 Low and Intermediate Tensile Strength Carbon Steel Plates

B. UL 508A Industrial Control Panels

1.3 SUBMITTALS

A. Submittals shall be furnished in accordance with Sections 01 33 00 – Submittal Procedures and Section 40 70 00 – Instrumentation and Controls, General.

B. Shop Drawings: The Contractor shall submit shop drawings for each panel and enclosure provided under Division 40. The shop drawings shall completely define and document the construction, finish, layout, power circuits, signal and safety grounding circuits, fuses, circuit breakers, signal circuits, internally mounted instrumentation, face plate mounted instrumentation components, internal panel arrangements, and external panel arrangements. The submittal shall include the following:

1. A complete index shall appear in the front of each bound volume. Drawings and data sheets associated with a panel shall be grouped together with the panels being indexed by systems or process areas. Panel tagging and nameplate nomenclature shall be consistent with the requirements of the Contract Documents.

2. Scaled physical arrangement drawings drawn to scale that define and quantify the physical groupings comprising control panel sections, auxiliary panels, subpanels, and racks. Cutout locations with nameplate identifications shall be shown.

3. Front of panel layouts for all control panels.

4. Schematic/elementary diagrams shall depict all control devices and circuits and their functions.

5. Interconnection diagrams shall locate and identify all external connections between the control panel/control panel devices and associated equipment. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all panel ingress and egress points.

6. A bill of material that enumerates all devices associated with the control panel.

PART 2 - PRODUCTS

2.1 GENERAL

A. Environmental Suitability: Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided, as indicated, in order to maintain all instrumentation devices within 20 percent of the minimums and maximums of their rated environmental operating ranges. The Contractor shall provide all power wiring for these devices. Instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

B. The control panel shall be the source of power for any 120 VAC solenoid valves interconnected with the control panel. Equipment associated with the control panel shall be ready for service after connection of conductors to equipment, controls, and control panel.

C. Instrument power circuits shall be fed from the associated PLC panel.

D. Control panels shall not contain any voltages greater than 120VAC.

E. Unless indicated otherwise, control panels shall be housed in NEMA rated enclosures in accordance with Section 26 05 00 – Electrical, General. Panels shall be either freestanding, pedestal-mounted or equipment skid-mounted, as indicated. Internal control components shall be mounted on an internal back-panel or side-panel as required.

F. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks. Each control panel shall be provided with identified terminal strips for the connection of all external conductors. The Contractor shall provide sufficient terminal blocks to connect 25 percent additional conductors for future use.

G. Motor starters, where required, shall be in accordance with Section 26 29 00 – Motor Controllers and Section 26 29 23 – Variable-Frequency Motor Controllers. Each motor starter shall be provided with contact closures for motor overload, local indication, and remote alarm. Discrete outputs from the control panel shall be provided by electrically isolated interposing relay contacts. Analog inputs and outputs leaving the envelope of the building shall be isolated 4-20 mA, 2-wire signals with power supply. All analog inputs and outputs shall be individually fused.

H. Control panel mounted devices shall be mounted a minimum of 3 feet above finished floor elevation.

2.2 CONTROL PANELS

A. Each PLC and remote I/O system and corresponding housing, including I/O modules, power supply modules, communication interface devices, and peripheral equipment shall be mounted inside a NEMA enclosure in accordance with Section 26 05 00 – Electrical, General. I/O wiring from the field to the remote I/O system shall be terminated on terminal blocks in the lower portion of the enclosure.

B. Materials: Panels shall be made of Grade 304 stainless steel. Panel section faces shall be No. 12 gauge minimum thickness for free standing panels and No. 14 gauge minimum thickness for wall mounted or pedestal mounted panels. Materials shall be selected for levelness and smoothness.

1. Relay rack high density type panels shall utilize standard relay racks with No. 14 gauge steel frame and supports.

2. Structural shapes and strap steel shall comply with ASTM A 283 - Low and Intermediate Tensile Strength Carbon Steel Plates, Grade C.

3. Bolting Material: Commercial quality carbon steel bolts, nuts, and washers shall be 1/2-inch diameter with UNC threads. Carriage bolts shall be used for attaching end plates. All other bolts shall be hex end machine bolts. Nuts shall be hot pressed hex, American Standard, heavy. Standard wrought washers shall be used for foundation bolts and attachments to building structures. Other bolted joints shall have SAE standard lock washers.

C. Construction: Dimensions shall be in accordance with vendor's requirements. Elevations and horizontal spacing shall be subject to Engineer's approval.

D. Fabrication: End plates, top plates, and top closure panels (to hung ceiling) shall be provided when required by the material requisition. End plates, top plates, and top closure panels shall be removable with countersunk bolts to match panels. Top closure panels shall be furnished in lengths which match the widths of standard panels, except that one top closure panel may extend across two 4-foot 6-inch wide or five 2-foot wide standard panels. The vertical joints of these panels shall align with the vertical joints of the standard panels.

1. End closure or rear closure doors shall be provided where required. Such doors shall be flush fitting, gasketed, and be of the hinged lift-off type with lockable door handles. A common key shall be provided for all doors on one panel assembly. Removable access panels shall be provided with dished handle fasteners. Screw driver 1/4 turn or Dzus type fasteners are not acceptable.

2. The flanged edges of all panels shall be straight and smooth. Corners shall be welded and ground smooth.

3. The face of the panel shall be true and level after angling.

4. All panel cutouts and holes may be cut or drilled by any standard method that does not cause deformation. Burrs shall be ground smooth.

5. Adjacent panels shall assemble with races flush. Gaps or cracks shall not be visible from the front of the assembled instrument board.

6. Stiffeners shall be welded to the back of panels, as required to prevent panel deformation due to the weight of face mounted instruments.

7. Panels shall be self-supporting as defined below.

E. Framework and Supports: The rear of each panel section shall have a steel framework assembled to it for supporting conduit, wireways, switches, piping, and instrument accessory Items such as relay or terminal enclosures, transducers, pressure switches, valves, and air relays.

1. The main frame work shall be constructed of standard structural shapes. Special shapes such as "Unistrut" may be used for secondary supports. Framework must neither interfere with instrument connections nor interfere with access needed for maintenance or adjustments.

2. Steel framework shall extend 2-feet 4-inches back from the panel face or as indicated in the material requisition. Where indicated, individual adjustable leg supports shall be provided at the back of the framework so that the entire panel is self-supporting.

F. Preparation of Panel Surface: The following requirements apply to the front and rear face of the panel, both sides and the edges of all flanges, and the periphery of all holes or cutouts.

1. High spots, burrs, and rough spots shall be ground smooth.

2. The surfaces shall be sanded or sandblasted to a smooth, clean, bright finish.

3. All traces of oil shall be removed with a solvent.

4. The first coat of primer shall be applied immediately.

G. Instrument Finishing: The final coats applied to painted surface of instrument cases, doors, or bezels which are visible from the front of panels shall be manufacturer's standard unless otherwise indicated. Black Japan or "crinkle" finishes on instrument cases are not acceptable.

H. Mounting of Instruments: The panel vendor shall provide cutouts, and shall mount all instrument items indicated to be panel mounted, including any instruments indicated to be furnished by other vendors but installed in the panel.

1. The panel vendor shall also mount behind the panels other instrument accessory items as required for functionality as indicated.

2. Equipment mounted at the rear of panel shall be installed to allow for commissioning adjustments, servicing requirements, and cover removal.

3. Spare space shall be kept clear of wiring, etc., to give maximum space for future additions.

I. Panel Components:

1. Terminal Blocks.

a. Terminal blocks for power distribution and digital signals shall comply with the following requirements

1) Terminal blocks shall be UL rated for 600V, 30A minimum.

2) Terminal blocks shall have a compression-style screw clamp connection.

3) Terminal blocks shall be capable of accepting #12 AWG wire.

4) Terminal blocks directly associated with digital I/O signals shall be two-tier with pre-manufactured jumper bars for distribution of common signals.

b. Terminal blocks for analog signals shall comply with the following requirements:

1) Terminal blocks shall be UL rated for 300V, 20A minimum.

2) Terminal blocks shall have a compression-style screw clamp connection.

3) Terminal blocks shall be capable of accepting #16 AWG wire.

4) Terminal blocks shall be three-tier sensor blocks for termination of signal positive, negative, and shield with pre-manufactured jumper bars for distribution of common signals.

c. Fuse blocks shall comply with the following requirements:

1) Fuse blocks shall be UL rated for 600V, 10A minimum.

2) Fuse blocks shall incorporate a hinged lever that accepts 5x20 mm fuses.

3) Fuse blocks shall have a compression-style screw clamp connection.

4) Fuse blocks shall be capable of accepting #12 AWG wire.

5) Fuse blocks shall contain blown-fuse indication through the use of a neon lamp or an LED.

d. All terminal blocks and fuse blocks shall be designed for DIN rail mounting. Extra deep 15 mm DIN rail shall be used.

e. Contractor shall provide terminal block end sections and end stops as necessary for a complete installation.

f. Terminal blocks and fuse blocks shall be provided with pre-printed snap-on label strips. Stick-on labeling is not acceptable. Labeling shall be consistent with Contractor's control panel drawings. Contractor shall clearly label all terminal blocks in every control panel; unlabeled terminal blocks are not acceptable.

g. Terminal blocks and fuse blocks shall be ABB, Allen-Bradley, or approved equal.

2. Instrument Power: All instruments requiring power that are wired to a PLC shall also have power supplied from the same PLC control panel. All instrument power sources shall be individually fused.

3. Signal surge suppressors. Signal surge suppressors shall be provided for all analog signals leaving the envelope of the building.

   a. Signal surge suppressors shall be Phoenix Contact TT-2-PE-24DC or equal.

4. Control Relays. Control relays shall comply with the following requirements:

   a. Relays shall be plug-in style with a DIN-rail mountable base.

   b. Relays shall have on/off indication.

   c. General purpose control relays shall have 24VDC or 120VAC coil as required for application. Relay contacts shall be rated 10 Amp at 120VAC or 125VDC. Contractor shall be responsible for quantity of contacts as required for application. New general purpose control relays shall be Allen Bradley 700-HA series or equal.

   d. Digital output interposing relays shall be terminal block style. Allen Bradley 700-HL series or equal.

5. Intrinsically Safe Barriers. Relays shall be solid-state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe use in hazardous areas. Relays shall be located in non-hazardous areas. Relays shall be manufactured by GEMS, MTL, R.Stahl, Inc., or Turck.

6. Circuit Breakers. Circuit breakers for use in control panels shall be rated for 600V service.

   a. Control panel circuit breakers shall be DIN-rail mounted.

   b. Control panel circuit breakers shall be Allen-Bradley, Square D, or approved equal.

7. Surge Suppression. PLC control panels shall incorporate a transient-voltage surge suppressor on the incoming line. Surge suppressors shall be properly sized by the Contractor based upon the maximum current draw of the control panel.

   a. Surge suppressors shall be Innovative Technology, Leviton, or equal.

8. DC Power Supplies. PLC control panels shall be provided with a redundant DC power supply system containing two identical 24VDC power supplies and a redundancy module to regulate loading.

a. DC Power Supplies shall be redundant. A redundancy module shall be used to regulate loading.

b. Size DC power supplies based upon the actual 24V load. Power supplies shall not be loaded more than 50% of rated capacity.

c. DC power supply systems shall be Sola HD SDN Series, ABB CP Series, or equal.

9. Digital Panel Indicators. Digital indicators shall be designed for semi-flush mounting in a panel. The indicator shall be a 3 1/2 digit LED, LCD, or gas discharge type display, with digits at least 0.5 inch high. The indicator shall be easily read at a distance of 10 feet in varying control room lighting environments. Operating temperature range shall be 32°F to 140°F. Accuracy shall be ±0.1 percent. The indicator shall be scaled in engineering units, with the units engraved on the display face or on the associated nameplate. The indicator shall have a selectable decimal point and shall provide over-range indication. Digital indicators shall be manufactured by Invensys/Eurotherm/Action Instruments, Newport Electronics, Precision Digital Corporation, or Red Lion Controls.

10. Selector Switches. Selector switches shall be 30.5-mm, heavy-duty, oil-tight type with gloved-hand or wing lever operators. Position legends shall be engraved on the switch faceplate. Switches for electric circuits shall have silver butting or sliding contacts, rated 10 amperes continuous at 120 V ac. Contact configuration shall be as indicated on the Drawings or for the application. Switches used in electronic signal circuits shall have contacts suitable for that duty. Switches shall be Eaton/Cutler-Hammer "10250T", General Electric "CR104P", or Allen Bradley “800T”.

11. Indicating Lights. Indicating lights shall be 30.5-mm, heavy-duty, oil-tight type, with full voltage LED lamps. Legends shall be engraved on the lens or on a legend faceplate. Lights shall be push-to-test type. Indicating lights shall be Eaton/Cutler Hammer "10250T", General Electric "CR104P", or Allen Bradley “800T”.

12. Pushbuttons. Push buttons shall be 30.5-mm, heavy-duty, oil-tight type. Legends shall be engraved on the push-button faceplate. Contacts shall be rated 10 amperes continuous at 120 V ac. Push buttons shall be Eaton/Cutler-Hammer "10250T", General Electric "CR104P", or Allen Bradley “800T”.

13. Alarm Horns. Horns shall be high-decibel, panel-mount, vibrating type designed for heavy-duty use. Horn volume shall be field-adjustable from 78 to 103 dB at 10 feet. Horns shall operate at 120 volts ac. Horns shall be weatherproof NEMA Type 4X. Horns shall be panel front mounted and shall be supplied with gasket. Horns shall be Edwards Signals “870P Series.”Horns shall be supplied with a field mounted enclosure. Horns shall be Edwards Signals “876 series.”

J. Electrical Requirements:

1. All conduit, wireways, switches, wire, and electrical fittings for 120 volt circuits to instruments and other electrical devices as required for a complete and operable installation.

2. Conduit, wireways, junction boxes and fittings shall be provided for signal wire, thermocouple, or resistance thermometer lead wire. Conduit or wireway runs shall include those required between temperature sensors and temperature transmitters and between the thermocouple wireway or junction box and instruments.

3. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. Wiring shall be identified with stamped tubular wire end markers.

4. PLC control panels shall be provided with a 15 amp, 120 volt, service outlet circuit within the back-of-panel area.

5. PLC control panels shall be provided with fluorescent light and door activated switch.

6. Wall mounted or pedestal mounted panels shall be so sized as to adequately - dissipate heat generated by equipment mounted in or on the panel.

7. Control panels mounted outside shall be provided with thermostatically controlled heaters that maintain inside temperature above 40 degrees F.

8. Wiring Methods: Wiring methods and materials for all panels shall be in accordance with the NEC requirements for General Purpose (no open wiring) unless otherwise indicated. Control Panels shall be UL508A listed Control Panels.

9. Signal and Control Circuit Wiring: Wire type and sizes: Conductor shall be flexible stranded copper machine tool wire, UL listed Type MTW, and shall be rated 600 volts. Wires, including shielded cables, shall be No. 16 AWG minimum.

    a. Wire Insulation Colors: Ungrounded control circuit conductors operating at the supply voltage shall have a black insulation. Grounded circuit conductors shall have white insulation. Insulation for ungrounded AC control circuit conductors operating at less than the supply voltage shall be red. Wires energized by a voltage source external to the control panel shall have yellow insulation. Insulation for ungrounded DC conductors shall be blue. Insulation for grounded DC conductors shall be white with blue stripe. Twisted pair wiring shall be positive(+) black and negative(-) white/clear.

    b. Wire Marking: Wire numbers shall be marked using white numbered wire markers made from plastic-coated cloth, Brady Type B 500 or equal, or shall be heat shrink plastic.

    c. Flexible conduit is not acceptable except when specifically approved by the Engineer in writing. Conduit fittings shall be Crouse Hinds cast fittings or equal.

    d. Splicing of wires will only be allowed in junction boxes. Splices shall be either soldered or pressure crimped type.

e. For case grounding, panels shall be provided with a 1/4-inch by 1-inch copper ground bus complete with soderless connector for one No.4 AWG bare stranded copper cable. The copper cable shall be provided by the Contractor and be connected to a system ground loop.

10. Power Supply: Unless otherwise indicated control panel primary power supplies shall be 120 volt, 60 Hz circuits. 24VDC subsystems shall be provided for PLC control panels and as indicated on the drawings.

K. Labor and Workmanship: Panels shall be fabricated, piped, and wired by fully qualified workmen who are properly trained, experienced, and supervised.

L. At a minimum, control panels shall be constructed in a UL shop and contain UL labels prior to shipment.

2.3 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Provide and install UPS(s) to power all PLC hardware furnished under this Specification.

B. The UPS shall receive a 120 VAC, 60 HZ power input, and generate a 120 VAC, 60 HZ output signal which is protected from incoming spikes, sags, noise, brownouts, and power outages.

1. The UPS shall incorporate a transformer, a battery pack, a battery charger, an inverter, and a microprocessor based controller to provide continuous, on-line, computer grade uninterruptible power. Lighting and surge protection shall meet ANSI/IEEE c62.41 categories A and B. The UPS shall be U.L. listed. Spike attenuation shall be 2000 to 1. The output neutral shall be bonded to ground. Noise isolation shall be 120 Db common-mode, 60 Db normal mode. Output voltage regulation shall be + 3% with less than 5% total harmonic distortion. UPS efficiency shall be at least 85%. The UPS shall be rated for ambient temperatures from 32 degrees F to 104 degrees F and relative humidity from 0 to 95%

2. Each UPS shall maintain power to all of its connected loads, including non-constant loads such as alarms and printers, for a minimum of 15 minutes with a 50% growth factor over the connected load. The equipment submittal shall include sizing calculations which support the model and size selected. The UPS shall be supplied with a low output voltage cutoff to prevent damage to loads when the battery power is exhausted.

C. The equipment shall include sizing calculation which support the unit selected being able to power all its connected loads for the indicated time period with a 50% growth factor.

D. The uninterruptible power supply shall be Eaton Ferrups UPS series, Liebert, IPM or equal.

2.4 SPARE PARTS AND SPECIAL TOOLS

A. Control panel spare parts selected by the Engineer and special tools shall be furnished in accordance with Section 40 70 00 – Instrumentation and Control, General.

PART 3 - EXECUTION

3.1 LISTING AND INSTALLATION

A. Control panels shall be installed in accordance with Section 40 70 00 – Instrumentation and Control, General.

B. Control Panels shall be fabricated in accordance with UL 508A, and shall be UL Listed Industrial Control Panels.

3.2 EQUIPMENT DELIVERY

A. Panels shall be crated for shipment using a heavy framework and skids. Panel sections shall be cushioned to protect the finish of the instruments and panel during shipment. Instruments which are shipped with the panel shall further have suitable shipping stops and cushioning material installed to protect parts which could be damaged due to mechanical shock. Each separate panel unit shall be provided with removable lifting lugs to facilitate handling.

B. Shipments by air ride van unless otherwise indicated. Control panel testing and inspection, if required, shall be performed prior to shipping.

3.3 CONTROL PANEL SIGNAL AND CONTROL CIRCUIT WIRING

A. Wiring Installation: Wires shall be run in plastic wireways except (1) field wiring, (2) wiring between mating blocks in adjacent sections, (3) wiring from components on a swing out panel to components on a part of the fixed structure, and (4) wiring to panel mounted components. Wiring run from components on a swing out panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals.

B. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and be secured to the inside face of the panel using adhesive mounts.

C. Wiring to rear terminals on panel-mount instruments shall be in plastic wireways secured to horizontal brackets above or below the instruments in about the same plane as the rear of the instruments.

D. Shop Drawings shall show conformance to the above wiring installation requirements.

E. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on Shop Drawings. These numbers shall be marked on conductors at every terminal.

3.4 CALIBRATION, TESTING, AND INSTRUCTION

A. Calibration, testing, and instruction shall be performed in accordance with Section 40 79 23 – Testing, Calibration, and Commissioning.

B. Inspection and Approval: Panel fabricator shall conduct the following tests before shipment.

1. Alarm circuits rung out to determine their operability.

2. Electrical circuits checked for continuity and where applicable, operability.

3. Any other test required to place the panel in an operating condition.

C. It shall be the responsibility of the Contractor to furnish all necessary testing devices and sufficient manpower to perform the tests required by the Engineer.

D. Factory Acceptance Testing: PLC control panels shall be factory tested as required by Division 40 specifications.

E. Field Testing: Each control panel shall be tested again for functional operation in the field after the connection of external conductors and prior to equipment startup.

END OF SECTION 40 67 00

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LOCATION	PANEL NO.	P&ID	PANEL DESCRIPTION	POWER	AREA CLASSIFICATION	DIMENSIONS	MOUNTING	RATING	SPECIFICATION	FURNISHED BY	NEW/EXISTING/ RELOCATED
HEADWORKS	A-PLC-01	EI-701-A	HEADWORKS BUILDING CONTROL PANEL	120 VAC	UNCLASSIFIED	36" W x 20" D	WALL	EXISTING	N/A	N/A	EXISTING
HEADWORKS	LCP-SCR-1	EI-701-A	SCREEN 1 CONTROL PANEL	480 VAC	UNCLASSIFIED	36" W x 20" D	WALL	EXISTING	N/A	N/A	EXISTING
HEADWORKS	LCP-SCR-2	EI-701-A	SCREEN 2 CONTROL PANEL	480 VAC	UNCLASSIFIED	36" W x 20" D	WALL	NEMA 1 (MIN.)	46 21 35	CONTRACTOR	NEW
HEADWORKS	LCP-VG-1	EI-701-A	GRIT VORTEX PANEL	480 VAC	UNCLASSIFIED	36" W x 20" D	WALL	EXISTING	N/A	N/A	EXISTING
HEADWORKS	LCP-HWLS-01	EI-702-A	HEADWORKS LIFT STATION PANEL	480 VAC	UNCLASSIFIED	72" W x 20" D	FLOOR	EXISTING	N/A	N/A	EXISTING
IFAS BLOWER BUILDING	VCP-100-B2	EI-701-B EI-701-B2	IFAS CONTROL PANEL	120 VAC	UNCLASSIFIED	60" H x 48" W x 18" D	FLOOR	NEMA 1 (MIN.)		VENDOR	NEW
ELECTRICAL BLDG.	LCP-RAS-1	EI-701-C	RAS/WAS 1 CONTROL PANEL	480 VAC	UNCLASSIFIED	36" H x 36" W x 18" D	WALL	EXISTING	N/A	N/A	EXISTING
ELECTRICAL BLDG.	LCP-RAS-2	EI-701-C	RAS/WAS 2 CONTROL PANEL	480 VAC	UNCLASSIFIED	36" H x 36" W x 18" D	WALL	EXISTING	N/A	N/A	EXISTING
ELECTRICAL BLDG.	LCP-CLA-1	EI-701-C	CLARIFIER 1 CONTROL PANEL	480 VAC	UNCLASSIFIED	24" H x 24" W x 18" D	WALL	EXISTING	N/A	N/A	EXISTING
ELECTRICAL BLDG.	LCP-CLA-2	EI-701-C	CLARIFIER 2 CONTROL PANEL	480 VAC	UNCLASSIFIED	24" H x 24" W x 18" D	WALL	EXISTING	N/A	N/A	EXISTING
TERTIARY TREATMENT	RCP-4000	EI-701-D	TERTIARY TREATEMENT REMOTE CONTROL PANEL	120 VAC	UNCLASSIFIED	36" H x 30" W x 18" D	WALL	NEMA 1 (MIN.)	40 67 00	CONTRACTOR	NEW
TERTIARY TREATMENT	VCP-4000	EI-701-D	AIR CONTROL PANEL	120 VAC	UNCLASSIFIED	36" H x 30" W x 12"D	WALL	NEMA 1 (MIN.)		VENDOR	NEW
TERTIARY TREATMENT	VCP-4001	EI-701-D	COMPRESSOR SKID CONTROL PANEL	480 VAC	UNCLASSIFIED	3.5" W x 3" H x 2.25" D	SKID	NEMA 1 (MIN.)		VENDOR	NEW
TERTIARY TREATMENT	MCP-4300	EI-701-D1	LIFT STATION MOTOR CONTROL PANEL	480 VAC	UNCLASSIFIED	36" H x 30" W x 12"D	WALL	NEMA 1 (MIN.)	40 67 00	CONTRACTOR	NEW
DEWATERING	LCP-100-E	EI-701-E	LOCAL CONTROL PANEL	120 VAC	UNCLASSIFIED	24" H x 24 "W x 10" D	WALL	NEMA 1 (MIN.)	40 67 00	CONTRACTOR	NEW
DEWATERING	VCP-SCP-1	EI-701-E	SCREW PRESS 1 VENDOR CONTROL PANEL	480 VAC	UNCLASSIFIED	60" H x 36" W x 12" D	WALL	NEMA 1 (MIN.)		VENDOR	NEW
DEWATERING	VCP-ACP-1	EI-701-E	SCREW PRESS 1 AIR CONTROL PANEL	N/A	UNCLASSIFIED	18"H x 14" W x 9" D	SKID	NEMA 1 (MIN.)		VENDOR	NEW
DEWATERING	VCP-LPF-1	EI-701-E	POLYMER SYSTEM VENDOR CONTROL PANEL	120 VAC	UNCLASSIFIED	20" H x 18" W x 6" D	SKID	NEMA 1 (MIN.)		VENDOR	NEW
DEWATERING	VCP-9000	EI-702-E	AIR GAP VENDOR CONTROL PANEL	480 VAC	UNCLASSIFIED	57" H x 24.5" W x 10" D	FLOOR	NEMA 1 (MIN.)		VENDOR	NEW
DEWATERING	VCP-SCP-2	EI-703-E	SCREW PRESS 2 VENDOR CONTROL PANEL	480 VAC	UNCLASSIFIED	60" H x 36" W x 12" D	WALL	NEMA 1 (MIN.)	N/A	VENDOR	FUTURE
DEWATERING	VCP-ACP-2	EI-703-E	SCREW PRESS 2 AIR CONTROL PANEL	120 VAC	UNCLASSIFIED	18"H x 14" W x 9" D	WALL	NEMA 1 (MIN.)	N/A	VENDOR	FUTURE
DEWATERING	VCP-LPF-2	EI-703-E	POLYMER PUMP VENDOR CONTROL PANEL	120 VAC	UNCLASSIFIED	20" H x 18" W x 6" D	SKID	NEMA 1 (MIN.)	N/A	VENDOR	FUTURE
DEWATERING	RIP-8001	EI-701-E	SLUDGE PUMP TEMPERATURE SWITCH PANEL	120 VAC	UNCLASSIFIED	10" H x 10" W x 6" D	WALL	NEMA 1 (MIN.)	40 67 00	CONTRACTOR	NEW
DEWATERING	MCP-CONV	EI-701-E	CONVEYOR MOTOR CONTROL PANEL	480 VAC	UNCLASSIFIED	36" H x 30" W x 12"D	WALL	NEMA 1 (MIN.)	41 12 13.36	CONTRACTOR	NEW
DEWATERING	DNE-100-E	EI-700	SITE DATA NETWORKING ENCLOSURE	120 VAC	UNCLASSIFIED	26" H x 23" W X 25" D	WALL	NEMA 1 (MIN.)		CONTRACTOR	NEW
BLOWER	RCP-5000	EI-701-G	BLOWER REMOTE CONTROL PANEL	120 VAC	UNCLASSIFIED	36" H x 30" W x 18" D	WALL	NEMA 1 (MIN.)	40 67 00	CONTRACTOR	NEW
BLOWER	STR-5001	EI-701-G	BLOWER PANEL	480 VAC	UNCLASSIFIED	30" H x 18" W x 10"D	WALL	EXISTING	N/A	N/A	EXISTING
BLOWER	STR-5002	EI-701-G	BLOWER PANEL	480 VAC	UNCLASSIFIED	30" H x 18" W x 10"D	WALL	EXISTING	N/A	N/A	EXISTING
BLOWER	STR-5003	EI-701-G	BLOWER PANEL	480 VAC	UNCLASSIFIED	30" H x 18" W x 10"D	WALL	NEMA 1 (MIN.)	26 29 13.13	CONTRACTOR	NEW
DECANT LIFT STATION	MCP-7000	EI-701-G2	DECANT LIFT STATION MOTOR CONTROL PANEL	480 VAC	UNCLASSIFIED	36" H x 30" W x 12"D	WALL	NEMA 1 (MIN.)	40 67 00	CONTRACTOR	NEW

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SECTION 40 70 00 – INSTRUMENTATION AND CONTROL, GENERAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. General requirements applicable to all Process Control and Instrumentation Work.

2. General requirements for process control and instrumentation submittals.

3. See Section 40 70 00.2 – Instrumentation and Control, System Description for a list of Prequalified System Integrator (SI) and a complete description of the system.

4. As specified in this Section the Contractor shall provide the following services including, but not limited to:

   a. PLC panels and panel submittals

   b. Instrumentation required for the successful completion of the project that is not explicitly provided by others. Refer to Sections 40 67 00 A and 40 70 00 A for description of equipment which is provided by the Contractor.

   c. Termination of all control wiring of instrumentation in the field and in control panels.

   d. Loop testing and documentation of all instrumentation loops.

   e. System Integrator shall be responsible for:

      1) HMI software and configuration

      2) PLC software and programming

      3) SCADA system programming

      4) SCADA computer(s) hardware and installation

      5) Assist electrical contractor in performing loop tests.

      6) Control system startup, documentation, and training.

5. It is the intent of these Specifications that the entire instrumentation and control system be complete and operable. Provide all necessary material and labor for the complete system from source of power to final utilization equipment, including all connections, testing, calibration of all equipment furnished by others, as well as equipment furnished by the Contractor.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.

a. Items involving electrical, control, and instrumentation construction may be indicated on the Drawings or specified in the Specifications that do not apply specifically to electrical, control and instrumentation systems.

3. It is the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.

C. Interfaces to equipment, instruments, and other components:

1. The Drawings, Specifications, and overall design are based on preliminary information furnished by various equipment manufacturers, which identify a minimum scope of supply from the manufacturers. This information pertains to, but is not limited to, instruments, control devices, electrical equipment, packaged mechanical systems, and control equipment provided with mechanical systems.

2. Provide all material and labor needed to install the actual equipment furnished, include all costs to add any additional instruments, wiring, control system inputs/outputs, controls, interlocks, electrical hardware etc., which may be necessary to make a complete, functional installation based on the actual equipment furnished:

a. Make all changes necessary to meet the manufacturer's wiring requirements.

3. Submit all such changes and additions to the Engineer for acceptance as specified in Section C700 – General Conditions.

4. Review the complete set of Drawings and Specifications in order to ensure that all items related to the instrumentation and control systems are completely accounted for. Include any items indicated on the Drawings or in Specifications from another discipline in the scope of Work:

a. If a conflict between Drawings and Specifications is discovered, refer conflict to the Engineer as soon as possible for resolution.

D. All instrumentation, and control equipment and systems for the entire project to comply with the requirements specified in the Instrumentation and Control Specifications, whether referenced in the individual Equipment Specifications or not:

1. The requirements of the Instrumentation and Control Specifications apply to all Instrumentation and Control Work specified in other Specifications, including HVAC controls, packaged mechanical systems, LCPs, VCPs, etc.

2. Inform all vendors supplying instrumentation, control systems, panels, and/or equipment of the requirements of the Instrumentation and Control Specifications.

3. The Owner is not responsible for any additional costs due to the failure of the Contractor to notify all subcontractors and suppliers of the Instrumentation and Control Specifications' requirements.

E. Contract Documents:

1. General:

a. The Drawings and Specifications are complementary and are to be used together in order to fully describe the Work.

2. Specifications:

a. Section C700 – General Conditions and Section C800 – Supplementary Conditions of the Contract Documents govern the Work.

b. These requirements are in addition to all General Requirements.

3. Contract Drawings:

a. The Instrumentation and Control Drawings show in a diagrammatic manner, the desired locations, and arrangements of the components of the Instrumentation Work. Follow the Drawings as closely as possible, use professional judgment and coordinate with the other trades to secure the best possible installation, use the entire Drawing set for construction purposes.

b. Locations of equipment, control devices, instruments, boxes, panels, etc. are approximate only, exercise professional judgment in executing the Work to ensure the best possible installation:

1) The equipment locations and dimensions indicated on the Drawings and elevations are approximate. Use the shop drawings to determine the proper layout, foundation, and pad requirements, etc. for final installation. Coordinate with all subcontractors to ensure that all instrumentation and control equipment is compatible with other equipment and space requirements. Make changes required to accommodate differences in equipment dimensions.

2) The Contractor has the freedom to select any of the named manufacturers as identified in the individual Specifications; however, the Engineer has designed the spatial equipment layout based upon a single manufacturer and has not confirmed that every named manufacturer's equipment fits in the allotted space. It is the Contractor's responsibility to ensure that the equipment being furnished fits within the defined space.

c. Installation details:

1) The Contract Drawings include installation details showing means and methods for installing instrumentation and control equipment. For cases where typical details are not provided or compatible with an installed location, develop installation details that are necessary for completing the Work, and submit these details for review by the Engineer.

d. Schematic diagrams:

1) Schematic diagrams show control function only. Incorporate other necessary functions for proper operation and protection of the system.

2) Add slave relays, where required, to provide all necessary contacts for the control system or where needed to function as interposing relays for control voltage coordination, equipment coordination, or control system voltage drop considerations.

3) Mount all devices shown on motor controller schematic diagrams in the controller compartment enclosure, unless otherwise noted or indicated.

4) Control schematics are to be used as a guide in conjunction with the descriptive operating sequences in the Specifications. Combine all information and furnish a coordinated and fully functional control system.

F. Alternates/Alternatives:

1. Substitute item provisions as specified in Section C700 – General Conditions.

G. Changes and change orders:

1. As specified in Section C700 - General Conditions.

1.2 REFERENCES

A. See Section 40 70 00.1 – Instrumentation and Control, References and Definitions

1.3 DEFINITIONS

A. See Section 40 70 00.1 – Instrumentation and Control, References and Definitions

1.4 SYSTEM DESCRIPTION

A. See Section 40 70 00.2 – Instrumentation and Control, System Description

1.5 SUBMITTALS

A. Furnish submittals as specified in Section 01 33 00 – Submittals and this Section.

1. Furnish the submittals required by each section in the Electrical Specifications.

2. Adhere to the wiring numbering scheme specified in Section 26 05 00 – Electrical, General throughout the Project:

a. Uniquely number each wire.

b. Wire numbers must appear on all Equipment Drawings.

3. Use equipment and instrument tags, as indicated on the Drawings, for all submittals.

B. Submittal organization as specified in Section 01 33 00 – Submittal Procedures and this Section

C. Submittal requirements as specified in Section 01 33 00 – Submittal Procedures and this Section:

1. Furnish submittals including:

a. Project Shop Drawing submittals.

b. The Process Control and SCADA Software Submittal including control system software, programming, and screens.

c. Testing, Calibration and Start-up procedures.

d. O&M Manual as specified in Section 01 78 23 – Operation and Maintenance Data.

e. Training Submittals.

f. Record Documents.

g. Testing Documents

D. Submittal preparation as specified in Section 01 33 00 – Submittal Procedures and this Section:

E. Specific submittal requirements:

1. Control panel hardware submittal in 1 package

a. Project Shop Drawing submittals.

1) Control panel hardware submittal in 1 package with complete and detailed bills of materials:

a) Including quantity, description, manufacturer, and part number for each assembly or component for each control panel.

b) Include all items within an enclosure.

2) Furnish sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications.

3) Use equipment and instrument tags as depicted on the P&IDs for all submittals.

4) Adhere to wiring identification scheme outlined in Specification 26 05 00 – Electrical, General throughout the Project.

5) Wire numbers must appear on all equipment drawings.

b. Requirements for physical separation between control system components and 120 VAC, 480 VAC, and medium voltage power cables.

c. UPS and battery load calculations to show that the backup capacity and time meet the specified requirements.

d. Provide a data sheet for each control system component together with a technical product brochure or bulletin.

2. O&M Manual

a. Spare parts list:

b. Control and SCADA System Software Record Documents:

1) Include electronic copies of all software and applications.

2) Navigation tree and screen shots of all SCADA screens with basic narrative.

3) Navigation tree and screen shots of all OIT screens with basic narrative

c. Instrument data sheets and cut sheets:

d. Training Submittals.

e. Record Documents.

3. Training submittals:

a. Develop and submit for review a general training plan. Include complete descriptions of all planned training classes, a preliminary training schedule, a list of all proposed instructors along with resumes, examples of proposed training manuals, and a description of any special training tools to be used (simulators, self-paced modules, personal computer-based training, etc.).

b. The Engineer will review the general training plan. Special emphasis will be placed on review of the qualifications of the proposed instructors and the timing of the individual courses to maximize their effectiveness. If, in the opinion of the Engineer, the proposed instructors are not sufficiently qualified to conduct the specified training courses, or lack experience, where required, on the specific configuration of the system, provide more qualified instructors.

4. Record documents:

a. Furnish as specified in Section 01 77 00 – Closeout Procedures.

b. Provide record documents of all Instrumentation Drawings.

c. Shop drawings:

d. Review and corrections:

1) Correct any record documents or other documents found to be incomplete, not accurate, of poor quality, or containing errors.

e. Control Panel Drawings

f. Control System Diagram:

1) Submit a complete set of control system diagrams including the following information:

a) All PLCs, workstations, printers, communication devices, and communication links:

b) All cables required for communication requirements.

5. Testing, Calibration, and Start-up Submittal:

a. General testing submittal requirements are specified in this Section and other Sections.

b. Test Procedure Submittals:

1) Submit the proposed procedures to be followed during tests of the PCIS and its components in two parts:

a) Preliminary Submittal: Outline of the specific proposed tests and examples of proposed forms and checklists.

b) Detailed Submittal: After successful review of the Preliminary Submittal, submit the proposed detailed test procedures, forms, and checklists. Include a statement of test objectives with the test procedures.

c. Provide certified and witnessed test and calibration checklists for any of the following tests:

1) Calibration, adjustment, and test details for all components and systems.

2) Factory Acceptance Tests (FAT).

3) Site Acceptance Test (SAT)

4) Operational Readiness Test (ORT).

d. Test reports:

1) As specified in Section 01 33 00 – Submittal Procedures.

1.6 QUALITY ASSURANCE

F. Manufacture instruments at facilities certified to the quality standards of ISO 9001.

G. Furnish all equipment listed by and bearing the label of UL or of an independent testing laboratory acceptable to the Engineer and the Authority Having Jurisdiction.

H. The panel provider must have their own operating UL listed panel fabrication facility. All panels must be fabricated at this facility and meet all UL 508/508A requirements.

I. System Integration:

1. The Contractor, through the use of a pre-qualified SI, is responsible for the implementation of the PCIS and the integration of the PCIS with other required instrumentation and control devices.

2. The contractor assumes full responsibility, working with the SI where applicable, to perform all work to select, furnish, install, test, calibrate, and place into operation all instrumentation, controls, telemetry equipment, control panels, and SCADA system including application software, for a complete, integrated and functional PCIS system.

3. Due to the complexities associated with the interfacing of numerous control system devices, it is the intent of these Specifications that the SI be responsible for the integration of the PCIS with existing devices and devices provided under the Contract Documents with the objective of providing a completely integrated control system.

J. Hazardous Location Rating of Equipment: Equipment manufacturer shall reference the hazardous-area classification drawing in the Contract Documents and provide equipment in compliance with the defined NEC- classification requirements. It will be the manufacturer's sole responsibility to submit equipment in compliance with the Contract Documents, NFPA 820, and NEC requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

K. Store all equipment and materials delivered to the job site in a location that will not interfere with the construction or the Owner’s operations.

L. Shipping precautions:

1. After completion of shop assembly, successful FAT, pack all equipment, cabinets, panels, and consoles in protective crates and enclose in heavy-duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture.

2. Place dehumidifiers when required, inside the polyethylene coverings.

3. Skid-mount the equipment for final transport.

4. Provide lifting rings for moving without removing protective covering.

5. Display boxed weight on shipping tags together with instructions for unloading, transporting, storing, and handling at the job site.

M. Tagging:

1. Tag each component and/or instrument to identify its location, instrument tag number, and function in the system.

2. Firmly attach a permanent tag indelibly machine marked with the instrument tag number, as given in the tabulation, on each piece of equipment constituting the PCIS.

3. Tag instruments immediately upon receipt in the field.

4. Prominently display identification on the outside of the package.

5. Utilize the Tag and Loop Number identifications shown on the P&IDs.

N. Delivery and inspection:

1. Deliver products in undamaged condition, in manufacturer's original container or packaging with identifying labels intact and legible. Include date of manufacture on label.

1.8 PROJECT OR SITE CONDITIONS

O. Site conditions:

1. Provide a PCIS, including all equipment, raceways and any other components required for a complete installation that meets the environmental conditions for the Site as specified in the General Requirements and below.

1.9 SEQUENCING

P. General:

1. As specified in Section 01 31 19 – Project Meetings and 01 35 13 – Special Project Procedures.

2. Testing requirements are specified in Section 40 70 00 – Instrument Calibration, and other sections.

3. General scheduling requirements are specified in Section 01 32 16 – Construction Progress Schedule.

4. Other scheduling activities to be determined between the Owner, Contractor, Engineer and SI.

Q. Training:

1. As specified in this Section.

2. Complete all training as agreed upon with the Owner, Contractor, Engineer and SI.

3. Within 10 days after the completion of training, submit the following:

   a. A list of all Owner personnel that attended the session.

   b. A copy of the training materials utilized during the lesson with all notes, diagrams, and comments.

R. Site Acceptance Test (SAT) or Pre-commissioning test:

1. Commence after acceptance of all training, wire test, calibration tests, and loop validation tests, and all inspections have demonstrated that the PCIS complies with all Contract requirements.

2. The Programmer will assist with SAT testing for PLCs programmed by the Programmer.

3. The Programmer shall not be required to be on site, nor shall the Programmer be required to supply application software, until the loop validation tests are complete for a PLC and all prerequisites for the pre-commissioning test are completed.

4. Complete SAT test before the ORT.

S. Operational Readiness Test (ORT)

1. Complete all with the Owner, Contractor, Engineer and SI.

2. Confirmation by the Owner, Contractor and Engineer that the PCIS functions correctly and as designed.

T. Substantial completion testing: The following conditions be fulfilled before the PCIS is considered complete:

1. All submittals have been completed and approved.

2. The Owner training has been performed.

3. All required spare parts, expendable supplies, and test equipment have been delivered to the Owner.

4. The PCIS has been calibrated, loop tested and pre-commissioned.

5. The ORT has been successfully completed.

6. All debris associated with installation of instrumentation has been removed.

7. All probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

1.10 WARRANTY

U. Warrant the PCIS as specified in Section C800 – Standard General Conditions of the Construction Contract:

1. Provide additional warranty as specified in the individual Instrumentation and Control Specifications.

1.11 SYSTEM START-UP

V. Replace or modify equipment, software, and materials that do not achieve design requirements after installation in order to attain compliance with the design requirements:

1. Following replacement or modification, retest the system and perform additional testing to place the complete system in satisfactory operation and obtain compliance acceptance from the Engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide similar items from a single manufacturer throughout the PCIS portion of the Project.

B. Allowable manufacturers are specified in individual instrument and equipment specifications in other sections of the Instrumentation and Control Specifications.

2.2 MATERIALS

A. Furnish all materials under this Contract that are new, free from defects, and standard products produced by manufacturers regularly engaged in the production of these devices and that bear all approvals and labels as required by the Specifications.

B. Provide materials complying with the applicable industrial standard as specified in the Contract Documents.

2.3 SOURCE QUALITY CONTROL

A. Provide all equipment that is new, free from defects, and standard products produced by manufacturers regularly engaged in the production of these products that bear all approvals and labels as required by the Specifications.

B. Arrange with all manufacturers of the equipment and fabricators of panels and cabinets, to allow the Owner and Engineer to inspect and witness the testing of the equipment at the site of fabrication:

1. Equipment includes the cabinets, special control systems, flow measuring devices, and other pertinent systems and devices.

C. Factory testing is specified in Division 26 and other sections of the Electrical, and the Instrumentation and Control Specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The SI is encouraged to attend a pre-bid conference and examine the premises completely before bidding. It is the SI's responsibility to be fully familiar with the existing conditions and local requirements and regulations.

B. Review the existing Site conditions and examine all shop drawings for the various items of equipment in order to determine exact routing and final terminations for all wiring and cables.

C. Provide a complete instrumentation and control system:

1. Install all extra conduits, cables, and interfaces as may be necessary to provide a complete and operating electrical, and process control and instrumentation system.

3.2 FIELD QUALITY CONTROL

A. Inspection:

1. Allow for inspection of PCIS installation.

2. Provide any assistance necessary to support inspection activities.

3. Engineer inspections may include, but are not limited to, the following:

a. Inspect equipment and materials for physical damage.

b. Inspect installation for compliance with Drawings and Specifications.

c. Inspect installation for obstructions and adequate clearances around equipment.

d. Inspect equipment installation for proper leveling, alignment, anchorage, and assembly.

e. Inspect equipment nameplate data to verify compliance with design requirements.

f. Inspect cable terminations.

g. Inspect/witness instrument calibrations/verifications.

4. Inspection activities conducted during construction do not satisfy inspection requirements specified in Division 26.

B. Instrument Installation Inspection:

1. Provide any assistance necessary to support inspection activities.

2. Inspections may include, but are not limited to, the following:

a. Inspect equipment and materials for physical damage.

b. Inspect the installed arrangement, lay lengths, orientation, piping obstructions etc. that could affect the instruments accuracy or repeatability.

c. Inspect installation for compliance with Drawings and Specifications.

d. Inspect installation for obstructions and adequate clearances around equipment.

e. Inspect equipment installation for proper leveling, alignment, anchorage, and assembly.

f. Inspect equipment nameplate data to verify compliance with design requirements.

g. Inspect cable terminations.

h. Inspect/witness instrument calibrations/verifications.

3. Inspection activities conducted during construction do not satisfy inspection requirements specified in Division 26.

C. Field testing is specified in Division 26 and Section 01 75 16.

D. Installation supervision:

1. Ensure that the entire PCIS is installed in a proper and satisfactory manner. At a minimum, the contractor with assistance of the SI where applicable, shall provide the following services:

a. Installation resources:

1) Coordinate with the Contractor regarding installation requirements of the Contract Documents.

b. Provide technical assistance to installation personnel by telephone:

1) Furnish installation personnel with at least one copy of the approved submittals, including all installation details.

c. Periodic inspections during the construction period.

d. A complete check of the completed installation to ensure that it is in conformance with the requirements of the equipment manufacturer and the Contract Documents.

e. Field-verify accuracy and calibration of all instruments.

3.3 CLEANING

A. As specified in Section 01 77 00 – Project Closeout.

3.4 PROTECTION

A. Protect all Work from damage or degradation until date of Substantial Completion.

END OF SECTION 40 70 00

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LOCATION	INSTRUMENT TAG NO.	SERVICE DESCRIPTION	POWER	P&ID	SETPOINT/RANGE	SPECIFICATION	SCOPE	FURNISHED BY	INSTALLED BY	NOTES
HEADWORKS	LIT-1001	SCR-01 OUTLET LEVEL	---	EI-701-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS	LIT-1002	SCR-01 INLET LEVEL	---	EI-701-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS	LE-1001	SCR-01 INFLOW LEVEL ELEMENT	---	EI-701-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS	LE-1002	SCR-01 OUTFLOW LEVEL ELEMENT	---	EI-701-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS	SV-1001	SCR-01 SOLENOID VALVE	---	EI-701-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS	SV-1002	SCR-01 SOLENOID VALVE	---	EI-701-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS	SV-1003	SCR-01 SOLENOID VALVE	---	EI-701-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS	PS-1001	SCR-1 PRESSURE SWITCH	---	EI-701-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS	SV-1004	GC-1 SOLENOID VALVE	---	EI-701-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS	AIT-1001-1	LEL GAS DETECTOR	---	EI-701-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS	AIT-1001-2	H2S GAS DETECTOR	---	EI-701-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS	FE-1020	SCR-2 INFLOW MAG ELEMENT	---	EI-701-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS	FIT-1020	SCR-2 INFLOW	---	EI-701-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS	LT-1008	SCR-2 OUTLET LEVEL	120V	EI-701-A	BY VENDOR	40 72 00	NEW	VENDOR	CONTRACTOR	REFER TO HUBER FINE SCREEN
HEADWORKS	SV-1005	SCR-2 WASH SOLENOID VALVE	N/A	EI-701-A	NC	40 05 82	NEW	VENDOR	VENDOR	REFER TO HUBER FINE SCREEN
HEADWORKS	SV-1006	SCR-2 WASH SOLENOID VALVE	N/A	EI-701-A	NC	40 05 82	NEW	VENDOR	VENDOR	REFER TO HUBER FINE SCREEN
HEADWORKS	SV-1007	SCR-2 WASH SOLENOID VALVE	N/A	EI-701-A	NC	40 05 82	NEW	VENDOR	VENDOR	REFER TO HUBER FINE SCREEN
HEADWORKS LIFT STATION	LT-0101	HEADWORKS LIFT STATION LEVEL TRANSMITTER	---	EI-702-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS LIFT STATION	LE-0101	HEADWORKS LIFT STATION LEVEL ELEMENT	---	EI-702-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS LIFT STATION	LS-0105	PEAK FLOW LAG PUMP ON LEVEL SWITCH	---	EI-702-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS LIFT STATION	LS-0104	PEAK FLOW LEAD PUMP ON LEVEL SWITCH	---	EI-702-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS LIFT STATION	LS-0103	NORMAL FLOW LAG PUMP ON LEVEL SWITCH	---	EI-702-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS LIFT STATION	LS-0102	NORMAL FLOW LEAD PUMP ON LEVEL SWITCH	---	EI-702-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS LIFT STATION	LS-0101	LOW LEVEL PUMPS OFF LEVEL SWITCH	---	EI-702-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS LIFT STATION	TS-0101	P-0101 TEMPERATURE SWITCH	---	EI-702-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS LIFT STATION	MS-0101	P-0101 MOISTURE SWITCH	---	EI-702-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS LIFT STATION	TS-0102	P-0102 TEMPERATURE SWITCH	---	EI-702-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS LIFT STATION	MS-0102	P-0102 MOISTURE SWITCH	---	EI-702-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS LIFT STATION	TS-0103	P-0103 TEMPERATURE SWITCH	---	EI-702-A	---	---	EXISTING	EXISTING	EXISTING	
HEADWORKS LIFT STATION	MS-0103	P-0103 MOISTURE SWITCH	---	EI-702-A	---	---	EXISTING			
IFAS TREATMENT	AIT-2002	IFAS TRAIN #2 DO CONCENTRATION/ TEMPERATURE	120V	EI-701-B	0-100% / 0-100	40 75 43	NEW	VENDOR	CONTRACTOR	REFER TO VEOLIA
IFAS TREATMENT	AE/TE-2002	IFAS TRAIN #2 ANALYZER ELEMENT	N/A	EI-701-B	0-100%	40 75 43	NEW	VENDOR	CONTRACTOR	REFER TO VEOLIA
IFAS TREATMENT	LSH-2003	IFAS BASIN #2A HIGH LEVEL SWITCH	N/A	EI-701-B	13'6"	40 72 00	NEW	VENDOR	CONTRACTOR	REFER TO VEOLIA
IFAS TREATMENT	AIT-2004	IFAS TRAIN #1 DO CONCENTRATION/ TEMPERATURE	120V	EI-701-B	0-100%	40 75 43	NEW	VENDOR	CONTRACTOR	REFER TO VEOLIA
IFAS TREATMENT	AE/TE-2004	IFAS TRAIN #1 ANALYZER ELEMENT	N/A	EI-701-B	0-100%	40 75 43	NEW	VENDOR	CONTRACTOR	REFER TO VEOLIA
IFAS TREATMENT	LSH-2005	IFAS BASIN #1A HIGH LEVEL SWITCH	N/A	EI-701-B	13'6"	40 72 00	NEW	VENDOR	CONTRACTOR	REFER TO VEOLIA
IFAS TREATMENT	LSH-2006	IFAS BASIN #2B HIGH LEVEL SWITCH	N/A	EI-701-B	13'6"	40 72 00	NEW	VENDOR	CONTRACTOR	REFER TO VEOLIA
IFAS TREATMENT	LT-2007	IFAS TRAIN #2 LEVEL	LOOP	EI-701-B	0-13'6"	40 72 00	NEW	VENDOR	CONTRACTOR	REFER TO VEOLIA
IFAS TREATMENT	LT-2008	IFAS TRAIN #1 LEVEL	LOOP	EI-701-B	0-13'6"	40 72 00	NEW	VENDOR	CONTRACTOR	REFER TO VEOLIA
IFAS TREATMENT	SV-2009	CYLINDRICAL SCREEN SCOUR SOLENOID COMMAND BASIN #1A	120V	EI-701-B	NC	40 05 82	NEW	VENDOR	CONTRACTOR	REFER TO VEOLIA
IFAS TREATMENT	SV-2010	CYLINDRICAL SCREEN SCOUR SOLENOID COMMAND BASIN #2A	120V	EI-701-B	NC	40 05 82	NEW	VENDOR	CONTRACTOR	REFER TO VEOLIA
IFAS TREATMENT	SV-2013	CYLINDRICAL SCREEN SCOUR SOLENOID COMMAND BASIN #2B	120V	EI-701-B	NC	40 05 82	NEW	VENDOR	CONTRACTOR	REFER TO VEOLIA
IFAS TREATMENT	SV-2014	CYLINDRICAL SCREEN SCOUR SOLENOID COMMAND BASIN #1B	120V	EI-701-B	NC	40 05 82	NEW	VENDOR	CONTRACTOR	REFER TO VEOLIA
IFAS TREATMENT	LSH-2015	IFAS BASIN #1B HIGH LEVEL SWITCH	N/A	EI-701-B	13'6"	40 72 00	NEW	VENDOR	CONTRACTOR	REFER TO VEOLIA
IFAS BLOWERS BUILDING	FE-2104	THERMAL DISPERSION FLOW ELEMENT	N/A	EI-701-B2	BY VENDOR	40 71 76	NEW	VENDOR	CONTRACTOR	REFER TO VEOLIA
IFAS BLOWERS BUILDING	FIT-2104	AIR FLOW TO IFAS TRAIN #1	120V	EI-701-B2	BY VENDOR	40 71 76	NEW	VENDOR	CONTRACTOR	REFER TO VEOLIA
IFAS BLOWERS BUILDING	FE-2105	THERMAL DISPERSION FLOW ELEMENT	N/A	EI-701-B2	BY VENDOR	40 71 76	NEW	VENDOR	CONTRACTOR	REFER TO VEOLIA
IFAS BLOWERS BUILDING	FIT-2105	AIR FLOW TO IFAS TRAIN #2	120V	EI-701-B2	BY VENDOR	40 71 76	NEW	VENDOR	CONTRACTOR	REFER TO VEOLIA
IFAS BLOWERS BUILDING	PI-2101	BLOWER #1 PRESSURE GAUGE	N/A	EI-701-B2	BY VENDOR	40 73 00	NEW	VENDOR	VENDOR	REFER TO VEOLIA
IFAS BLOWERS BUILDING	TI-2101	BLOWER #1 TEMPERATURE GAUGE	N/A	EI-701-B2	BY VENDOR	40 74 00	NEW	VENDOR	VENDOR	REFER TO VEOLIA
IFAS BLOWERS BUILDING	TSH-2101	BLOWER #1 TEMPERATURE SWITCH	N/A	EI-701-B2	BY VENDOR	40 74 00	NEW	VENDOR	VENDOR	REFER TO VEOLIA
IFAS BLOWERS BUILDING	PI-2102	BLOWER #2 PRESSURE GAUGE	N/A	EI-701-B2	BY VENDOR	40 73 00	NEW	VENDOR	VENDOR	REFER TO VEOLIA
IFAS BLOWERS BUILDING	TI-2102	BLOWER #2 TEMPERATURE GAUGE	N/A	EI-701-B2	BY VENDOR	40 74 00	NEW	VENDOR	VENDOR	REFER TO VEOLIA

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LOCATION	INSTRUMENT TAG NO.	SERVICE DESCRIPTION	POWER	P&ID	SETPOINT/RANGE	SPECIFICATION	SCOPE	FURNISHED BY	INSTALLED BY	NOTES
IFAS BLOWERS BUILDING	TSH-2102	BLOWER #2 TEMPERATURE SWITCH	N/A	EI-701-B2	BY VENDOR	40 74 00	NEW	VENDOR	VENDOR	REFER TO VEOLIA
IFAS BLOWERS BUILDING	PI-2103	BLOWER #3 PRESSURE GAUGE	N/A	EI-701-B2	BY VENDOR	40 73 00	NEW	VENDOR	VENDOR	REFER TO VEOLIA
IFAS BLOWERS BUILDING	TI-2103	BLOWER #3 TEMPERATURE GAUGE	N/A	EI-701-B2	BY VENDOR	40 74 00	NEW	VENDOR	VENDOR	REFER TO VEOLIA
IFAS BLOWERS BUILDING	TSH-2103	BLOWER #3 TEMPERATURE SWITCH	N/A	EI-701-B2	BY VENDOR	40 74 00	NEW	VENDOR	VENDOR	REFER TO VEOLIA
CLARIFIERS	FE-3001	WAS FLOW MAGNETIC FLOW ELEMENT	---	EI-701-C	---	---	EXISTING	EXISTING	EXISTING	
CLARIFIERS	FIT-3001	WAS FLOW TO DIGESTER 1	---	EI-701-C	---	---	EXISTING	EXISTING	EXISTING	
CLARIFIER 1	TS-3001	P-3001 RAS PUMP 1 TEMPERATURE SWITCH	---	EI-701-C	---	---	EXISTING	EXISTING	EXISTING	
CLARIFIER 1	MS-3001	P-3001 RAS PUMP 1 MOISTURE DETECT	---	EI-701-C	---	---	EXISTING	EXISTING	EXISTING	
CLARIFIER 1	TS-3002	P-3002 RAS PUMP 2 TEMPERATURE SWITCH	---	EI-701-C	---	---	EXISTING	EXISTING	EXISTING	
CLARIFIER 1	MS-3002	P-3002 RAS PUMP 2 MOISTURE DETECT	---	EI-701-C	---	---	EXISTING	EXISTING	EXISTING	
CLARIFIER 1	NSH-CLA-1A	CLARIFIER 1 LONG COLLECTOR TORQUE SWITCH	---	EI-701-C	---	---	EXISTING	EXISTING	EXISTING	
CLARIFIER 1	NSH-CLA-1B	CLARIFIER 1 CROSS COLLECTOR TORQUE SWITCH	---	EI-701-C	---	---	EXISTING	EXISTING	EXISTING	
CLARIFIERS	FE-3002	RAS FLOW MAGNETIC FLOW ELEMENT	---	EI-701-C	---	---	EXISTING	EXISTING	EXISTING	
CLARIFIERS	FIT-3002	RAS FLOW TO IFAS SPLITTER BOX	---	EI-701-C	---	---	EXISTING	EXISTING	EXISTING	
CLARIFIER 2	TS-3003	P-3003 RAS PUMP 1 TEMPERATURE SWITCH	---	EI-701-C	---	---	EXISTING	EXISTING	EXISTING	
CLARIFIER 2	MS-3003	P-3003 RAS PUMP 1 MOISTURE DETECT	---	EI-701-C	---	---	EXISTING	EXISTING	EXISTING	
CLARIFIER 2	TS-3004	P-3004 RAS PUMP 2 TEMPERATURE SWITCH	---	EI-701-C	---	---	EXISTING	EXISTING	EXISTING	
CLARIFIER 2	MS-3004	P-3004 RAS PUMP 2 MOISTURE DETECT	---	EI-701-C	---	---	EXISTING	EXISTING	EXISTING	
CLARIFIER 2	NSH-CLA-2A	CLARIFIER 2 LONG COLLECTOR TORQUE SWITCH	---	EI-701-C	---	---	EXISTING	EXISTING	EXISTING	
CLARIFIER 2	NSH-CLA-2B	CLARIFIER 2 CROSS COLLECTOR TORQUE SWITCH	---	EI-701-C	---	---	EXISTING	EXISTING	EXISTING	
TERTIARY TREATMENT	FE-4001	MAGNETIC FLOW METER	N/A	EI-701-D	0-4000GPM	40 70 13	NEW	CONTRACTOR	CONTRACTOR	
TERTIARY TREATMENT	FIT-4001	TERTIARY FILTER INFLUENT FLOW	120V	EI-701-D	0-4000GPM	40 70 13	NEW	CONTRACTOR	CONTRACTOR	
TERTIARY TREATMENT	PCV-4001	AIR TO SAND FILTERS	N/A	EI-701-D	BY VENDOR		NEW	VENDOR	VENDOR	GAUGE ON PCV
TERTIARY TREATMENT	FE-4002	MAG FLOW METER	N/A	EI-701-D	0-4000GPM	40 70 13	NEW	CONTRACTOR	CONTRACTOR	
TERTIARY TREATMENT	FIT-4002	TERTIARY FILTER EFFLUENT FLOW	120V	EI-701-D	0-4000GPM	40 70 13	NEW	CONTRACTOR	CONTRACTOR	
TERTIARY TREATMENT	PI-4014	HEADLOSS PRESSURE GAUGE	N/A	EI-701-D	BY VENDOR	40 73 00	NEW	VENDOR	CONTRACTOR	REFER TO NEXOM
TERTIARY TREATMENT	PT-4014	HEADLOSS PRESSURE TRANSMITTER	LOOP	EI-701-D	BY VENDOR	40 73 00	NEW	VENDOR	CONTRACTOR	REFER TO NEXOM
TERTIARY TREATMENT	AE-4015	PH PHOSPHATE TERTIARY EFFLUENT ANALYZER	N/A	EI-701-D	0.05-15.00mg/L	40 75 69	NEW	CONTRACTOR	CONTRACTOR	REFER TO MANUFACTURER FOR INSTALLATION
TERTIARY TREATMENT	AIT-4015	PH PHOSPHATE TERTIARY EFFLUENT ANALYZING TRANSMITTER	120V	EI-701-D	0.05-15.00mg/L	40 75 69	NEW	CONTRACTOR	CONTRACTOR	REFER TO MANUFACTURER FOR INSTALLATION
TERTIARY TREATMENT	XV-4003	PNEUMATIC VALVE TO FIL-1	DISCRETE	EI-701-D	NC	40 05 64	NEW	VENDOR	CONTRACTOR	REFER TO NEXOM
TERTIARY TREATMENT	XV-4004	PNEUMATIC VALVE TO FIL-2	DISCRETE	EI-701-D	NC	40 05 64	NEW	VENDOR	CONTRACTOR	REFER TO NEXOM
TERTIARY TREATMENT	XV-4005	PNEUMATIC VALVE TO FIL-3	DISCRETE	EI-701-D	NC	40 05 64	NEW	VENDOR	CONTRACTOR	REFER TO NEXOM
TERTIARY TREATMENT	XV-4006	PNEUMATIC VALVE TO FIL-4	DISCRETE	EI-701-D	NC	40 05 64	NEW	VENDOR	CONTRACTOR	REFER TO NEXOM
TERTIARY TREATMENT	XV-4007	PNEUMATIC VALVE TO FIL-5	DISCRETE	EI-701-D	NC	40 05 64	NEW	VENDOR	CONTRACTOR	REFER TO NEXOM
TERTIARY TREATMENT	LSL-4008	OPERATING LEVEL FIL-1	DISCRETE	EI-701-D	BY VENDOR	40 72 00	NEW	VENDOR	CONTRACTOR	REFER TO NEXOM
TERTIARY TREATMENT	LSL-4009	OPERATING LEVEL FIL-2	DISCRETE	EI-701-D	BY VENDOR	40 72 00	NEW	VENDOR	CONTRACTOR	REFER TO NEXOM
TERTIARY TREATMENT	LSL-4010	OPERATING LEVEL FIL-3	DISCRETE	EI-701-D	BY VENDOR	40 72 00	NEW	VENDOR	CONTRACTOR	REFER TO NEXOM
TERTIARY TREATMENT	LSL-4011	OPERATING LEVEL FIL-4	DISCRETE	EI-701-D	BY VENDOR	40 72 00	NEW	VENDOR	CONTRACTOR	REFER TO NEXOM
TERTIARY TREATMENT	LSL-4012	OPERATING LEVEL FIL-5	DISCRETE	EI-701-D	BY VENDOR	40 72 00	NEW	VENDOR	CONTRACTOR	REFER TO NEXOM
TERTIARY TREATMENT	PSL-4013	LOW FILTER AIR PRESSURE SWITCH	DISCRETE	EI-701-D	BY VENDOR	40 73 00	NEW	VENDOR	CONTRACTOR	REFER TO NEXOM
TERTIARY TREATMENT	LT-4101	ALUM TANK LEVEL	LOOP	EI-702-D	0-5'	40 72 00	NEW	CONTRACTOR	CONTRACTOR	
TERTIARY TREATMENT	LI/LE-4101	REVERSE FLOAT LEVEL INDICATION	N/A	EI-702-D	0-5'	40 72 00	NEW	VENDOR	CONTRACTOR	
TERTIARY TREATMENT	YS-4102	ALUM LEAK DETECTOR SWITCH	120V	EI-702-D	NO	40 72 83	NEW	CONTRACTOR	CONTRACTOR	
TERTIARY TREATMENT	YE-4102A	LEAK DETECTOR PROBE IN PIPE TO IFAS TRAIN #1	N/A	EI-702-D	NO	40 72 83	NEW	CONTRACTOR	CONTRACTOR	
TERTIARY TREATMENT	YE-4102B	LEAK DETECTOR PROBE IN PIPE TO IFAS TRAIN #2	N/A	EI-702-D	NO	40 72 83	NEW	CONTRACTOR	CONTRACTOR	
TERTIARY TREATMENT	PI-4110	ALUM P-4101 DISCHARGE PRESSURE GAUGE	N/A	EI-702-D	BY VENDOR	40 73 00	NEW	VENDOR	VENDOR	REFER TO BLUE-WHTE
TERTIARY TREATMENT	FI-4111	ALUM P-4101 DISCHARGE ROTAMETER	N/A	EI-702-D	BY VENDOR	40 70 13	NEW	VENDOR	VENDOR	REFER TO BLUE-WHTE
TERTIARY TREATMENT	PI-4120	ALUM P-4102 DISCHARGE PRESSURE GAUGE	N/A	EI-702-D	BY VENDOR	40 73 00	NEW	VENDOR	VENDOR	REFER TO BLUE-WHTE
TERTIARY TREATMENT	FI-4121	ALUM P-4102 DISCHARGE ROTAMETER	N/A	EI-702-D	BY VENDOR	40 70 13	NEW	VENDOR	VENDOR	REFER TO BLUE-WHTE
TERTIARY TREATMENT	PI-4130	ALUM P-4103/P-4104 DISCHARGE PRESSURE GAUGE	N/A	EI-702-D	BY VENDOR	40 73 00	NEW	VENDOR	VENDOR	REFER TO BLUE-WHTE
TERTIARY TREATMENT	FI-4131	ALUM P-4103/P-4104 DISCHARGE ROTAMETER	N/A	EI-702-D	BY VENDOR	40 70 13	NEW	VENDOR	VENDOR	REFER TO BLUE-WHTE
TERTIARY TREATMENT	PI-4210	CAUSTIC SODA P-4201/P-4202 DISCHARGE PRESSURE GAUGE	N/A	EI-703-D	BY VENDOR	40 73 00	NEW	VENDOR	VENDOR	REFER TO BLUE-WHTE
TERTIARY TREATMENT	FI-4211	CAUSTIC SODA P-4201/P-4202 DISCHARGE ROTAMETER	N/A	EI-703-D	BY VENDOR	40 70 13	NEW	VENDOR	VENDOR	REFER TO BLUE-WHTE
TERTIARY LIFT STATION	ME-4301	P-4301 MOISTURE DETECTOR	N/A	EI-701-D1	NO	40 72 83	NEW	VENDOR	VENDOR	INTERNAL TO PUMP
TERTIARY LIFT STATION	TE-4301	P-4301 TEMPERATURE DETECTOR	N/A	EI-701-D1	NO	40 74 00	NEW	VENDOR	VENDOR	INTERNAL TO PUMP
TERTIARY LIFT STATION	ME-4302	P-4302 MOISTURE DETECTOR	N/A	EI-701-D1	NO	40 72 83	NEW	VENDOR	VENDOR	INTERNAL TO PUMP
TERTIARY LIFT STATION	TE-4302	P-4302 TEMPERATURE DETECTOR	N/A	EI-701-D1	NO	40 74 00	NEW	VENDOR	VENDOR	INTERNAL TO PUMP
TERTIARY LIFT STATION	ME-4303	P-4303 MOISTURE DETECTOR	N/A	EI-701-D1	NO	40 72 83	NEW	VENDOR	VENDOR	INTERNAL TO PUMP
TERTIARY LIFT STATION	TE-4303	P-4303 TEMPERATURE DETECTOR	N/A	EI-701-D1	NO	40 74 00	NEW	VENDOR	VENDOR	INTERNAL TO PUMP
TERTIARY LIFT STATION	LSHH-4307	TERTIARTY LIFT STATION WET WELL HIGH LEVEL	N/A	EI-701-D1	6'	40 72 00	NEW	CONTRACTOR	CONTRACTOR	
TERTIARY LIFT STATION	LSLL-4308	TERTIARY LIFT STATION WET WELL LOW LEVEL	N/A	EI-701-D1	3'	40 72 00	NEW	CONTRACTOR	CONTRACTOR	
TERTIARY LIFT STATION	LT-4309	TERTIARTY LIFT STATION WET WELL LEVEL	LOOP	EI-701-D1	0'5"-9'	40 72 00	NEW	CONTRACTOR	CONTRACTOR	

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LOCATION	INSTRUMENT TAG NO.	SERVICE DESCRIPTION	POWER	P&ID	SETPOINT/RANGE	SPECIFICATION	SCOPE	FURNISHED BY	INSTALLED BY	NOTES
TERTIARY LIFT STATION	PI-4310	P-4301 DISCHARGE PRESSURE GAUGE WITH ANNULAR SEAL	N/A	EI-701-D1	0-50 PSI	40 73 00	NEW	CONTRACTOR	CONTRACTOR	
TERTIARY LIFT STATION	PI-4311	P-4302 DISCHARGE PRESSURE GAUGE WITH ANNULAR SEAL	N/A	EI-701-D1	0-50 PSI	40 73 00	NEW	CONTRACTOR	CONTRACTOR	
TERTIARY LIFT STATION	PI-4312	P-4303 DISCHARGE PRESSURE GAUGE WITH ANNULAR SEAL	N/A	EI-701-D1	0-50 PSI	40 73 00	NEW	CONTRACTOR	CONTRACTOR	
DECANT LIFT STATION	MSH-7010	P-7010 MOISTURE SWITCH	N/A	EI-701-G2	NC	40 72 83	NEW	VENDOR	VENDOR	
DECANT LIFT STATION	TSH-7010	P-7010 TEMPERATURE SWITCH	N/A	EI-701-G2	NC	40 74 00	NEW	VENDOR	VENDOR	
DECANT LIFT STATION	MSH-7020	P-7020 MOISTURE SWITCH	N/A	EI-701-G2	NC	40 72 83	NEW	VENDOR	VENDOR	
DECANT LIFT STATION	TSH-7020	P-7020 TEMPERATURE SWITCH	N/A	EI-701-G2	NC	40 74 00	NEW	VENDOR	VENDOR	
DECANT LIFT STATION	LSH-7005	DECANT LIFT STATION WET WELL LEVEL HIGH SWITCH	N/A	EI-701-G2	4'	40 72 00	NEW	CONTRACTOR	CONTRACTOR	
DECANT LIFT STATION	LSL-7006	DECANT LIFT STATION WET WELL LEVEL LOW SWITCH	N/A	EI-701-G2	1'	40 72 00	NEW	CONTRACTOR	CONTRACTOR	
DECANT LIFT STATION	LT-7007	DECANT LIFT STATION WET WELL LEVEL	LOOP	EI-701-G2	1-4'	40 72 00	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	FSL-8028	LOW POLYMER FEED SWITCH	N/A	EI-701-E	BY VENDOR	40 70 13	NEW	VENDOR	VENDOR	REFER TO VELODYNE
DEWATERING BUILDING	SV-8023	SOLENOID VALVE FROM AIR GAP PUMPS	120V	EI-701-E	NC	40 05 82	NEW	VENDOR	VENDOR	REFER TO VELODYNE
DEWATERING BUILDING	PI-8025	WATER TO POLYMER MIXER PRESSURE	N/A	EI-701-E	BY VENDOR	40 73 00	NEW	VENDOR	VENDOR	REFER TO VELODYNE
DEWATERING BUILDING	FI-8024	WATER TO POLYMER MIXER ROTAMETER	N/A	EI-701-E	BY VENDOR	40 70 13	NEW	VENDOR	VENDOR	REFER TO VELODYNE
DEWATERING BUILDING	TE-8001	P-8001 DRY RUN PROTECTION	N/A	EI-701-E	BY VENDOR	40 74 00	NEW	VENDOR	VENDOR	REFER TO VELODYNE
DEWATERING BUILDING	TS-8001	P-8001 DRY RUN SWITCH	120V	EI-701-E	BY VENDOR	40 74 00	NEW	VENDOR	VENDOR	REFER TO VELODYNE
DEWATERING BUILDING	PDSL-8026	LOW POLYMER PRESSURE DIFFERENTIAL SWITCH	N/A	EI-701-E	BY VENDOR	40 73 00	NEW	VENDOR	VENDOR	REFER TO VELODYNE
DEWATERING BUILDING	PI-8027	POLYMER DIFFERENTIAL PRESSURE GAUGE	N/A	EI-701-E	BY VENDOR	40 73 00	NEW	VENDOR	VENDOR	REFER TO VELODYNE
DEWATERING BUILDING	TE-8002	P-8002 DRY RUN PROTECTION	N/A	EI-701-E	BY VENDOR	40 74 00	NEW	VENDOR	VENDOR	REFER TO VELODYNE
DEWATERING BUILDING	TS-8002	P-8002 DRY RUN SWITCH	120V	EI-701-E	BY VENDOR	40 74 00	NEW	VENDOR	VENDOR	REFER TO VELODYNE
DEWATERING BUILDING	PI-8003	INLET SLUDGE FEED PRESSURE GAUGE WITH ANNULAR SEAL	N/A	EI-701-E	-7-6PSI	40 73 00	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	PI-8004	SLUDGE FEED DISCHARGE PRESSURE GAUGE WITH ANNULAR SEAL	N/A	EI-701-E	0-70PSI	40 73 00	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	PSH-8004	HIGH SLUDGE FEED DISCHARGE PRESSURE SWITCH WITH ANNULAR SEAL	N/A	EI-701-E	70 PSI	40 73 00	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	FE-8005	MAGNETIC FLOW METER	N/A	EI-701-E	0-15GPM	40 70 13	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	FIT-8005	FLOW FROM DIGESTERS	120V	EI-701-E	0-15GPM	40 70 13	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	TSH-SCP-1A	SCREW PRESS MOTOR HIGH TEMPERATURE SWITCH	N/A	EI-701-E	BY VENDOR	40 74 00	NEW	VENDOR	VENDOR	
DEWATERING BUILDING	TSH-SCP-1B	SCREW PRESS SPRAY MOTOR HIGH TEMPERATURE SWITCH	N/A	EI-701-E	BY VENDOR	40 74 00	NEW	VENDOR	VENDOR	
DEWATERING BUILDING	PT-8006	SCREW PRESS PRESSURE	LOOP	EI-701-E	VENDOR SPECIFIED	40 73 00	NEW	VENDOR	VENDOR	REFER TO HUBER SCREW PRESS
DEWATERING BUILDING	ZS-8007	SPRAY ARM HOME	N/A	EI-701-E	NO	40 70 00	NEW	VENDOR	VENDOR	REFER TO HUBER SCREW PRESS
DEWATERING BUILDING	ZS-8008	SPRAY ARM AWAY	N/A	EI-701-E	NO	40 70 00	NEW	VENDOR	VENDOR	REFER TO HUBER SCREW PRESS
DEWATERING BUILDING	SV-8009	SCREW PRESS SPRAY SOLENOID - PNEUMATIC CONE	120V	EI-701-E	NC	40 05 82	NEW	VENDOR	VENDOR	REFER TO HUBER SCREW PRESS
DEWATERING BUILDING	SV-8010	SCREW PRESS SPRAY SOLENOID - LOWER WASH #1	120V	EI-701-E	NC	40 05 82	NEW	VENDOR	VENDOR	REFER TO HUBER SCREW PRESS
DEWATERING BUILDING	SV-8011	SCREW PRESS SPRAY SOLENOID - LOWER WASH #2	120V	EI-701-E	NC	40 05 82	NEW	VENDOR	VENDOR	REFER TO HUBER SCREW PRESS
DEWATERING BUILDING	SV-8012	SCREW PRESS SPRAY SOLENOID - UPPER WASH #1	120V	EI-701-E	NC	40 05 82	NEW	VENDOR	VENDOR	REFER TO HUBER SCREW PRESS
DEWATERING BUILDING	SV-8014	SCREW PRESS AIR SOLENOID VALVE	120V	EI-701-E	NC	40 05 82	NEW	VENDOR	VENDOR	REFER TO HUBER SCREW PRESS
DEWATERING BUILDING	PSL-8015	SCREW PRESS AIR LOW PRESSURE SWITCH	N/A	EI-701-E	NO	40 73 00	NEW	VENDOR	VENDOR	REFER TO HUBER SCREW PRESS
DEWATERING BUILDING	PSL-8023	SCREW PRESS WATER SOLENOID VALVE	120V	EI-701-E	NC	40 05 82	NEW	VENDOR	CONTRACTOR	REFER TO HUBER SCREW PRESS
DEWATERING BUILDING	SSL-8014	CONVEYOR #1 LOW SPEED SWITCH	N/A	EI-701-E	0RPM	40 05 93	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	HS-8016	CONVEYOR #1 E-STOP PULL CORD	N/A	EI-701-E	NC	40 05 93	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	ISH-8015	CONVEYOR #1 LOCKED ALARM	120V	EI-701-E	NC	40 05 93	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	SSL-8020	CONVEYOR #2 LOW SPEED SWITCH	N/A	EI-701-E	NC	40 05 93	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	HS-8017	CONVEYOR #2 E-STOP PULL CORD	N/A	EI-701-E	NC	40 05 93	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	ISH-8019	CONVEYOR #2 LOCKED ALARM	120V	EI-701-E	NC	40 05 93	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	SSL-8022	CONVEYOR #3 LOW SPEED SWITCH	N/A	EI-701-E	NC	40 05 93	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	HS-8018	CONVEYOR #3 E-STOP PULL CORD	N/A	EI-701-E	NC	40 05 93	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	ISH-8021	CONVEYOR #3 LOCKED ALARM	120V	EI-701-E	NC	40 05 93	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	PI-8017	INLET SLUDGE FEED PRESSURE GAUGE WITH ANNULAR SEAL	N/A	EI-701-E	-7-6PSI	40 73 00	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	PSH-8018	HIGH SLUDGE FEED DISCHARGE PRESSURE SWITCH WITH ANNULAR SEAL	N/A	EI-701-E	70PSI	40 73 00	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	PI-8018	SLUDGE FEED DISCHARGE PRESSURE GAUGE WITH ANNULAR SEAL	N/A	EI-701-E	0-70 PSI	40 73 00	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	FSL-8102	LOW SUPPLY AIRFLOW SWITCH	N/A	EI-702-E	NO	23 09 23 14	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	FSL-8103	LOW EXHAUST AIRFLOW SWITCH	N/A	EI-702-E	NO	23 09 23 14	NEW	CONTRACTOR	CONTRACTOR	
DEWATERING BUILDING	PI-9001	PRESSURE GAUGE	N/A	EI-702-E	0-100PSI	40 73 00	NEW	VENDOR	VENDOR	REFER TO GRUNDFOS
DEWATERING BUILDING	LSL-9002	LOW TANK LEVEL SWITCH	N/A	EI-702-E	NC	40 72 00	NEW	VENDOR	VENDOR	REFER TO GRUNDFOS
DEWATERING BUILDING	PI-9003	PRESSURE GAUGE	N/A	EI-702-E	0-100PSI	40 73 00	NEW	VENDOR	VENDOR	REFER TO GRUNDFOS
DEWATERING BUILDING	PIT-9004	AIR GAP DISCHARGE PRESSURE	LOOP	EI-702-E	0-100PSI	40 73 00	NEW	VENDOR	VENDOR	REFER TO GRUNDFOS
DEWATERING BUILDING	FE-9005	MAGNETIC FLOW METER	N/A	EI-702-E	0-180GPM	40 70 13	NEW	VENDOR	VENDOR	REFER TO GRUNDFOS
DEWATERING BUILDING	FIT-9005	AIRGAP DISCHARGE FLOW	120V	EI-702-E	0-180GPM	40 70 13	NEW	VENDOR	CONTRACTOR	REFER TO GRUNDFOS
UV BUILDING	AE-301		---	EI-701-K	---	---	EXISTING	---	---	
UV BUILDING	AIT-301		---	EI-701-K	---	---	EXISTING	---	---	
UV BUILDING	AE-302		---	EI-701-K	---	---	EXISTING	---	---	
UV BUILDING	AIT-302		---	EI-701-K	---	---	EXISTING	---	---	
UV BUILDING	AE-305		---	EI-701-K	---	---	EXISTING	---	---	

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LOCATION	INSTRUMENT TAG NO.	SERVICE DESCRIPTION	POWER	P&ID	SETPOINT/RANGE	SPECIFICATION	SCOPE	FURNISHED BY	INSTALLED BY	NOTES
UV BUILDING	AIT-305		---	EI-701-K	---	---	EXISTING	---	---	
UV BUILDING	AE-306		---	EI-701-K	---	---	EXISTING	---	---	
UV BUILDING	AIT-306		---	EI-701-K	---	---	EXISTING	---	---	

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SECTION 40 70 00.1 – INSTRUMENTATION AND CONTROL, REFERENCES AND DEFINITIONS

1.1 REFERENCES

A. Code compliance:

1. As specified in Section 01 42 19 – Reference Standards.

a. The publications are referred to in the text by basic designation only. The latest edition accepted by the Authority Having Jurisdiction of referenced publications in effect at the time of Bid governs.

2. The following codes and standards are hereby incorporated into this Section:

a. American National Standards Institute (ANSI).

b. International Organization for Standardization (ISO):

1) 9001 – Quality Management Systems – Requirements.

c. International Society of Automation (ISA):

1) 5.1 – Instrumentation Symbols and Identification.

2) 5.4 – Instrument Loop Diagrams.

3) 20 – Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.

d. National Electrical Manufacturers Association (NEMA):

1) 250 – Enclosures for Electrical Equipment (1000 V Maximum).

e. National Fire Protection Association (NFPA).

f. National Institute of Standards and Technology (NIST).

g. Underwriters Laboratories, Inc. (UL):

1) 508 – Standard of Safety for Industrial Control Equipment.

2) 508A – Standard of Safety for Industrial Control Panels.

B. Compliance with Laws and Regulations:

1. As specified in Section C-700 – General Conditions.

1.2 DEFINITIONS

A. Definitions of terms and other electrical and instrumentation considerations in accordance with:

1. Factory Mutual (FM).

2. International Electrotechnical Commission (IEC).

3. Institute of Electrical and Electronics Engineers (IEEE).

4. International Society of Automation (ISA).

5. International Organization for Standardization (ISO).

6. National Electrical Code (NEC).

7. National Electrical Manufacturers Association (NEMA).

8. InterNational Electrical Testing Association (NETA).

9. National Fire Protection Association (NFPA).

10. National Institute of Standards and Technology (NIST).

11. Underwriters Laboratories (UL).

B. Specific definitions:

1. Control circuit: Any circuit operating at 120 volts alternating current (VAC) or direct current (VDC) or less, whose principal purpose is the conveyance of information (including performing logic) and not the conveyance of energy for the operation of an electrically powered device.

2. Panel: An instrument support system that may be a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems. Unless otherwise specified or clearly indicated by the context, the term “panel” in these Contract Documents is interpreted as a general term, which includes flat surfaces, enclosures, cabinets and consoles.

3. Power circuit: Any circuit operating at 90 volts (AC or DC) or more, whose principal purpose is the conveyance of energy for the operation of an electrically powered device.

4. Signal circuit: Any circuit operating at less than 50 VAC or VDC, which conveys analog information or digital communications information.

5. Digital bus: A communication network, such as PROFIBUS, Foundation Fieldbus, or DeviceNet, allowing instruments and devices to transmit data, control functions and diagnostic information.

6. 2-Wire transmitter (loop powered): A transmitter that derives its operating power supply from the signal transmission circuit and requires no separate power supply connections. As used in this Section, two-wire transmitter refers to a transmitter that provides 4 to 20 milliamperes current regulation of a signal in a series circuit with an external 24 VDC driving potential.

7. Powered transmitters: A transmitter that requires a separate power source (120 VAC, 240 VAC, etc.) in order for the transmitter to develop its signal. As used in this Section, the produced signal may be a 4 to 20 milliampere current signal, a digital bus communications signal or both.

8. System supplier - As specified in SI Qualifications in the Quality Assurance article of this Section.

9. Modifications: Changing, extending, interfacing to, removing or altering an existing circuit.

C. NEMA:

1. Type 1 enclosure in accordance with NEMA 250.

2. Type 2 enclosure in accordance with NEMA 250.

3. Type 3 enclosure in accordance with NEMA 250.

4. Type 3R enclosure in accordance with NEMA 250.

5. Type 3S enclosure in accordance with NEMA 250.

6. Type 3X enclosure in accordance with NEMA 250.

7. Type 3RX enclosure in accordance with NEMA 250.

8. Type 3SX enclosure in accordance with NEMA 250.

9. Type 4 enclosure in accordance with NEMA 250.

10. Type 4X enclosure in accordance with NEMA 250.

11. Type 5 enclosure in accordance with NEMA 250.

12. Type 6 enclosure in accordance with NEMA 250.

13. Type 6P enclosure in accordance with NEMA 250.

14. Type 12 enclosure in accordance with NEMA 250.

15. Type 12K enclosure in accordance with NEMA 250.

16. Type 13 enclosure in accordance with NEMA 250.

D. Acronym definitions:

1. CCS: The SCADA central computer system (CCS) consisting of personal computers and software. The personal computer-based hardware and software system that includes the operator interface, data storage, data retrieval, archiving, alarming, historian, reports, trending, and other higher level control system software and functions.

2. DPDT: Double-pole, double-throw.

3. ES: Enterprise system: Computer based communications or data sharing system utilized for non-process control functions such as E-mail, sharing files, creating documents, etc.

4. FAT: Factory acceptance test.

5. HART: Highway addressable remote transducer.

6. HOA: Hand-Off-Auto control function that is totally PLC based. In the Hand mode, equipment is started or stopped, valves are opened or closed through operator direction under the control of the PLC software. In the Auto mode, equipment is started or stopped and valves are opened or closed through a control algorithm within the PLC software. In the Off mode, the equipment is prohibited from responding from the PLC control.

7. HMI: Human machine interface: PLC based operator interface device consisting of an alphanumeric or graphic display with operator input functionality. The HMI is typically a flat panel type of display mounted on the front of a PLC enclosure with either a touch screen or tactile button interface.

8. IJB: Instrument junction boxes: A panel designed with cord sets to easily remove, replace or relocate instrument signals.

9. I/O: Input/Output.

10. IP: Internet protocol or ingress protection.

11. LCP: Local control panel: Operator interface panel that may contain an HMI, pilot type control devices, operator interface devices, control relays, etc. and does not contain a PLC or RIO.

12. LAN: Local area network: A control or communications network that is limited to the physical boundaries of the facility.

13. LOR: Local-Off-Remote control function. In the Remote mode, equipment is started or stopped, and valves are opened or closed through the PLC based upon the selection of the HOA. In the Local mode, equipment is started or stopped, valves are opened or closed based upon hardwired control circuits completely independent of the PLC with minimum interlocks and permissive conditions. In the Off mode, the equipment is prohibited from responding to any control commands.

14. NJB: Network junction box. An enclosure that contains multiple access points to various networks within the facility. Networks could be Ethernet, Ethernet/IP, Fieldbus, RIO etc.

15. OIT: Operator interface terminal: PC-based interface device used for operator interface with the SCADA system.

16. P&ID: Process and instrumentation diagram.

17. PC: Personal computer.

18. PCIS: Process control and instrumentation system: Includes the entire instrumentation system, the entire control system, and all of the Work specified in the Instrumentation and Control Specifications and depicted on the Instrumentation Drawings.

19. PCM: Process control module: An enclosure containing any of the following devices: PLC, RTU, or RIO.

20. PJB: Power junction box: An enclosure with terminal blocks that distribute power to multiple instruments.

21. PLC: Programmable logic controller.

22. RIO: Remote I/O device for the PLC consisting of remote I/O racks, or remote I/O blocks.

23. RTU: Remote telemetry unit: A controller typically consisting of a PLC, and a means for remote communications. The remote communications devices typically are radios, modems, etc.

24. SCADA: Supervisory control and data acquisition system: A general name for the computerized system that gathers and processes data from sensors and applies operational controls to the process equipment. It includes the PLCs and/or RTUs, HMI PLC-based operator interface units, related interconnecting communications systems, and the CCS operator interface and data management system.

25. SI: System Integrator: Subcontractor who specializes in the design, construction, fabrication, software development, installation, testing, and commissioning of industrial instrumentation and control systems.

26. SPDT: Single-pole, double-throw.

27. SPST: Single-pole, single-throw.

28. UPS: Uninterruptible power supply.

29. VCP: Vendor control panel: Control panels that are furnished with particular equipment by a vendor other than the SI. These panels may contain PLCs, RIO, OIT, HMI, etc.

30. WAN: Wide area network: A control or communications network that extends beyond the physical boundaries of the facility.

END OF SECTION 40 70 00.1

SECTION 40 70 00.2 – INSTRUMENTATION AND CONTROL, SYSTEM DESCRIPTION

1.1 SYSTEM DESCRIPTION

A. Prequalified System Integrator (SI) include the following:

a. Keller Associates, Meridian, ID

B. Scope of work.

1. SCADA Hardware/Software Upgrades. Provide primary SCADA server and new thin clients.

a. Existing System.

1) Proficy iFIX workspace. This system serves the existing plant PLCs.

b. Upgrades.

1) Provide new SCADA server with new Ignition program.

2) Configure up to 8 existing City staff computers for Remote Desktop sessions to SCADA server for HMI client access.

3) Configure all existing SCADA functions including but not limited to graphics, trending, alarming, reporting, and PLC communications.

4) Add new SCADA functions as defined in these drawings and specifications.

5) It is the responsibility of the Contractor to verify existing SCADA software and licensing. Contractor may utilize credit for existing licenses as allowed by Manufacturer.

2. PCIS Network Upgrades.

a. Existing PCIS Network.

1) The current Ethernet switch based PCIS network originates from building H (electrical building) and extends out in a star configuration to existing PLCs at the UV building, clarifiers, and blower buildings. A fiber optic cable and patch panel connects the network to the headworks building.

2) Each existing location has existing unmanaged ethernet switches.

3) SCADA center is currently located in building F. This shall be moved to building E.

b. PCIS Network Upgrades. – To be Provided by the Contractor

1) Provide and install new single mode fiber where specified.

2) Provide and install new industrial Ethernet switches for new PLC locations and remote IO panels.

3) Refer to EI-700 for network configuration.

3. PCIS PLCs – To be Provided by the Contractor.

a. PLC-100-E

4. Package System Interfaces. Provide SCADA interface to the following vendor supplied package systems. Where vendor systems do not include PLCs, interface shall be via hard wired I/O as described in these specifications. Where vendor system includes a PLC, interface shall be in the form of message commands or produced/consumed tags between SCADA PLCs and vendor PLCs or via direct communications between vendor PLCs and SCADA software. Package system providers will be required to supply a list of data addresses for SCADA interface requirements. Package systems include:

a. Fine screen. SCR-1

b. Fine screen. SCR-2

c. Headworks lift station. LCP-HWLS

d. IFAS. PLC-100-B2

e. LCP-RAS-1

f. LCP-RAS-2

g. Tertiary filter air control panel. VCP-4000

h. Alum chemical dosing pump skids (x2)

i. Caustic soda chemical dosing pump skid.

j. Dewatering screw press (SCP-1)

k. Polymer feed skid (VCP-LPF-1)

l. Dewatering conveyors

m. Air Gap skid

5. Instrumentation. Contractor to provide and install control system instrumentation as described in the drawings and specifications. Refer to 40 70 00 A – Device List for complete list of instrumentation

6. Control Panels. Contractor to provide control panels as described in the drawings and specifications. Refer to 40 67 00 – Control Panels

7. Contractor to provide conduit and cable for associated instrumentation and control as described in the drawings and specifications. Refer to cable schedules in drawings

8. Programming/Startup/Commissioning/Training. Provide complete system installation, programming, commissioning, and training as described in these drawings and specifications and as necessary to provide a complete and functional instrumentation and control system.

C. Control system installation and startup constraints:

1. Every effort shall be made to minimize downtime and maintain SCADA access to existing PLC hardware during construction and startup.

2. All PCIS and network outages shall be scheduled and pre-approved by the Engineer. The Contractor shall submit a PCIS and network cutover plan to the Engineer for approval.

3. The new SCADA server shall be fully and completely tested as specified prior to installation, cut-over, and commissioning. The existing SCADA server shall remain in service through the duration of construction until the new SCADA server is prepared and ready to be put online.

4. The new network shall be fully installed, terminated, tested per specifications, and approved by the Engineer prior to cut-over from the existing network. This includes all patch panels, network switches, cables, fiber jumpers, and patch cords.

D. General requirements:

1. The Work includes everything necessary for and incidental to executing and completing the Instrumentation and Control System Work indicated on the Drawings and specified in the Specifications and reasonably inferable there from including but not limited to:

a. Preparing hardware submittals for field instrumentation.

b. Design, develop, and draft control panel designs and all other drawing submittals specified in the Instrumentation and Control Specifications.

c. Prepare the test plan, the training plan, and the spare parts submittals.

d. Provide all SCADA system hardware and software as indicated in documentation.

e. Fabricate panels.

f. Perform factory tests on panels.

g. Perform bench calibration and verify calibration after installation.

h. Oversee and certify installation of the PCIS.

i. Oversee, document, and certify loop testing.

j. Oversee, document, and certify system pre-commissioning.

k. Conduct the performance tests.

l. Prepare operation and maintenance manuals.

m. Conduct training classes.

n. Integrate the PCIS with instrumentation and control devices provided under other sections.

o. Prepare Record Drawings.

1) Develop all Record Drawings associated with instruments and equipment provided under the scope of this contract.

2) Contract Documents and all Owner furnished and any existing equipment the system is interfacing.

p. Resolve signal, power, or functional incompatibilities between the PCIS and interfacing devices.

q. Perform all required corrective and preventative maintenance.

2. Coordinate all aspects of the Work between Contractor and all subcontractors before bidding to ensure that all costs associated with a complete installation are included. The Owner is not responsible for any change orders due to lack of coordination of the Work between the Contractor, the SI, the other subcontractors or suppliers.

3. Furnish detailed, complete, and thorough operations and maintenance documentation, including but not limited to operations manuals, maintenance manuals, as-built wiring drawings, training manuals, as-built software documentation, and all other documentation required to operate, modify, and maintain all parts of the PCIS.

4. Portions of this Project involve installation in existing facilities and interfaces to existing circuits, power systems, controls, and equipment. Perform and document detailed field investigations of existing conditions (circuits, power systems, controls, equipment, etc.) before performing any Work.

5. Defective Work:

a. As specified in Section C-700 – General Conditions.

E. Operating facility:

1. Portions of this existing facility must remain fully functional throughout the entire construction period. In consideration of this requirement, comply with the following guidelines:

    a. All outages must be of minimal duration and fully coordinated and agreed to by the Owner. Adjust the construction to meet the requirements of the Owner.

    b. As weather and facility demand conditions dictate, re-adjust the construction schedule to meet the demands placed upon Owner by its users.

2. The Contractor is responsible for the integrity and measurement accuracy of all loops. However, any defect found in existing equipment is the responsibility of the Owner.

3. The standards of documentation, instrument tagging, cable and conductor termination, terminal identification and labeling that apply to the new installation apply equally to the existing installation effected by this work.

END OF SECTION 40 70 00.2

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SECTION 40 70 13 – IN-LINE LIQUID FLOW MEASURING SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide in-line liquid flow measuring systems, complete and operable, in accordance with the Contract Documents. The transmitter portion of the system shall be remotely mounted as shown in the Contract Drawings.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

1.	ISA – S 5.1	Instrumentation Symbols and Identification
2.	ANSI – B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
3.	ANSI/AWWA C207	Steel Pipe Flanges for Waterworks Service – Sized 4-inch through 144-inch
4.	ANSI/AWWA C700	Cold Water Meters
5.	ASME Report	Fluid Meters, Sixth Edition, 1971

1.3 SUBMITTALS

A. Shop Drawings: At a minimum, the following information shall be submitted with each meter supplied:

1. Data sheets and catalog literature for the flow meter and the microprocessor-based signal converter.
2. Connection diagrams for equipment wiring.
3. Materials of construction and connection fittings.
4. Recommended spare parts list.

B. Test Data: Signed, dated, and certified calibration data for each flow metering system which requires factory testing, submitted before shipment of equipment.

C. Certifications: The Contractor shall provide Manufacturer's certification of proper installation and certification of satisfactory field testing.

D. Owner’s Manual: Submit Owner’s manual as specified in Special Provisions, to include operation and maintenance data and other information for the equipment.

1.4 QUALITY ASSURANCE

A. Each flow metering system shall be hydraulically calibrated at a facility which is traceable to the National Institute of Standards and Technologies. The calibration procedure shall conform to the requirements of ANSI/NCSL Z 540-1 Calibration. A real-time computer-generated printout of the actual calibration data shall be submitted to the Engineer at least 30 days prior to shipment to the site.

B. Accuracy Requirements: Unless otherwise indicated, flow meters shall be guaranteed to register flow to an accuracy of plus and minus 0.3% of actual flow throughout the range indicated.

C. Guarantees, Warranties: After completion the Contractor shall furnish to the Owner the manufacturer’s written guarantee that the metering systems will operate within the published accuracies and flow ranges and meet these specifications. The Contractor shall also furnish the manufacturer’s warranties as published in its literature.

PART 2 - PRODUCTS

2.1 GENERAL

A. All meters shall be capable of operating at a minimum ambient temperature ranging from -4 to 140 degrees F.

B. All meters shall be rated for NFPA hazardous areas, see Drawings for further information.

C. The Contractor shall be responsible for confirming necessary cable length with the meter manufacturer prior to ordering any meter equipment.

2.2 ELECTROMAGNETIC (MAG) FLOW METERS

A. The electromagnetic flowmeter shall consist of a flow sensor based on Faraday’s Law of Electromagnetic Induction, the flow of liquid through the sensor induces an electrical voltage that is proportional to the velocity of the flow.

B. Electromagnetic flowmeter systems shall be the low frequency electromagnetic induction type which produces a DC pulse signal directly proportional to and linear with the liquid flow rate. Complete zero stability shall be an inherent characteristic of the flowmeter system. Each magnetic flow metering system shall include a metering tube, signal cable, transmitter, and flowmeter grounding rings.

C. Meter Tube: The tube shall be constructed of 304 or 316 stainless steel tubes with ductile iron flanged or Carbon Steel connections and include a minimum of two (2) self-cleaning electrodes. The electrodes shall be constructed of materials conforming to the manufacturer's recommendation for the intended service. The meter housing shall be IP67 or IP68, rated for a submergence depth of 3 meters for a duration of 48 hours. Grounding rings shall conform to the manufacturer's bore and material recommendation for the intended service. Grounding rings shall be designed to protect and shield the liner's edge interface from abrasion at the meter end.

D. Magnetic flow meters shall require a maximum of 1 pipe diameter upstream and 0 pipe diameters downstream from valves, bends and fittings to maintain specified accuracy while in operation.

E. Performance Requirements: The flow metering system shall conform to the following:

No.	Item	Units	Value
1	Time Constant	Secs	0.5 – 1,000
2	Accuracy	%	0.5 of Full Flow
3	Repeatability	%	0.25 full scale
4	Power Consumption	watts	50 or less
5	Power Requirements	VAC	120

F. Transmitter: The microprocessor-based signal converter/transmitter shall be remote mounted outdoors on disconnect support structure and shall have the following:

1. Transmitter shall be suitable for installation outdoors, subject to direct sunlight and full temperature range at installed location. Transmitter housing to be NEMA 4X, with min. IP65 ingress protection. Provide sun shield and/or other accessories as recommended by manufacturer.

2. DC pulse technique to drive flux-producing coils and capability to convert DC pulse signal from the tube to a standardized flow VDC pulse contact and a 4-20 mA DC signal into a minimum of 700 ohms.

3. Six-digit LCD displays flow rate, percent of span, and totalization. An operator interface with keypad which responds to English text entry.

4. Integral low flow cutoff and zero return to produce a consistent zero output signal in response to an external dry contact closure.

5. Automatic range change and capability to measure flow in both directions.

6. Programmable parameters include meter size, full scale Q, magnetic field frequency, primary constant, time constant.

7. Data retention for minimum of five (5) years without auxiliary power (main or battery).

8. Self-diagnostics and automatic data checking.

9. Protected terminals and fuses in a separate compartment which isolates field connection from electronics.

G. Schedule: Provide the magnetic meters listed in the following table.

ID	Size (in)	Velocity Range (fps)	Pipe Type	P&ID	Service
FE-4001	8	0-10	DI, flanged	EI-701-D	Tertiary Filters
FE-4002	12	0-10	DI, flanged	EI-701-D	Tertiary Filters

H. Manufacturers, or equal

1. Krohne

2. Siemens

3. Endress+Hauser

2.3 ROTAMETERS

A. The meters shall be suitable for the service and chemicals conveyed at process temperatures.

B. Basic Design: Unless otherwise indicated, all rotameters in chemical solution lines and where shown shall have vertical bottom inlets and top outlets with ANSI 150-lb flanged ends, for vertical mounting. Meters in gas, air, and pump seal flushing lines shall be of the modified rotameter design with screwed ends, spring-loaded pistons, and union bodies for mounting in any position. All meters shall be rated for a minimum working pressure of 150 psi.

C. Flanged Meters for Chemical Solutions: Flanged rotameters for chemical solutions and other service, where indicated, shall be calibrated in gallons per minute, pounds per 24 hours (for chlorine gas), or cubic feet per minute for other gases and air. The meters shall have Hastelloy C floats, 10-inch long scales, and a range of 10:1 with an accuracy of plus and minus 2 percent. The scales shall be suitable for the capacity ranges shown in the schedule above. The following body materials shal1 be used for the rotameters:

1. Chlorine Service - cast iron ends, Teflon-lined, or PVC ends, with heavy borosilicate glass tubes and packing glands.

D. Screwed Meters for Water, Air, and Fuel Gas: Rotameters with NPT screwed ends for water, air, and fuel gas service shall be calibrated in gallons per minute or cubic feet per minute. The bodies shall have union ends for ease of maintenance, polysulfone tubes, aluminum or brass end fittings, Type 316 stainless steel internal parts and scales suitable for the capacity range shown in the schedule above. The meters shall have an accuracy of not less than plus and minus 5 percent over the capacity range.

E. Schedule: Refer to Device Schedule 43 70 00A.

F. Manufacturers, or Equal

1. Chlorine Service - Brooks No. 1180, or Pennwalt "Varea-Meter”

2. Water, Air and Gas Meters - Headland "In-Line Meters", or Universal Flow Monitors, Inc. "INSITE" meters.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall assemble and install all equipment specified herein, in strict accordance with the manufacturer's published instructions, under the supervision of the manufacturer's representative, under the general review of the Engineer. All installations shall be accomplished by competent craftsmen in a workmanlike manner.

B. Final acceptance of the equipment is contingent on satisfactory operation after installation.

3.2 INSTALLATION

A. The meters shall be installed in easily accessible locations for ease of reading and maintenance, and where shown, for balancing of flow in several lines, in conjunction with throttling and shut-off valves. Where possible, all meters shall be installed in such a way to provide the manufacturer's recommended straight approach and straight piping downstream. All meters, shut-off and balancing valves shall be firmly supported from the structure or from the floor with approved supports. In-line meters shall be installed to provide full-line flow and not less than the manufacturer's recommended head at all items.

B. Wiring between flow sensors and remote mounted signal converters shall use cable type and procedures as per the manufacturer's recommendations. Provide sufficient cable from meter vault to location where local display will be located. Confirm cable lengths prior to submitting shop drawings.

3.3 TESTING

A. Equipment shall be prepared for operational use in accordance with manufacturer's instructions, including bench test and calibration, where required.

B. Each item shall be subjected to an operating test over the total range of capability of the equipment. Where applicable, tests shall be conducted in accordance with the Test Code of the Standards of the Hydraulic Institute. The Contractor shall notify the Engineer one week in advance of all tests to be conducted on site.

3.4 CLEANUP

A. After completion and testing of its work, the Contractor shall remove all debris from the site, clean all meters, controls, cabinets, and other metering appurtenances, to hand over each system in perfect operating condition.

3.5 MANUFACTURERS SERVICE REPRESENTATIVE

A. Erection and Startup Assistance: During erection and startup of the magnetic flow meters, the Contractor shall obtain all necessary assistance from an experienced factory service representative to ensure a correct and first-class installation, in accordance with the manufacturer's instructions.

B. Instruction of Owner's Personnel: After completion of the installation and during startup of the plant, the Contractor shall instruct the Owner's personnel in the proper operation, maintenance and repair of all metering equipment. For this purpose, the Contractor shall obtain the services of an experienced factory service representative, who shall half a day on the site to fully instruct the Owner's operating personnel on all phases of its equipment. The Contractor shall video tape the training session and provide a DVD of the training to the Owner.

END OF SECTION 40 70 13

SECTION 40 72 00 – LEVEL MEASURING SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide level sensing equipment, complete and operable, in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 40 70 00 – Instrumentation and Control, General.

1.3 QUALITY ASSURANCE

A. Calibration: All level sensing equipment shall be shipped to the project site factory calibrated and accompanied with certificate of such.

B. Warranty: All sensors shall be provided with manufacturer's standard one-year product warranty.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE PRESSURE SENSOR

A. Submersible pressure sensors shall consist of a transducer, transmitter/receiver, and control relays. The pressure sensing unit shall consist of a top half of a 316 stainless steel seal with a welded 316 stainless steel diaphragm. The liquid level shall be obtained by converting pressure sensed across a diaphragm-protected transducer element. A microprocessor shall amplify and convert the signal into a digital representation from pressure to a liquid level surface reading. An output is produced when manually determined trip values are exceeded. The microprocessor-based electronics shall enable user selection of range, span, setpoints, time delay, units of distance, and selectable failsafe mode. Relay setpoints shall be adjustable over the entire span without the use of reference targets. Automatic temperature compensation circuitry shall be incorporated.

1. Diaphragm: The diaphragm shall be glycerin-filled and be welded 316 stainless steel with a 0.13 cubic inch displacement.

2. Material: All wetted parts, including standoff ring, spacers, nuts and bolts shall be of 316 Stainless steel. The body shall be made of 300 stainless steel and shall be explosion-proof design. Cable shall be polyurethane-jacketed, and 40-ft shall be provided as standard.

3. Signal Output: A 4-20 MADC using 2-wire twisted pair grounded shield cable. FM and CSA explosion-proof and intrinsically safe with a response time less than 5 ms.

4. Accuracy: the pressure sensing transducer shall have a static accuracy of 0.25% FSO BFSL and a 1-year stability accuracy of 0.20% FSO.

5. Remote mounted units shall be provided with a connecting cable provided by the manufacturer of the switches. Input power shall be 120 VAC.

6. Switches shall be SPBT with a minimum rating of 10 Amps at 120 V AC.

7. Repeatability shall be 0.1-inch or less with a response time of less than one second and an accuracy of plus or minus 0.25 percent of full scale.

B. Manufacturers, or equal

1. Blue Ribbon, Model BC001Birdcage TM

2. WIKA, LS-10 LevelGuard

3. Equal must be approved during the bidding process.

2.2 NON-INTRUSIVE ULTRASONIC LEVEL SENSORS

A. Non-intrusive ultrasonic level sensors shall consist of a transducer, transmitter/receiver, and control relays. The sonic level switch transmitter shall generate pulses that are directed to the liquid level. The returning echo/signal shall be detected by the receiver. A microprocessor shall amplify and convert the signal into a digital representation of the distance from the reflecting surface. An output is produced when manually determined trip values are exceeded. The microprocessor-based electronics shall enable user selection of range, span, setpoints, time delay, units of distance, and selectable failsafe mode. Relay setpoints shall be adjustable over the entire span without the use of reference targets. Automatic temperature compensation circuitry shall be incorporated.

1. The transducer housing shall be PVC with corrosion resistant sensor element.

2. Remote mounted units shall be provided with a connecting cable provided by the manufacturer of the switches. Input power shall be 120 V AC.

3. Switches shall be SPBT with a minimum rating of 10 Amps at 120 V AC.

4. Repeatability shall be 0.1-inch or less with a response time of less than one second and an accuracy of plus or minus 0.25 percent of full scale.

B. Manufacturer, or equal

1. SIEMENS HydroRanger 200

2. Equal must be approved during the bidding process.

2.3 FLOAT SWITCHES

A. The float switch shall be a non-floating (tilting switch action only) SPDT submersible switch. The switch shall be intrinsically safe with a Zener barrier between the switch contacts and the power source. The switch shall be sealed in a polypropylene housing with a submersible cable sealed in the float switch body. The switch shall be supplied with a cable with adequate length to reach the barrier location without splicing the cable.

PART 3 - EXECUTION

3.1 GENERAL

A. Level detection switches shall be executed according to Section 40 70 00 – Instrumentation and Control, General.

B. Mounting: All level sensing devices shall be mounted inside a PVC tube as shown on drawings with sufficient horizontal and/or vertical separation from other similar devices such that interference of signals is not possible. The Contractor shall verify installation requirements prior to mounting similar level sensing devices.

END OF SECTION 40 72 00

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SECTION 40 72 83 – LEAK DETECTION SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Contractor shall provide leak detection switches, complete and operable, in accordance with the Contract Documents. The leak detection shall be mounted as recommended by the manufacturer's installation instructions for optimum accuracy.

B. This Section describes the requirements for leak detection switches.

1.2 REFERENCE STANDARDS

A. Commercial Standards

1. ISA – S 5.1 Instrumentation Symbols and Identification

1.3 SHOP DRAWING SUBMITTALS

A. General: Follow the procedures specified in Section 01 33 00 – Submittal Procedures.

B. Each switch shall be identified with its equipment number as indicated. The following shall be included in the submittal for this Section:

1. Data Sheets and Catalog literature for the pressure transmitter.

2. Connection diagrams for equipment wiring.

3. Material of construction, cable lengths and dimensional data.

C. Technical Manual: Furnish 5 identical copies of complete operation and maintenance instruction of all the leak detection switches including instrumentation and controls.

D. Spare Parts List: The Contractor shall furnish a list of manufacturer's recommended spare parts.

1.4 SUBSTANTIAL COMPLETION

A. At Substantial Completion of Project, be ready to demonstrate that all leak switches are installed and operational.

1.5 QUALITY ASSURANCE

A. Accuracy Requirements: n/a

B. Warranties: After completion the Contractor shall furnish to the Owner the manufacturer's written guarantees, that the switch will operate within the published accuracies and ranges and meet these specifications. The Contractor shall also furnish the manufacturer's warranties as published in its literature.

PART 2 - PRODUCTS

2.1 SCHEDULE

A. The final mounting location shall be finalized by the Owner and Engineer prior to installation.

2.2 LIQUID LEAK DETECTOR

A. Leak detector shall detect the presence of liquid once it reaches a level that bridges two conductive strips on the bottom of the housing

B. Performance

1. Sensing Height: As low as 1/32" using an adjustable mounting bracket

2. Type: External powered models DPDT

3. Electrical Rating: 1A @ 24 VAC/DC

4. External Power: 11 to 27 VAC/DC

5. Audible Alarm: Not required

6. Visual Alarm: Red LED for water level; Green LED for power condition

7. Temperature Limits: 32 to 122 degrees F

8. Enclosure Material: ABS and polycarbonate with flammability classification UL 94 V-0.

9. Mounting Bracket: To be supplied with leak detector

C. The leak detector switch shall be as manufactured by Dwyer Instruments WD3-LP-D2 or approved equal.

2.3 CHEMICAL LEAK DETECTOR

A. Leak detector shall detect the presence of liquid using an electronic microprocessor based alarm panel that monitors the resistance of the probes.

1. External Power : 120VAC

2. Output relay for common leak detection.

3. Visual Alarm: Red LED

4. Audible Alarm: Horn

5. Temperature Limits : 32 to 120 degrees F

B. Leak detection panel shall be LiquidWatch Probe Leak Detection System or equivalent.

C. Leak detection probes shall be PermAlert AGT-Gold or equivalent.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall assemble and install all equipment specified herein, in strict accordance with the manufacturer's published instructions. All installations shall be accomplished by competent craftsman in a workmanlike manner.

3.2 INSTALLATION

A. The leak detector switch shall be mounted in such a way that it does not pose a tripping hazard or in a direct pathway.

B. Wiring between leak detection switch and SCADA RTU shall use cable type and procedures as per the manufacturer's recommendations.

C. Final acceptance of the equipment is contingent on satisfactory operation after installation.

END OF SECTION 40 72 83

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SECTION 40 73 00 – PRESSURE MEASURING AND DETECTION SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide pressure measuring systems, complete and operable, in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Shop Drawings and Technical Manual shall be submitted in conformance with the requirements of Section 01 33 00 – Submittal Procedures and Section 40 70 00 – Instrumentation and Control, General.

1.3 SUBMITTALS

A. Warranty: All pressure measuring, and detection systems shall be provided with manufacturer's standard one-year warranty.

PART 2 - PRODUCTS

2.1 GENERAL

A. Pressure gauges shall be provided on suction and discharge connections to pumps; discharge connections from blowers and compressors; each side of pressure reducing valves; and where shown on the Contract Drawings. Vacuum gauges shall be provided for vacuum pumps shown on the Contract Drawings. In all locations (such as certain pump suction connections) where pressures may vary below and above atmospheric head, compound gauges shall be installed.

B. Diaphragm Seals: Pressure sensing devices shall be equipped with diaphragm seals, or equal protective pressure or vacuum sensing devices as per standard details shown on the drawings. Diaphragm seals shall be provided for all gauges, pressure transmitters, or pressure switches where fluid has medium solids (i.e., nonpotable or plant effluent), contains chemicals, is of a corrosive nature, or high temperature which could affect the accuracy of the pressure sensing device. Diaphragm seals shall be provided, whether shown on the drawings or not, for these applications. Materials shall be suitable for the intended application.

C. Annular Seals: Gauges and pressure sensing devices shall be provided with a flanged annular seal for all high solids (raw sewage, scum, and sludge) applications, including clarifier scum and sludge, waste activated sludge, return activated sludge, thickener feed sludge, thickened sludge, and anaerobically digested sludge. Annular seals shall be provided, whether shown on the drawings or not, for these applications.

D. Liquid-filled gauges for potable water service shall be filled with an NSF 61-approved liquid.

2.2 PRESSURE AND VACUUM GAUGES

A. Gauges shall be industrial quality type with Type 304 or 316 stainless steel movement and stainless steel or alloy case. Unless otherwise shown or specified, gauges shall have a 4½-inch dial, ¼-inch threaded connection, a Type 304 or 316 stainless steel snubber adapter, and shut-off valve. Gauges shall be calibrated to read in applicable units, with an accuracy of ± 1 percent, to 150 percent of the working pressure or vacuum of the pipe or vessel to which they are connected. Gauges shall read in psi. All gauges shall be vibration and shock resistant.

B. Approved manufacturers, or equal, as approved by Engineer

1. Ashcroft
2. Foxboro
3. Rosemont

2.3 DIFFERENTIAL AND GAUGE PRESSURE TRANSMITTERS

A. Electronic differential transmitters shall consist of a capsule assembly, bottom works, vent plug, drain plug, cover flange, process connector and connection, amplifier unit, integral indicator, terminal box with cover, block and bleed valves, and conduit connections. Pressure applied to the unit shall be transmitted by a sealed fill fluid to both sides of a sensing diaphragm. The sensing diaphragm and the sensor body shall function as the moving and fixed electrodes, respectively, of a differential capacitor. As the applied pressure causes the diaphragm to move, the capacitance of the cell shall change.

B. Performance Requirements: The amplifier unit shall convert the change in capacitance to a 4 - 20 mA DC signal, 2 wire type, with an allowable loop load of no less than 600 ohms. Static pressure rating shall be a minimum of 500 psig. The maximum overrange pressure limit shall be a minimum of 150 percent of the range. Span shall be adjustable over a minimum of 5:1 range. External adjustments shall include zero and span. Output signal damping shall be provided as an internal adjustment.

1. Equipment shall be suitable for an ambient operating range of minus 40 degree F to plus 212 degrees F.
2. The integral indicator shall be calibrated in process units.
3. Power supply shall be 24 VDC.
4. Accuracy, including linearity and repeatability, shall be a plus or minus 0.2 percent of span.
5. Differential pressure transmitters used for flow service shall include square root extraction to produce an output signal linearly proportional to flow.

C. Wetted parts, including block and bleed valve parts, shall be constructed of Type 316 stainless steel.

D. Schedule: Refer to Device Schedule 40 70 00 A.

E. Approved manufacturers, or equal, as approved by Engineer

1. With local indicator and controller:

a. Foxboro

1) IGP10/IDP10

b. Rosemount

1) 3051

2) 2088

c. Yokogawa

1) YA43/44

2. Without local indicator and controller:

a. Noshok

1) 100 series

b. SICK,

1) Part number 6049897.

2.4 ADJUSTABLE PRESSURE SWITCH

A. Adjustable pressure switches shall be diaphragm-actuated, dual adjustment pressure switches with SPDT contacts rated for a minimum of 5 Amps at 120 V AC. The dead band shall be adjustable up to 60 percent of full scale. Set points shall fall between 20 and 80 percent of the adjustable range. The diaphragm shall be Buna-N, and the lower housing shall be brass with a 1/4-inch bottom sensing connection, unless otherwise indicated.

B. Approved manufacturers, or equal, as approved by Engineer

1. United Electric

a. Series 400

2. Ashcroft

a. Series B or L Series

2.5 DIAPHRAGM SEALS

A. Diaphragm seals shall consist of bottom housing, lower ring, diaphragm capsule, fill screw, flushing connection, and a top housing.

1. The diaphragm seal shall have a removable bottom housing to permit servicing.

2. The diaphragm seal shall be factory assembled to the corresponding pressure instrument and be factory-filled. The assembly shall be shipped with a tag reading "Do not disassemble for installation".

3. Exposed surfaces housings shall be constructed of Type 316 stainless steel for pressure service over 15 psi.

4. The diaphragm seal shall attach to the inlet connection of a pressure instrument to isolate its measuring element from the process fluid. The space between the diaphragm and the pressure element shall be completely filled with a suitable liquid. Displacement of the liquid fill in the pressure element through the movement of the diaphragm shall transmit process pressure changes directly to a gauge, transmitter, switch, or other pressure instrument.

B. Materials of Diaphragm: Seals shall be of Type 304 or 316 stainless steel with stainless steel diaphragm for pressure over 15 psi and elastomer diaphragm for pressure of 15 psi and less. Type 316 stainless steel nuts and bolts, fill connection and valved flush port size ¼-inch NPT capable of disassembly without loss of filler fluid.

C. Approved manufacturers, or equal, as approved by Engineer

1. Ashcroft Model 101

2. U.S. Gauge (Ametek) SG

3. Marshalltown Series 225-01

4. Snubber Manufacturers, or equal

a. Cajon Company

b. Weksler Instruments, Corp.

2.6 ANNULAR SEALS FOR PRESSURE MEASURING SYSTEMS

A. Annular seals shall consist of a bolt-through Isolator Ring and Type 304 or 316 stainless steel calibration/evacuation accessory. Any required instrument manifolds shall be Type 316 stainless steel, minimum size of ½" with NPT connection of size required for pressure sensing device. Pressure transmitters, switches and gauges shall be shipped to annular seal manufacturer for factory assembly, evacuation, and calibration.

B. Isolator ring shall include a valve and/or quick release device to allow instruments to be removed while the piping is in service and to prevent loss of fill fluid.

C. Materials of Diaphragm: Seals shall be of Type 304 or 316 Stainless Steel for center section and end plates with Neoprene or EPDM diaphragm. Fill fluid shall be Silicone Fluid.

D. Approved manufacturers, or equal, as approved by Engineer

1. Onyx Valve

2. Ashcroft

2.7 SCHEDULE

A. The Contractor shall provide pressure and vacuum gauges as indicated in 2.1.A and pressure transmitters and switches as indicated in the Instrumentation Schedule included as Appendix A to Section 40 70 00 – Instrumentation and Control, General.

PART 3 - EXECUTION

A. Pressure measuring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested.

END OF SECTION 40 73 00

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SECTION 40 75 43 – DISSOLVED OXYGEN MEASURING SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide dissolved oxygen (D.O.) measuring equipment, complete and operable, in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures and Section 40 70 00 – Instrumentation and Control, General.

1.3 QUALITY ASSURANCE

A. Calibration: All D.O. measuring equipment shall be shipped to the project site factory calibrated and accompanied with certificate of such.

B. Warranty: A written Contractor's warranty shall be provided for the equipment specified in this Section. The warranty shall be for a minimum period of one (1) year from the date of Substantial Completion equipment. The Contractor shall repair or replace all defects of materials or workmanship in the equipment.

PART 2 - PRODUCTS

2.1 DISSOLVED OXYGEN MEASURING SYSTEM

1. The dissolved oxygen (D.O.) monitoring system shall consist of a sensor, analyzer, and auxiliary equipment to facilitate mounting the D.O. monitoring system.

2. The system shall output a signal proportional to the dissolved oxygen level and the measured temperature. The analyzer shall meet NEMA 4X/IP66 requirements and shall be supplied with sufficient cable to connect the probes to the transmitter/indicators (22.9 feet minimum). The system shall be able to display the following parameters at a minimum:

    a. Dissolved Oxygen Concentration

    b. Temperature

    c. Relay Status

    d. Selected Salinity at Calibration

    e. Selected Value for Alarm Relays (High and Low Dissolved Oxygen)

    f. Error Pending and Error Log

g. The system shall be able to perform automatic calibration of the dissolved oxygen monitoring system. The Power supply shall be 115 VAC, +10%, -15%.

3. The wetted probe shall sense the dissolved oxygen concentration via a luminescent sensor. The signal from the sensor shall be tied to the interface unit that will send all pertinent data to the PLC via ethernet cable. The dissolved oxygen transmitter shall be utilized for monitoring the dissolved oxygen concentration in the tank.

4. The measuring principle shall be based on luminescent material that is sensitive to oxygen.

5. Sensor replacement shall not require factory service personnel to be present. Calibration shall be accomplished in free air and will not require special chemical baths.

6. The interface unit shall be housed in a NEMA 4X/IP66 metal enclosure with a corrosion-resistant finish. The panel must be complete with terminal strips and wire ducts (if needed).

7. The interface unit shall be capable of managing a minimum of six (6) inputs.

8. Operation Characteristics:

a. The dissolved oxygen probe shall be a continuous-reading probe that utilizes luminescent sensor technology.

b. The probe will not require calibration more frequently than once every six months.

c. The probe material shall be formed either Noryl® and 316 Stainless Steel or 316Ti, POM, and PVC. All parts of the probe shall be corrosion resistant and fully immersible.

d. The sensor material shall be either poly butyl methacrylate or PMMA, PVC and silicone.

e. The measurement range shall be 0.00 to 20.00 mg/L dissolved oxygen with an accuracy of ±0.2 ppm.

f. The operation of the analyzers shall not be affected by H_2S, pH, K^{+1}, Na^{+1}, Mg^{+2}, Ca^{+2}, NH_4^{+1}, Al^{+3}, Pb^{+2}, Cd^{+2}, Zn^{+2}, $Cr_{(total)}$, Fe^{+2}, Fe^{+3}, Mn^{+2}, Cu^{+2}, Ni^{+2}, Co^{+2}, CN^{-1}, NO_3^{-1}, SO_4^{-2}, S^{-2}, $PO_4^{+}3$, Cl^{-1}, anion-active tensides, crude oils, or Cl_2.

g. The sensor shall be supplied with a microprocessor-based analyzer. The analyzer shall contain a digital display with menu-driven software, two analog 4-20 mA outputs and 3 unpowered SPDT form ‘C’ alarm contacts. The controller shall be enclosed in a corrosion resistant IP66 enclosure.

h. The probe shall provide electrolyte-free operation without the requirements of sample conditioning.

i. The probe shall be furnished with a mounting kit.

j. The temperature range is 0 to 50°C.

k. The temperature accuracy is ± 0.2°C.

9. The dissolved oxygen sensor shall be suitable for submerged or flow through installation.

10. Spare Parts

a. Supplier shall provide a minimum of one (1) spare DO probe for shelf stock.

b. Supplier shall provide a minimum of one (1) spare interface unit (transmitter) for shelf stock.

11. Manufacturer of D.O. sensors and analyzers, or equal

a. Hach LDO2 transmitter (Part No. 9020000) with Hach SC1000 controller (Part No. LXV402.99.12002) and Hach Sunroof and Mounting Hardware for SC1000 Controller (Part No. LZX957).

b. YSI Optical DO with System 2020 3G – 20 Channel Terminal/Controller, IQ Sun Shield, and Rail Mounting Kit.

c. Equal must be approved during bidding process

PART 3 - EXECUTION

3.1 SERVICE REPRESENTATIVE

A. Erection and Startup Assistance: During erection and startup, the Contractor shall obtain all necessary assistance from an experienced factory service representative to ensure a correct and first-class installation, in accordance with the manufacturer’s instructions.

B. Instruction of Owner’s Personnel: After completion of the installation and during startup of the plant, the Installation Contractor shall instruct the Owner’s personnel in the proper operation, maintenance and repair of all equipment.

END OF SECTION 40 75 43

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SECTION 40 75 69 – PHOSPHATE ANALYZERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish, install, calibrate, test, adjust, and place into satisfactory operation analyzers as shown on the Drawings and specified herein.

B. The Drawings and Specifications illustrate and specify functional and general construction requirements of analyzers and do not necessarily show or specify all components, wiring, piping, and accessories required to make a completely integrated system. Provide all components, piping, wiring, accessories, and labor required for a complete and integrated system for measuring ortho-phosphate in water and wastewater treatment systems.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures and Section 40 70 00 – Instrumentation and Control, General.

1.3 QUALITY ASSURANCE

A. Calibration: All ortho-phosphate measuring equipment shall be shipped to the project site factory calibrated and accompanied with certificate of such.

B. Warranty: A written Contractor's warranty shall be provided for the equipment specified in this Section. The warranty shall be for a minimum period of one (1) year from the date of Substantial Completion. The Contractor shall repair or replace all defects of materials or workmanship in the equipment.

PART 2 - PRODUCTS

2.1 GENERAL

A. Measurement principle shall be colorimetry by means of the vanadomolybdate method (yellow method).

B. Ortho-Phosphate measurement system shall be intended for use as a stand-alone instrument or as part of a multiparameter monitoring network by connecting ortho-phosphate analyzer to network cables.

2.2 PERFORMANCE REQUIREMENTS

A. Design Requirements

1. Design ortho-phosphate measurement system for continuous monitoring of samples at discrete intervals.

2. Ortho-phosphate measurement system shall be either single or dual channel system as indicated below.

B. Operating Requirements

1. Operating range:

a. Ambient Temperature: -4°F to 104°F (-20°C to 40°C).

b. Sample Temperature: 39°F to 113°F (4°C to 45°C).

c. pH: 5.0 S.U. to 9.0 S.U.

C. Measurement Requirements:

1. Measuring range:

a. 0.015 mg PO4-P /L to 2.0 mg PO4-P /L

2. Measuring accuracy:

a. 2% ±0.05 mg PO4-P /L

3. Resolution:

a. 0.01 mg PO4-P /L

4. Reproducibility:

a. 0.7% ±0.005 mg PO4-P /L

5. Measuring interval:

a. 10 minutes to 120 minutes (user adjustable)

6. Measurement channels:

a. Two channels

7. Automatic calibration

2.3 MANUFACTURER

A. Provide the following manufacturer or engineer approved equal.

1. YSI Incorporated

2. Hach Company

2.4 MANUFACTURED UNIT

A. Enclosure:

1. UV resistant, outdoor, IP-54 or IP-55 rated, NEMA 4X

2. Rail mounted

3. Power supply: 120V / 60 Hz

4. Controller

a. (4) 4-20 mA analog outputs

b. (8) discrete outputs

c. (4) relays

d. Controller shall have Ethernet IP capabilities.

5. Status LED, signal lights with text fault indication

B. Filtration pump and return line (heat traced).

C. Filter membrane module with suction line (heat traced).

D. Connection cable with IP68 (waterproof) protection rating.

E. Manufacturer's mounting kit.

F. Reagents:

1. Provide manufacturer’s reagents for a minimum of approximately 1 year.

PART 3 - EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Ortho-phosphate measurement system shall not be delivered to the site until all product information and system shop drawings for the system have been approved.

B. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

C. Storage and Handling Requirements:

1. Store and handle materials in accordance with manufacturer’s instructions.

2. Keep materials in manufacturer’s original, unopened containers and packaging until installation.

3. Store materials in clean, dry area indoors.

4. Protect materials during storage, handling, and installation to prevent damage.

5. Temperature range for storage: -4°F to 122°F (-20°C to 50°C)

3.2 INSTALLATION

A. Contractor shall ensure the following space and installation requirements are met:

1. Below: 20 inches minimum clear space

2. Above: 8 inches minimum clear space

3. Door hinge side: 27 inches minimum clear space to allow 180° range for door.

4. Filter membrane module

a. Mount vertically

b. Mount filter module to be completely immersed at all times.

5. Cable bend radius

a. Permanent bend: not less than 3.2 in.

b. One-time bend: not less than 2 in.

3.3 START-UP

A. Install analyzers in strict accordance with the manufacturer's instructions and recommendations.

B. Manufacturer's representative will include a half-day of start-up service by a factory-trained technician. Contractor will schedule a date and time for training with Owner's personnel. Manufacturer shall instruct the Owner's personnel in the proper operation, maintenance and repair of all equipment.

END OF SECTION 40 75 69

SECTION 40 75 93 – AUTOMATIC REFRIGERATED SAMPLERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall furnish and install automatic sampling units including automatic wastewater sampler, refrigerated sample collector, and sampling chamber and all necessary piping, pump, connections, controls, mounts, valves, fittings, motor, and appurtenances for a complete and operable installation, in accordance with the requirements of the Contract Documents.

B. The sampler shall be suitable for outdoor use as shown in the drawings.

C. Unit(s) shall be UL-certified.

1.2 SUBMITTALS

A. Complete data and shop drawings with detailed specifications for the sampler, refrigerated sample collector, and manufacturer's published specifications shall be submitted for approval in accordance with Section 01 33 00 – Submittal Procedures and Section 43 05 01 – Equipment General Provisions, prior to ordering of equipment.

B. Complete list of manufacturer's recommended spare parts and tools.

C. Provide operation and maintenance manual in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.3 QUALITY ASSURANCE

A. Warranty: Provide Manufacturer’s standard one (1) year warranty. The warranty period shall begin on the date of substantial completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. The method of sample collection shall be via high-speed peristaltic pump for collection of the sample liquid.

B. The method of sample detection shall be ultrasonic.

C. The automatic sampler shall consist of a controller and all-weather refrigerator.

D. Tubing:

1. Pump tube: 0.95 ID x 0.16 OD cm (3/8 ID x 5/8 in. OD)

2. Intake tube: 9.5 mm (3/8 in.) ID Teflon® lined polyethylene in 25-ft. length.

E. Weighted strainer constructed of 316 stainless steel.

2.2 PERFORMANCE REQUIREMENTS

A. Sample cooling: maintain sample liquid at 4 °C (39 °F) in ambient temperature to 50 °C (122 °F) maximum; accurate to ±0.8 °C (±1.5 °F).

B. Sample volume: programmable in 10 mL increments from 10 to 10,000 mL.

C. Sample volume repeatability ±5% of 200 mL sample volume with: 4.6 m (15 ft.) vertical lift, 4.9 m (16 ft.) of 3/8- in intake tube, single bottle, full bottle shut-off at room temperature and 1524 m (5000 ft.) elevation.

D. Pacing intervals: selectable in single increments from 1 to 9,999 flow pulses or 1 to 999 hours in 1-minute increments. Accepts 4-20 mA input from an external device to pace the sampler.

E. Vertical lift: 8.5 m (28 ft.) using 8.8 m (29 ft.) maximum of 3/8-in. intake tube at sea level at 20 to 25 °C (68 to 77 °F).

F. Sample volume accuracy: ±5% of 200 mL sample volume with: 4.6 m (15 ft.) vertical lift, 4.9 m (16 ft.) of 3/8- in. intake tube, single bottle, full bottle shut-off at room temperature and 1524 m (5000 ft.) elevation.

G. Sample transport velocity: 0.9 m/s (2.9 ft./s) at 4.6 m (15 ft.) vertical lift (16 ft. of 3/8-in. intake tubing at 70 °F at 5000 ft. elevation).

H. Pump flow rate: 4.8 L/min (1.25 gpm) at 1 m (3 ft.) vertical lift with 3/8-in intake tube typical.

I. Certifications

1. Controller: CE

2. Cabinet: UL

2.3 ENVIRONMENTAL REQUIREMENTS

A. Operational Criteria

1. Operating temperature with controller compartment heater: -40 to 50 ºC (-40 to 122 ºF)

2. Storage temperature: -30 to 60 °C (-22 to 140 °F)

2.4 SCHEDULE

A. The Vendor shall provide the following samplers:

Location	Sample
Headworks Bldg. Exterior	Plant Influent
Sampling Manhole by UV Disinfection Building	Plant Effluent

2.5 COMPONENTS

A. The manufactured sampler shall consist of the following:

1. Controller: high impact injection-molded ABS/PC plastic with heater and lock.

2. All weather cabinet: linear low density polyethylene with UV-inhibitors

3. Pump enclosure: corrosion-resistant polycarbonate door, high impact-resistant plastic, polyphenylene sulfide track

4. Provide intake strainer in standard size for all locations. Strainers shall be constructed of 316 stainless steels.

5. Exterior dimensions shall be approximately 51” H x 30” W x 32” D.

B. Accessories shall consist of the following:

1. Controller compartment heater

2. Provide two each 2.5-gallon containers for each sampler.

3. Tubing and strainers

4. AC battery back up

5. Cables and interfaces

6. Stainless Steel Anchor Brackets

2.6 SAMPLER EQUIPMENT

A. The controller housing shall be submersible, watertight, dust-tight, corrosion- and ice-resistant to NEMA 4X, 6, IP68 standards.

B. The Graphics Display shall be a 1/4 VGA, Color; self-prompting/ menu-driven program.

C. The desiccant cartridge, which prevents moisture from accumulating inside the controller electronics area, shall be visual and accessible externally from the side of the controller; the replacement of the desiccant shall not require tools or disassembly of controller from base.

D. The pump shall use spring loaded rollers and be accessible by a clear hinged cover with single thumbscrew.

E. Refrigerated cabinet is insulated with foam insulation on the walls, bottom and on top. The cover for the controller compartment shall also be insulated.

F. The cabinet shall have a heavy duty compressible gasket on controller compartment lid, compressor compartment lid and refrigeration compartment door.

G. The refrigeration components and copper plumbing shall be corrosion protected with conformal coating.

H. The thermal control system shall be a digital microprocessor-based and responds to a system of temperature sensors that continually monitor the evaporator plate, controller compartment air temperature, and refrigerated compartment air temperature.

I. An air sensing thermostat shall maintain the sample liquid within specified limits.

J. Power requirement: 115 V, 60 Hz.

K. Communication includes:

1. USB and RS485 (Modbus).

L. The membrane switch keypad user interface shall be a self-prompting/menu driven program with 2 multiple function soft keys.

M. Sampling pacing modes shall include Time Weighted, Flow Weighted, Time Table, Flow Table, and Event.

N. Internal software shall be protected by a 7 amp fuse.

O. Diagnostics: View event and alarm logs.

P. A program lock shall be provided for access code protection to prevent tampering of program and system settings.

Q. The sampler shall include a full bottle shut off for composite sampling.

R. Sampling features include:

1. Dual programming: Up to 2 sample programs can be run sequentially, in parallel, or according to day of week scheduling; enabling a single sampler to function like multiple samplers.

2. Cascade sampling: for two samplers in combination – the first sampler, at the completion of the program, initiates the second.

3. Status Screen: Communicates what program is running, if there are any missed samples, when the next sample will be taken, how many samples remain, number of logged channels, time of last measurement, memory available, number of active channels, if alarms were triggered, when alarms were triggered, active sensors and cabinet temperature.

S. Datalogging

1. Sample History: Unit shall store up to 4000 entries for sample time stamp, bottle number and sample status (success, bottle full, rinse error, user abort, distributor error, pump fault, purge fail, sample timeout, power fail and low main battery)

2. Measurements: Unit shall store up to 325,000 entries for selected measurement channels in accordance with the selected logging interval.

3. Event Log: Stores up to 2000 entries. Records Power On, Power Fail, Firmware Updated, Pump Fault, Distributor Arm Error, Low Memory Battery, Low Main Battery, User On, User Off, Program Started, Program Resumed, Program Halted, Program Completed, Grab Sample, Tube Change Required, sensor communication errors, cooling failed, heating failed, thermal error corrected.

T. Automatic shutdown modes:

1. Multiple bottle mode: after complete revolution of distributor arm (unless continuous mode is selected).

2. Composite mode: after preset number of samples have been delivered to composite container, from one to 999 samples, or upon full container.

U. Sample distribution modes include single bottle composite, multi-bottle composite, multi-bottle discrete, bottles per sample, samples per bottle or a combination of bottles per sample and samples per bottle.

V. The high-speed peristaltic sample pump uses four rollers with spring tension.

W. The intake air purge is made automatically before and after each sample. The duration automatically compensates for varying intake line lengths.

X. The intake line is optionally rinsed with source liquid prior to each sample from one to three times.

Y. The sample collection cycle is optionally repeated from one to three times if a sample is not obtained on the initial attempt.

2.7 ACCESSORIES

A. Spare Parts: The sampler shall be provided with 4 spare Teflon-lined sample tubing lengths. The sampler shall be furnished with one year's supply of the manufacturer's suggested spare parts and any other elements subject to wear or frequent replacement. All parts shall be properly labeled and identified with the name and number of the equipment to which they belong.

B. Tools: The Contractor shall supply one complete set of special wrenches or other special tools necessary for the assembly, adjustment, and dismantling of the equipment. All tools shall be of best quality and furnished in labeled tool boxes of suitable design.

2.8 MANUFACTURER

A. Hach AS950 All Weather Refrigerated Sampler.

B. Engineer-approved Equal.

PART 3 - EXECUTION

3.1 PROTECTIVE COATING

A. Protective coating of samplers shall conform to the requirements of this Section.

B. Surface Preparation: All steel surfaces of samplers and refrigerated sample collectors shall be blast cleaned in the shop to a commercial blast cleaned surface conforming to SSPC-SP-6. All dust shall be removed prior to coating. Surfaces shall be coated the same day sandblasting is performed.

C. All steel surfaces of samplers, refrigerated sample collectors and supporting framework, if any, shall be shop coated with a baked epoxy powder coating to a minimum dry film thickness of 12 mils. Powder coating shall be applied by the fluidized bed or electrostatic spray method by qualified, experienced personnel. Oven curing shall conform to the recommendations of the epoxy powder manufacturer. Interior surfaces of samplers and sample collectors shall be white. The exterior color shall be as directed by the Engineer.

3.2 OPERATIONAL TESTS

A. The Contractor shall provide the services of a qualified representative of the manufacturer for not less than one day to check the installed units and instruct the Owner's operating personnel.

B. Upon completion of the installation, each piece of equipment and each system shall be field-tested for satisfactory operation without excessive noise, vibration, overheating, etc. All equipment must be adjusted and checked for misalignment, clearances, supports, and adherence to safety standards.

END OF SECTION 40 75 93

SECTION 40 76 23 – COMBUSTIBLE GAS DETECTION AND MONITORING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide gas detection and monitoring equipment at the location indicated in the project drawings, complete and operable, in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

1.3 QUALITY CONTROL

A. Warranty: Sensors shall be provided with industry standard two-year unconditional warranty. Sensor life shall be 3 to 5 years typical.

PART 2 - PRODUCTS

2.1 COMBUSTIBLE GAS SENSOR

A. At the locations indicated in the project drawings the Contractor shall provide a catalytic bead and/or non-dispersive infrared technology that employ an electronic platform to provide 1 point of detection from a single head. The sensors shall include:

1. The measuring range shall be 0 -100 LEL in 1% increments.

2. Repeatability shall be +/- 2ppm or 10% of the applied gas, whichever is greater.

3. The response time shall be T50< 1 minute (screen) and T50< 2 minutes (sintered) with full-scale gas applied.

4. The unit shall be capable of operating from -40 Degrees F to 167 Degrees F.

2.2 TRANSMITTER

A. Housing shall be cast aluminum, explosion-proof, NEMA 4X design meeting NFPA Class 1, Division 1 requirements. Provide with dual-channel split-screen LED display (4 digit, 7 segment arrangement per channel) for simultaneous display of one or two gases.

B. Drift shall be less that 5% of full scale per year. Instrument accuracy shall be +/- 3% LEL up to 50% LEL and +/- 5% LEL greater than or equal to 51% LEL.

C. The unit shall be capable of operating from -40 Degrees F to 167 Degrees F.

D. Unit shall be dual channel configuration, with 2 on-board sensors

E. Unit shall transmit (2) 4-20 mA signals; one for each sensor.

F. Unit shall have a minimum of two alarm outputs, one for each sensor.

G. Transmitter/Sensor Manufacturer shall be Industrial Scientific iTrans Fixed-Point Monitor (Model No. 7814635-1G21145), or equal.

2.3 CALIBRATION EQUIPMENT

A. Calibration Equipment: One set of calibration equipment shall be provided for each type of gas being measured on this project. The equipment shall include all components necessary to test and calibrate the gas sensors and monitors specified. Calibrations hall be based on a sample of gas of know concentration. For a combustible gas, 0.6% propane in air shall be the basis of calibration. The calibration kit shall include the following components as a minimum:

1. Flow control gas regulator for each gas type.

2. Connection tubing for each gas type.

3. One cylinder of gas for each gas type.

4. Electronic calibrator.

PART 3 - EXECUTION

3.1 GENERAL

A. Gas monitoring devices shall be mounted in accordance with manufacturer instructions. The Contractor shall verify installation requirements prior to mounting of similar gas monitoring devices.

B. Gas monitoring devices shall be calibrated in accordance with the Manufacturer’s recommendations and Section 40 79 23 – Testing, Calibration, and Commissioning.

END OF SECTION 40 76 23

SECTION 40 79 23 – TESTING, CALIBRATION, AND COMMISSIONING

PART 1 - GENERAL

1.1 GENERAL PROCEDURES FOR INSPECTION, TEST, AND INSTRUMENT CALIBRATION

A. Each instrument shall be checked against the latest version of the design documents for tagging, manufacturer, model number, range, action, etc., before functional testing or calibration.

B. Any air system, permanent or temporary, used for energizing instrumentation shall be dry and clean at all times, and be blown down thoroughly before use. Any connection between the air supply system shall be via proper filter and regulator.

C. Plastic sealing plugs shall be used for all pneumatic connections and tubing except during tests and immediately before final connection in the field.

D. Care shall be observed when connecting electric power supplies to the instrumentation. Insure correct voltage and frequency on AC power supplies. Insure correct voltage, polarity, and superimposed ripple on DC power supplies. Insure correct polarity of the supply and proper grounding before connecting instruments.

E. The Instrumentation and Control Systems Contractor shall satisfy the requirement that the installation, calibration, and checkout of the instruments meet the requirements of the project specifications.

F. The Calibration procedures for verifying instrument precision should conform to accepted practices as outlined in ASTM, ASHRAE, ISA, etc. specifications.

G. The Instrumentation and Control Systems Contractor shall provide copies of manufacturer’s installation and calibration instructions to the calibration technicians prior to the commencement of calibration.

1.2 INSTRUMENT QUALITY LEVELS AND METEROLOGY

A. Instrumentation supplied for the calibrating sensing instruments for facility control system shall include documentation concerning the calibration method and traceability to the National Institute for Standards and Testing (NIST).

B. Process instrumentation shall be field checked for accuracy before installation even if the instruments have been calibrated by the manufacturer’s metrology facilities.

PART 2 - PRODUCTS

2.1 CALIBRATION AND TEST EQUIPMENT

A. All calibration and test equipment shall be in proper working order and calibrated using traceable standards and equipment set by the NIST. Certificates of traceability shall be kept on file in the field calibration office or field project office. Copies of the traceability documents shall be included with the submittal of the calibration forms.

B. All calibration and test equipment shall carry a documented current calibration sticker reflecting the date of the last calibration and the name or initials of the technician who performed the calibration. A current calibration will be performed before the equipment is shipped to the site. The calibration equipment shall be shipped directly from the calibrating authority to the site, in packaging provided by the calibrating authority. A current calibration will be performed for all calibration or test equipment every 180 days or within the normal calibration interval, whichever is less.

C. Any field instruments calibrated with test equipment whose calibration has expired will be rejected and will be required to be recalibrated.

D. All Calibration and test equipment shall be of a higher accuracy than the instrument being calibrated. The manufacturer's recommendations for calibration accuracy will prevail in all instances.

E. The Control Systems Contractor shall supply calibration and test equipment of sufficient quantity, quality, and type to calibrate the instruments and sensors used in the installation.

2.2 BENCH TEST AND CALIBRATION FORMS AND METHODOLOGY

A. Calibration forms and calibration procedures for each instrument type shall be generated by the Instrumentation and Control Systems Contractor and approved by the Owner or his representative before proceeding with any calibrations. The manufacturer's procedures or the Owner's existing procedures shall form the basis for the calibration procedure.

B. The following format shall be used for instrument calibration form:

1. A separate calibration form shall be generated for similar types of instruments that have different accuracy and tolerance requirements.

2. The form shall contain as found and as calibrated data areas. The form shall contain areas for the calibrating and testing instruments manufacture, serial number, and date of calibration.

3. The forms shall be filled out and signed in black ink.

4. Those instruments that can shall be calibrated on the bench under controlled conditions. Care shall be taken with those instruments that must be calibrated in the field to approximate the conditions of the bench test.

PART 3 - EXECUTION

3.1 GENERAL

A. The Control Systems Contractor shall calibrate all instrumentation in an environment suitable for quality testing procedures. High accuracy comparative instruments or mechanisms shall be the standard against which instrument calibration is tested.

B. Verify that all process and test instruments have been calibrated and traceable to the NIST or other appropriate reference standards. Verify that a calibration sticker has been affixed to the instrument and that each instrument is within its calibration period at the time that the calibration is performed.

C. Each instrument shall be calibrated as per Owner approved calibration procedures and forms.

D. Each instrument shall have a calibration sheet filled out with all pertinent data related to the calibration and system. These calibration sheets shall be organized in a binder by system and turned over to the Owner at the completion of the project.

E. Instruments shall have a calibration sticker placed on the instrument. The sticker shall not be placed until the instrument has successfully completed the calibration procedure and the associated calibration form has been filled out and signed. The sticker shall bear the date of calibration and expiration and initials of the technician certifying calibration.

END OF SECTION 40 79 23

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SECTION 41 12 13.36 - SCREW (SHAFTLESS) BULK MATERIAL CONVEYORS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Work includes three (3) horizontal and inclined shaftless screw conveyors for handling dewatered, aerobically-digested sludge from the screw presses. Contractor shall furnish and install a complete conveyor system for conveyance of dewatered sludge from the dewatering room to the sludge load-out area. The system shall include conveyors, drive motors, gear reducers, supports, anchor bolts, wiring, and all accessories and appurtenances specified or otherwise required for a complete and properly operating installation.

B. All equipment included in this Section shall be furnished by a single entity that shall be responsible for the design, coordination, and the satisfactory operation of the system. The conveyor equipment shall be controlled by the screw press control panel and shall be coordinated with the screw press equipment for both placement as well as controls to assure a completely integrated and functional dewatered sludge handling system in the Control and Dewatering Building.

C. The NEC-Area electrical classification for the Dewatering Room is unclassified.

1.2 MANUFACTURER'S QUALIFICATIONS

A. The shaftless screw conveyor shall be manufactured by a supplier with not less than 20 operating installations of shaftless screw conveyors in North America.

B. The manufacturer shall provide a written statement indicating at least 5 years' experience in the construction and manufacture of shaftless conveyor systems incorporating the design features as specified herein.

1.3 SUBMITTALS

A. Shop Drawings: The Contractor shall submit shop drawings in accordance with the requirements of Section 01 33 00 – Submittal Procedures. Shop Drawings shall contain the following information, at a minimum:

1. Complete description in sufficient detail to permit an item-by-item comparison with the Specifications.

2. Layout drawings to include accessories, appurtenances, coordination with peripheral equipment, drives, and required clearances.

3. Details of transition chutes, discharge chutes, flexible connectors, hinged covers and cover locking device.

4. Electrical data including control and wiring diagrams.

5. Drive and motor in accordance with Section 40 05 93 – Common Motor Requirements for Process Equipment.

6. Calculations showing the sizing of all drive components including gear reducers, belts, sheaves and electric motor horsepower. The calculations shall show allowances for all service factors and component efficiencies in determining sizing and shall show that all drive train components are capable of withstanding the drive motor torque at full load motor amps. Calculations shall be sealed by a Professional Engineer licensed in the State of Idaho.

7. Submit bearing life calculations for the gear reducer bearing and/or drive end bearings sealed by a registered Professional Engineer in the State of Idaho.

8. Provide design loadings to be transmitted to foundations or supports and anchoring calculations sealed by a registered Professional Engineer in the State of Idaho.

9. Shop drawings for equipment anchors.

10. Manufacturer's installation and testing instructions.

B. Owner’s Manual as specified in Section 01 78 23 – Operation and Maintenance Data.

C. Spare Parts List: A spare parts list shall contain the required information for each conveyor.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN REQUIREMENTS

A. The shaftless screw conveyor system shall be designed to meet the following minimum performance and design requirements.

Description	CONV-1	CONV-2	CONV-3
Cubic ft per Hour	50	50	50
Material	Dewatered Sludge	Dewatered Sludge	Dewatered Sludge
Material Density (lbs/ft3)	65	65	65
Solids (min.)	16%	16%	16%
Length	See dwgs	See dwgs	See dwgs
Angle	Horizontal	Inclined	Horizontal
Max Speed RPM	20	20	20
Max Trough Fill	40%	30%	40%
Min Flight OD	8.3 inches	8.3 inches	8.3 inches
Min Spiral Weight per ft	19.6 lbs	19.6 lbs	19.6 lbs
Minimum Trough Width	10.25 inches	10.25 inches	10.25 inches
Minimum HP	2	2	2
Drive Location	Outlet End	Inlet End	Outlet End
Motor Type	TEFC	TEFC	TEFC

B. Spiral Design: The torsional rating of the auger flighting shall be reached at 30% of the Fy value in the extreme fiber of the flight material. Calculations shall demonstrate that, at 250% of the motor nameplate horsepower, the drive unit cannot produce more torque than the torsional rating of the flighting, and that the "spring effect" of the spiral shall not exceed + 0.8 mm per meter of length at maximum load conditions.

2.2 MANUFACTURERS, OR EQUAL

A. JDV Equipment

B. Custom Conveyor Corporation

2.3 MATERIALS

A. Unless otherwise specified or permitted, the materials used in the fabrication of the equipment under this Section shall conform to the following:

1. Trough, Chutes, Covers — AISI 304 stainless steel, 1/8” thick
2. Drive and end plates — AISI 304 stainless steel, ½” thick min.
3. Spiral Flighting — Cold-formed, high strength micro-alloy spring steel with minimum hardness of 220 Brinell

4.	Wear Liner	Plastimeric (UMHW), 3/8” thick min.
5.	Inlet &Discharge Chutes	AISI 304 stainless steel, 1/8” thick
6.	Supports	AISI 304 stainless steel, ¼” thick
7.	Hardware	AISI 316 stainless steel
8.	Cover fasteners	AISI 304 stainless steel screw clamps
9.	Drive Shaft	AISI 1045

2.4 SHAFTLESS SCREW CONVEYOR CONSTRUCTION

A. Spiral Flighting

1. Spiral flighting for the shaftless screw conveyors shall be designed to convey material without a center shaft, and with the stability to prevent distortion and jumping in the trough.

2. The spiral flighting shall be formed in sections from one continuous flat hot-rolled spring steel bar and shall be concentric to within 2mm +/-. Sectional flighting formed from plate shall not be permitted.

3. Spiral flighting shall have full penetration welds at all splice connections. The flights shall be aligned to assure true alignment when assembled in the field and shall be made in accordance with the supplier's requirements. The spiral flights shall be coupled to the end shaft by a flanged, bolted connection.

4. The connection of the spiral to the drive system shall be through a flanged connection plate that is welded to the spiral forming a smooth and continuous transformation from the flange plate to the spiral. The drive shaft shall have a mating flange and shall be bolted to the spiral connection plate.

B. Trough and Liner

1. Troughs shall be similar to the dimensional standards of CEMA 300 and enclosure classification IIE. Each conveyor trough shall be U-shaped, fabricated from a minimum 1/8-inch stainless steel plate.

2. Each trough shall be lined with 3/8-inch minimum UHMW polyethylene, with retainer strips welded to the trough along the top of the liner. The wear liner shall be furnished in maximum four-foot sections to provide ease of replacement. Fasteners shall not be used below the spiral centerline to hold the liner.

3. Stiffeners shall be placed across the top of the trough and fastened to both sides of the trough to maintain trough shape and act as a face seal for the covers; apply a continuous gasket, one half inch width, to the entire top face of the trough top flange and stiffeners.

4. Each trough shall be equipped with filling and/or discharge openings as required by the contract drawings. If required, each filling and discharge opening shall be flanged suitable for interconnection to other devices. Any interconnecting devices such as chutes and hoppers shall be fabricated from the same material as the troughs.

5. Each conveyor shall be provided with a drainage connection at the low end.

6. The portion of each trough that is not covered by the filling chute shall be covered by a bolted cover of a material identical to the trough. The covers shall be manufactured in maximum four-foot length section to allow for access to the conveyors. To prevent unsafe access to the conveyors, quick opening covers will not be allowed.

C. Inlet Chutes: Inlet chutes shall be provided by the conveyor supplier and extended to the screw press discharge. All chutes shall be fabricated from the same material as the conveyor trough. Manufacturer shall provide rubber flexible connectors, ends as required, to connect to the screw presses as per the screw press manufacturer's recommendations. Provide bolted cover on inlet for future screw press.

D. Conveyor Supports

1. Manufacturer shall furnish conveyor with factory-mounted lugs for attaching to supports. Contractor shall furnish and install hangers, stands, beam connections, etc. to support the conveyors as shown on the drawings.

E. Drive Assembly

1. Each spiral conveyor shall be driven by a constant-speed integral gear reducer/motor drive unit mounted to an adapter flange mounted to the end plate of the conveyor. The adapter flange shall allow the leakage of any material from the conveyor trough to atmosphere rather than into the gear reducer/ motor drive unit. Direct coupling of the gear reducer/motor drive unit to the end flange of the conveyor will not be acceptable.

2. The drive unit shall be rigidly supported so there is no visible "wobble" movement under any operating condition. In the event of a prolonged power failure or emergency system shutdown, the drive system shall be designed, at a minimum, to start the conveyor from a dead stop with the trough filled throughout its entire cross-sectional area and length with partially dried and hardened dewatered material.

3. An adjustable greased gland packing ring consisting of two Teflon coated packing rings shall seal the drive shaft at its penetration through the end plate.

4. Motor: Each motor shall be 460-volt, 60 Hz, 3 phases conforming to the General Equipment specifications, except as modified herein.

5. Reducer: All gears shall be AGMA Class II, single or double reduction, helical gear units with high capacity roller bearings. Bearings shall be designed for the thrust loads from the fully loaded startup condition and shall have an AFBMA B10 life of 50,000 hours. The reducer will be the standard air-cooled unit with no auxiliary cooling. The gear reducer shall be sized with a torque service factor of 1.5 times the absorbed power or 1.1 times the motor nameplate, at the driven shaft speed, whichever is greater.

F. Torque Overload: Torque overload protection shall be provided to protect the drive components from torsional loadings exceeding the rating of the screw. A current transformer shall be provided and shall sense the current draw of the motor levels. The signal shall be transmitted to the current overload protection device, which is set as required by the equipment supplier.

G. Motion Failure Alarm Unit: Each conveyor drive unit shall be equipped with a motion failure alarm unit. The location and mounting details shall be as recommended by the conveyor manufacturer. Motion sensors shall be the non-contacting type using a probe with a pre-amplifier and main electronic assembly. The main electronic unit shall operate on 120-volt, single phase, 60 Hz power supply, and shall be housed in a NEMA 4X enclosure. A 0-60 second time delay shall be provided for startup of the conveyor.

H. Emergency Shutdown: Each conveyor shall be furnished with an emergency trip cord and safety switch. The cord shall run the full length of each conveyor. The trip switch shall immediately stop all conveyors when the switch is actuated.

2.5 OUTDOOR WEATHER PROTECTION

A. The weather protection system shall guarantee operation of the unit down to a minimum temperature of -13 deg F (-25 deg C) and shall be powered from the main control panel.

B. The screenings conveyor shall be furnished with heat tracing systems for outdoor weather protection for the section of the conveyor located outside of the Dewatering Building and the other two conveyors located outside under the sludge load-out area.

C. The outdoor weather protection system shall include self-regulating heat tracing, adjustable thermostat, insulation and a stainless steel protective jacket.

D. Bulkhead adapters shall be provided for any conduit penetrations.

E. Outdoor weather protection system for the sludge transport conveyors shall be powered from and controlled by components within the conveyor control panel.

2.6 CONTROLS

A. The vendor will provide a single NEMA 4X control panel to control all conveyors. The panel will consist of a separate disconnect for each conveyor that is externally accessible and lockable. The panel will be located in the dewatering room as shown on the drawings.

B. The control of the screw conveyors shall be through interlock signals with the screw press control system as described in Section 40 61 96 – Control Strategies.

C. Interlock signals for the conveyor system will include:

1. Running status

2. General Fault

a. Auto status

b. Overload/Torque fault status

c. E-Stop status

d. Zero motion status

3. Run CMD

D. Included components:

1. Zero motion probe

2. E-Stop cable system (NEMA 4X)

3. LOR (NEMA 4X)

4. Torque Overload

5. E-stop

E. Provide local control station for each conveyor a three-position (hand/off/automatic) switch and the E-stop enclosed in a NEMA 4X panel.

2.7 ANCHORAGE

A. Equipment manufacturer shall furnish all anchor bolts of ample size and strength required to securely anchor each item of equipment. Anchor bolts, hex nuts, and washers shall be Type 316 stainless steel. Anchor bolts shall be wedge or epoxy type in accordance with Section 05 50 00 – Metal Fabrications.

B. Anchor bolts shall be set by the Contractor. Equipment shall be leveled, shimmed, bolted down and grouted with non-shrinking grout.

2.8 SPARE PARTS

A. Contractor shall provide the following spare parts for each conveyor:

1. Full set of trough liners for each conveyor.

PART 3 - EXECUTION

3.1 QUALITY ASSURANCE

A. Prior to shipping, conveyors shall be inspected and operated in the shop with the actual drive unit for this project in its entire length. Conveyor longer than the required shipping lengths will have the screws tack welded together and tested in their entire length. Conveyors should be operated for a minimum of 15 minutes and observed for alignment and abnormal operation. Conveyors shall be corrected as necessary. Prior to shipment the tack welds will be broken apart and conveyors suitably prepared for shipment.

3.2 INSTALLATION

A. Contractor shall install conveyor equipment in accordance with manufacturer’s recommendations.

B. Operation of the conveyor system shall be coordinated with operation of the screening equipment, to start/stop automatically.

3.3 MANUFACTURER'S FIELD SERVICES

A. The conveyor manufacturer shall include in the cost of the equipment two trips to the site. A factory trained, experienced, competent, and authorized representative of the supplier shall spend at least 16 hours on the jobsite to inspect, check, and approve the equipment installation, supervise initial operation, and to train operating personnel in the proper operation and maintenance of the system.

END OF SECTION 41 12 13.36

SECTION 41 22 00 - CRANES AND HOISTS, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide the hoisting equipment, ancillary steel, safety equipment, appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of this Section apply to all hoists and cranes unless indicated otherwise.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

1.	AISC	Specifications for the Design, Fabrication Erection of Structural Steel for Building
2.	AGMA	American Gear Manufacturer's Association
3.	ANSI 830.11	Overhead and Gantry Cranes
4.	ANSI MH 27.1	Underhung Crane and Monorail Systems
5.	ASTM A36	Carbon Structural Steel
6.	CMAA Crane Manufacturer's Association of America	
7.	NEMA National Electrical Manufacturers Association	
8.	American Welding Society Welding of AWS, D14.1	American Welding Society Specification Industrial and Mill Cranes
9.	NEC, National Electrical Code	Article 610, Crane and Hoists
10.	Applicable Local, State and Federal Regulations and Codes	
11.	OSHA	1926.554 & 1910.179 Specifications

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings shall include all electrical requirements, weights, wheel loads, dimensional drawings, and clearances required.

C. Technical Manuals: Include complete operating and maintenance instructions of the hoist and crane systems.

1.4 QUALITY ASSURANCE

A. Inspection and Testing Requirements: After erection, the Contractor shall inspect and test all hoists and crane systems in the presence of the manufacturer's service representative, for proper operation and conformance to the Specifications.

B. Acceptance Criteria and Tolerances: The Engineer reserves the right to reject any equipment not conforming to the tolerances, deflections, and lateral stiffness indicated.

C. Fabrication, assembly, and welding shall be carried out by factory-trained specialists and certified welders. All welding design and procedures will conform to the latest revision of AWS D14.1 and the welders are to be certified as such. A copy of the welder certification certificates will be required before any order to supply the crane is given.

PART 2 - PRODUCTS

2.1 GENERAL

A. Equipment of similar design shall be from the same manufacturer.

B. The capacity of each hoist and trolley shall be permanently marked in a conspicuous manner on the equipment. The wire rope weaving shall be of the two-part double, cross mounted or similar appropriate type, to provide a true, vertical lift without drift, unless otherwise indicated.

C. All hooks shall be safety type with latch.

D. The Contractor shall verify all dimensions and clearances in the field prior to erection and shall be responsible for the proper fitting and operation of the equipment.

2.2 BASIC MATERIALS

A. All materials used must be new and of the best commercial grade. Where materials are not indicated, the Contractor shall have the manufacturer use the most suitable selection for the given application and environment.

2.3 TOOLS AND SPARE PARTS

A. Tools: The Contractor shall supply one complete set of special wrenches or other special tools necessary for the assembly, adjustment, and dismantling of the equipment. All tools shall be of best quality and furnished in labeled toolboxes of suitable design.

B. Spare Parts: Furnish spare parts as required by the hoist or crane section. Parts shall be properly labeled and identified with the name and number of the equipment to which they belong.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hoist and crane equipment shall be installed in strict accordance with the manufacturers printed instructions.

B. The workmanship shall be in accordance with the referenced standards and codes.

C. Care shall be taken, that the structural integrity of beams, columns, walls, floors, and roofs will be maintained at all times.

3.2 USE OF HOISTS AND CRANES BY CONTRACTOR

A. Hoists and cranes shall only be used in construction work if specifically allowed through written request of the Owner and Engineer. If such use is permitted, Contractor shall be responsible for obtaining any and all permits or certifications for hoist and crane operation. Contractor shall also be responsible for maintaining hoist and crane equipment in new condition and shall promptly repair any damage or wear to the Owner's satisfaction.

3.3 FIELD TESTING

A. After completion of the Work, the Contractor shall test all hoist and crane equipment in the presence of the manufacturer's field representative, who shall certify in writing that the equipment meets applicable standards and specifications.

B. The Contractor shall have the hoist or crane manufacturer furnish the services of a trained, qualified representative for at least one day after the units are installed, for the purpose of inspecting the installation and instructing the Owner's operating personnel.

C. Testing shall be in accordance with CMAA and OSHA requirements.

END OF SECTION 41 22 00

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SECTION 41 22 13.25 – PORTABLE DAVIT CRANE AND MANUAL WINCH

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall furnish, install, and place in satisfactory operation the portable davit crane and winch and appurtenances complete with all necessary safety equipment, in accordance with the requirements of the Contract Documents.

B. Provide pedestal bases with plastic covers to be mounted where indicated on the Drawings.

1.2 REFERENCE STANDARDS

A. Comply with all commercial standards referenced in Section 41 22 00 – Cranes and Hoists, General.

1.3 SUBMITTALS

A. Complete data and shop drawings with detailed specifications for davit crane and manufacturer's publish specifications shall be submitted for approval in accordance with Section 01 33 00 – Submittal Procedures.

B. At a minimum, the following information shall be submitted for review:

1. Materials of construction for mast, boom, pedestal, winch, drum, handle, wire rope, hook load, and accessories

2. Drawings showing dimensions of crane, bases, hook reach, and hook height

3. Crane lifting capacity

4. Finishes.

5. Anchoring requirements for pedestal bases.

C. Provide verification that hoist will have sufficient lifting capacity to remove existing RAS pumps located in the existing clarifiers as shown on the drawings.

D. Owner's Manual: Each crane shall be supplied with a technical manual outlining operation and maintenance requirements in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

A. Testing and acceptance criteria shall be required as outlined in Section 41 22 00 – Cranes and Hoists, General.

B. Warranty. Each crane shall be accompanied with the Manufacturer's standard two-year warranty.

PART 2 - PRODUCTS

2.1 GENERAL

A. Basic Materials: All materials used must be new and of the best commercial grade. Where materials are not specified, the Contractor shall have the manufacturer use the most suitable selection for the given application and environment.

B. Plant Fabrication Items: All fabrication, assembly, and welding shall be carried out by factory-trained specialists and certified welders.

2.2 PORTABLE DAVIT CRANE

A. The davit crane shall be a portable type and shall be pedestal base mounted where indicated on the plans. The crane shall be capable of being broken down for storage and transport. The crane shall rotate 360-degrees on a pin and sleeve bearing within the base. A stainless steel lock shall be included with the roller/ball bearing to lock the crane in place during winch operation.

B. The davit crane shall have an adjustable boom that telescopes to at least 4 different lengths and adjusts in height while under load with ratchet style screw-jack.

C. The davit crane shall have a minimum load capacity of 500 pounds and be designed for use with a manual wire rope hoist as specified in this section. The crane shall include a quick connect winch mounting plate with quick-connect pin connections.

D. All components of the davit crane, including boom and mast, shall have a three-part epoxy gray finish with a zinc-rich primer and stainless steel assembly hardware.

E. Pedestal bases shall be made of 316 stainless steel and shall be mounted at locations where indicated on the drawings and a plastic cover shall be provided to cover the mast hole of each base.

F. Schedule:

1. Provide one portable crane and provide two pedestal bases at locations as shown on the Drawings.

G. Manufacturers, or Equal:

1. Thern, Commander Series 5PT5;

2. EN Material Handling (Yale)

2.3 WINCH

A. Construction: The hoist shall be a manual, wire rope winch and shall be designed as follows:

1. Hoist - Manual with worm gear and a brake for load control.

2. Bearings - Heavy duty, lifetime lubricated.

B. Cable: The hoist cable shall be 316 stainless steel wire rope for outdoor service and shall be designed for the load specified. Cable shall have a swaged ball on one end and a 316 stainless steel swivel hook with safety latch other end. The cables will be permanently attached to each pump for quick connection to the hoist. Provide one cable and wire rope keeper for each pump. Attach the wire rope keeper above each pump with stainless steel fasteners.

1. Load Capacity (lbs.) - 650 (minimum)

2. Wire Thickness (inch) - 1/4

3. Wire Length (feet) - 45

4. Maximum lift (feet) - 23

5. Number of pumps - 4

C. Manufacturers, or Equal:

1. Thern;

2. ETN Material Handling (Yale).

PART 3 - EXECUTION

3.1 GENERAL

A. All davit crane and hoist equipment shall be installed in strict accordance with the manufacturer's printed instructions.

B. Contractor shall be responsible for coordinating the final location based on the equipment provided. Contractor shall demonstrate proper operation to Owner and Engineer to confirm that hoist has been properly installed.

END OF SECTION 41 22 13.25

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SECTION 43 05 01 – EQUIPMENT GENERAL PROVISIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The provisions of this Section apply to all sections of Divisions 41 to 43 and Division 46 unless specifically revised therein.

B. Furnish each piece of equipment complete with its base, drives, shafting, couplings, controls, guards, and other appurtenances which are specified or are required for proper and safe operation.

C. Furnish any special tools or equipment required for proper operation maintenance, testing, or adjusting.

1.2 REFERENCE STANDARDS

A. Codes: All codes, as referenced herein, are specified in Section 01 42 19 – Reference Standards.

B. Equipment shall be in accordance with the following standards, as applicable and as indicated in each equipment specification:

1.	AFBMA	Anti-Friction Bearing Manufacturers Association, Inc.
2.	ASTM	American Society for Testing and Materials
3.	ANSI	American National Standards Institute
4.	ASME	American Society of Mechanical Engineers
5.	AWWA	American Water Works Association
6.	ASHREA	American Society of Heating, Refrigerating, and Air Conditioning Engineers
7.	AWS	American Welding Society
8.	NFPA	National Fire Protection Association
9.	NEMA	National Electrical Manufacturers Association
10.	OSHA	General Industry Safety Orders

C. The following standards are referenced in this and other Divisions 41 to 43 and Division 46:

1.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800
2.	ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy and other Special Alloys
3.	ANSI B46.1	Surface Texture
4.	ANSI S12.6	Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors
5.	ASME B1.20.1	General Purpose Pipe Threads (Inch)
6.	ASME B31.1	Power Piping
7.	AWWA C206	Field Welding of Steel Water Pipe
8.	AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144-inches (100 mm through 3,600 mm)
9.	AWWA D100	Welded Steel Tanks for Water Storage
10.	ASTM A48	Gray Iron Castings
11.	ASTM A108	Steel Bars, Carbon, Cold-Finished, Standard Quality
12.	ASME B17.1	Keys and Keyseats
13.	ASME B106.1M	Design of Transmission Shafting

1.3 SUBMITTALS

A. Submittals shall be made in accordance with Section 01 33 00 – Submittal Procedures and the specific equipment specifications sections.

B. Shop Drawings: Furnish complete drawings and technical information for equipment, piping, valves, electrical and controls. Where indicated or required by the Engineer, Shop Drawings shall include clear, concise calculations showing equipment anchorage forces and the capacities of the anchorage elements proposed by the Contractor.

C. Spare Parts List: The Contractor shall obtain from the manufacturer and submit at the same time as Shop Drawings a list of suggested spare parts for each piece of equipment. Contractor shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.

D. Operation and Maintenance Manual: Provide technical operation and maintenance manuals in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 ADAPTATION OF EQUIPMENT

A. The Contractor shall furnish equipment readily adaptable for installation and operation. Equipment furnished shall be compatible with all other equipment furnished under the Contract.

B. The Contractor shall assume full responsibility for all modifications of mechanical and electrical controls, equipment, wiring, piping, as required to accomplish the function intended by the Contract Documents.

1.5 QUALITY ASSURANCE

A. Guarantees: Unless otherwise accepted herein, guarantee all equipment and its install required. Guarantees shall cover the following: (1) Faulty or inadequate design; (2) Improper assembly or erection; (3) Leakage, breakage, or other failure; and (4) Defective workmanship or materials.

B. Inspection, Start-up and Field Adjustment: The Contractor shall demonstrate that all equipment meets the specified performance requirements. Contractor shall provide the services of an experienced, competent, and authorized service representative of the manufacturer of each item of major equipment who shall visit the site of Work to perform the following tasks:

1. Assist the Contractor in the installation of the equipment.

2. To inspect, check, adjust if necessary and approve the equipment installation.

3. To start-up and field-test the equipment for proper operation, efficiency, and capacity.

4. To perform necessary field adjustments during the test period until the equipment installation and operation are satisfactory to the Engineer.

5. To instruct the Owner's personnel in the operation and maintenance of the equipment. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.

C. Quality and Tolerances: Tolerances and clearances shall be as shown on the Shop Drawings and shall be closely adhered to.

D. Machine Finish: The type of finish shall be the most suitable for the application and shall be shown in micro-inches in accordance with ANSI B46.1

E. Manufacturer's Experience: Equipment manufacturer shall have a record of at least 5 years of successful, trouble-free operation in similar applications and size equal to or larger than the equipment in this contract.

PART 2 - PRODUCTS

2.1 GENERAL

A. Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damages and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall always be kept thoroughly dry. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weather tight storage facilities prior to installation. For extended storage period, plastic equipment wrappers shall be avoided to prevent accumulation of condensate in gears and bearings. In addition, motor space heaters shall be energized, and shafts shall be rotated. Equipment delivered to the Site with rust or corroded parts shall be rejected. If equipment develops defects during storage, it shall be disassembled, cleaned, and recoated to restore it to original condition.

B. Identification Equipment Items: At the time of shipping, each item of equipment shall have a legible identifying mark corresponding to the equipment number in the Contract Documents for the particular item.

C. Protective Coating: Equipment shall be painted or coated in accordance with Section 09 90 00 – Painting and Coating, unless otherwise indicated. Non-ferrous metal and corrosive-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly and shipping.

D. Controls: Equipment and system controls shall be in accordance with Division 26 and Division 40.

E. All flanges on equipment and appurtenances provided under this Section shall conform to ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise shown. All pipe threads shall be in accordance with ANSI/ASME B1.20.1, and with requirements of Section 40 05 00– Piping, General.

F. Nameplates: Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the manufacturer’s name, model, serial number, size, characteristics, and appropriate date describing the machine performance ratings.

G. Tools: The Contractor shall furnish one complete set of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of the equipment. Tools shall be of best quality hardened steel forgoing with bright finish. Wrench heads shall have work faces dressed to fit nuts. Tools shall be suitable for professional work and manufactured by Snap On, Crescent, Stanley, or equal. The set of tools shall be neatly mounted in a labeled toolbox of suitable design provided with a hinged cover.

H. Lubricants: The Contractor shall install lubricants for all equipment during storage and prior to initial testing of the equipment. After successful initial testing, final testing, and satisfactory completion startup testing as specified in Section 01 75 16 – Startup Procedures, the Contractor shall conduct one complete lubricant change on all equipment. In addition, the Contractor shall be responsible for the proper disposal of all used lubricants. The Owner will then be responsible for subsequent lubricant changes.

2.2 EQUIPMENT SUPPORTS

A. All pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and load on equipment flanges and equipment. Supports and hangers shall be in accordance with the requirements of Section 43 05 50 – Equipment Mounting.

2.3 NOISE REQUIREMENTS

A. Noise Level: When in operation, no single piece of equipment shall exceed the OSHA noise level requirement of 105 dBA for one-hour exposure per day.

B. High Noise Level Location: The Contractor shall provide two personal hearing protection stations at the Blower Room.

C. Personal Hearing Protection: In each hearing protection station, the Contractor shall furnish three pairs of high attenuation hearing protectors in the original unopened packaging. The ear protectors shall be capable of meeting the requirements of ANSI S12.6 and shall produce a noise level reduction of 25 dBA at a frequency of 500 Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. The protectors shall be stored in a weatherproof, labeled, steel cabinet, provided at an approved location near the noise producing equipment.

2.4 VIBRATION LIMITATIONS

A. Vibration frequencies shall span the range from 5.0 to 5,000 Hz. Where specified, measurements shall be obtained while the installed equipment is operating within the specified speed range.

B. Centrifugal Machines with Sleeve Bearings: Unless otherwise specified, centrifugal machines with sleeve bearing shafts shall not exhibit unfiltered RMS readings for vibration displacement in excess of the following:

Shaft speed range range, rpm	Displacement peak to peak, mils
Up to 900	3.5
901-1800	3.0
1801-3000	2.5
3001-4500	2.0
Above 4500	1.6

Displacement measurements shall be taken radially on the shaft at two points at each bearing. Measuring points shall be 90 degrees apart.

C. Centrifugal Machines with Antifriction Bearings: Unless otherwise specified, centrifugal machines with antifriction bearing shafts shall not exhibit unfiltered RMS readings for vibration velocity in excess of 0.12 inch per second. Velocity measurements shall be taken on one point of each bearing housing.

D. Positive Displacement Machines: Unless otherwise specified, positive displacement machines of the rotary, reciprocating and controlled volume types shall operate without any lateral or torsional vibration characteristics that may accelerate wear of the equipment. The Contractor shall provide manufacturer's certification that the manufacturer has inspected the machine under operating conditions and found it to comply with the manufacturer's requirements.

E. Vibration Isolators: Air compressors, blowers, engines, inline fans shall be provided with restrained spring-type vibration isolators or pads per manufacturer's written recommendations. Vibration isolations shall be provided with seismic restraint.

2.5 CRITICAL SPEED REQUIREMENTS

A. Unless otherwise specified, rotating mechanical equipment shall not exhibit critical speeds within the specified range of operating speeds and impeller blade pass frequencies. Critical speeds for equipment with rigid rotor systems shall be at least 20 percent greater than maximum operating speed and maximum impeller blade pass frequency, whichever is greater. Critical speeds for equipment with flexible shaft-rotor systems shall be at least 15 percent below minimum operating speed and 20 percent above maximum operating speed and blade pass frequency.

2.6 DRIVE TRAINS AND SERVICE FACTORS

A. Drive Trains and Service Factors: Service factors shall be applied in the selection or design of mechanical power transmission components. All components of drive train assemblies between the prime mover and the driven equipment shall be designed and rated to deliver the maximum peak or starting torque, speed, and horsepower. All of the applicable service factors shall be considered, such as mechanical (type of prime mover), load class, start frequency, ventilation, ambient temperature, and fan factors. Drive train components include couplings, shafts, gears, and gear drives, drive chains, sprockets, and V-belt drives. Unless otherwise indicated, the following load classification shall apply in determining service factors:

Type of Equipment	Service Factor	Load Classification
Centrifugal Fans	1.0	Uniform
Pumps		
Centrifugal or Rotary	1.0	Uniform
Reciprocating	1.8	Moderate Shock
Cranes or Hoists	1.25	Moderate Shock

B. Mechanical Service Factors

	Mechanical Service Factors
Uniform	1.25
Moderate Shock	1.50
Heavy Shock	2.0

C. For thermal rating adjustments such as start frequency, ambient temperature, and hourly duty cycle factor, ventilation factor, and fan factor, refer to gear manufacturer sizing information.

D. For service factors of electric motor, see Section 40 05 93 – Common Motor Requirements for Process Equipment.

E. Where load classifications are not indicated, service factors based on AGMA 514.02 shall be used for standard load classification and for flexible couplings.

2.7 SHAFTING

A. Shafting shall be continuous between bearings and shall be sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. Shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.

B. Design Criteria: All shafts shall be designed to carry the steady state and transient loads suitable for unlimited number of load applications, in accordance with ASME B 106.1 M - Design of Transmission Shafting. Where shafts are subjected to fatigue stresses, such as frequent start and stop cycles, the mean stress shall be determined by using the modified Goodman Diagram. The maximum torsional stress shall not exceed the endurance limit of the shaft after application of the factor of safety of 2 in the endurance limit and the stress concentration factor of the fillets in the shaft and keyway. Stress concentration factor shall be in accordance with ASME Standard B17.1 - Keys and KeySeats.

C. Materials: Shafting materials shall be appropriate for the type of service and torque transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as indicated unless furnished as part of an equipment assembly.

1. Low carbon cold-rolled steel shafting shall conform to ASTM A 108, Grade 1018.

2. Medium carbon cold-rolled shafting shall conform to ASTM A 108, Grade 1045.

3. Other grades of carbon steel alloys shall be suitable for service and load.

4. Corrosion-resistant shafting shall be stainless steel or Monel, whichever is most suitable for the intended service.

D. Differential Settlement: Where differential settlement between the driver and the driven equipment may occur, a shaft of sufficient length with sets of universal type couplings shall be provided.

2.8 BEARINGS

A. Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA).

B. To assure satisfactory bearing application, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and lubrication shall be considered in bearing selection.

C. All re-lubricatable type bearings shall be equipped with a hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.

D. All lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to insure maximum bearing life and best performance.

E. Anti-Friction Type Bearing Life: Except where otherwise indicated, bearings shall have a minimum 10 life expectancy of 10 years or 20,000 hours, whichever occurs first. Where so indicated, bearings shall have a minimum rated L-10 life expectancy corresponding to the type of service, as follows:

Type of service	Design Life, years	L-10 Design Life, hours
	(Whichever comes first)	
8-hour shift	10	20,000
16-hour shift	10	40,000
Continuous	10	60,000

F. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as indicated or as recommended in the published standards of the manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.

G. Sleeve Type Bearings: Sleeve-type bearings shall have a steel, cast iron or ductile iron housing and Babbitt or bronze liner. Bearing housing shall be bolted and doweled to the lower casing half. These housings shall be provided with cast iron caps bolted in place and the bearing end caps shall be bored to receive the bearing shells. Sleeve bearings shall be designed on the basis of the maximum allowable load permitted by the bearing manufacturer. If the sleeve bearing is connected to an equipment shaft with a coupling, the coupling transmitted thrust will be assumed to be the maximum motor or equipment thrust. Lubricant, lubrication system, and cooling system shall be as recommended by the bearing manufacturer.

H. Plate Thrust Bearings: Thrust bearings shall be the Kingsbury Type, designed and manufactured to maintain the shaft in the fixed axial position without undue heating or the necessity of adjustment or attention. Bearings shall be oil lubricated to suit the manufacturer's standard method of lubrication for the specific bearing. If bearing cooling is required, the manufacturer shall provide necessary piping, filters, and valves.

2.9 ELECTRIC MOTORS

A. All motors shall comply with requirements listed in Section 40 05 93 – Common Motor Requirements for Process Equipment. All variable frequency drive (VFD) controlled motors shall comply with NEMA MG-1 Design “B” requirements.

2.10 SPARE PARTS

A. Spare parts, where specified, shall be provided in clearly labeled boxes. Labels shall display “City of Aberdeen" a major piece of equipment to which the part belongs, the part name, and the manufacturer's part number.

PART 3 - EXECUTION

3.1 PROTECTION

A. Box, crate, or otherwise completely enclose and protect all equipment during shipment, handling, and off-site storage. Responsibility for storage on the job site will be assigned to the installing Contractor.

B. Protect equipment from exposure to elements and always keep all items thoroughly dry. Protect against impact, abrasion, discoloration, and other damage. Protect electrical equipment, controls, and insulation against moisture, freezing, or water damage.

3.2 INSTALLATION

A. Equipment shall be installed in accordance with the manufacturers’ written recommendations. The Contractor shall select or recommend the size and type of coupling required to suit each specific application; installation shall be per equipment manufacturer's printed recommendations. All insulating connections shall be installed in accordance with the manufacturer's printed instructions.

B. Alignment: Equipment shall be field tested to verify proper alignment.

3.3 SERVICES OF MANUFACTURER

A. Inspection, Startup, and Field Adjustment: Where required by individual sections, an authorized, experienced, and competent service representative of the manufacturer shall visit the Site for the number of days indicated in those sections to witness or perform the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.

1. Installation of equipment

2. Inspection, checking, and adjusting the equipment and approving its installation

3. Startup and field testing for proper operation, efficiency, and capacity

4. Performing field adjustments during the test period to ensure that the equipment installation and operation comply with requirements

B. Instruction of the Owner's Personnel: Where required by the individual equipment sections, an authorized training representative of the manufacturer shall visit the Site for the number of days indicated in those sections to instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.

1. The representative shall have at least two years' experience in training. A resume of the representative shall be submitted.

2. Training shall be scheduled three weeks in advance of the scheduled session.

3. Proposed training material and a detailed outline of each lesson shall be submitted for review. Review comments from the Engineer shall be incorporated into the material.

4. The training materials shall remain with the trainees after the session. The Contractor shall videotape the training for later use by the Owner's personnel.

3.4 PACKAGED EQUIPMENT

A. When any system is furnished as pre-packaged equipment, the Contractor shall coordinate all necessary space and structural requirements, clearances, utility connections, signals, and outputs with subcontractors to avoid later change orders.

B. If the packaged system has any additional features (as safety interlocks, etc.) other than required by the Contract Documents, the Contractor shall coordinate such features with the Engineer and provide all material and labor necessary for a complete installation as required by the manufacturer.

3.5 FIELD TESTS

A. Where indicated by the individual equipment sections, equipment shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, or no overheating of bearings or motor.

B. The following field testing shall be conducted:

1. Start, check, and operate the equipment over its entire operating range. The vibration level shall be within the amplitude limits as indicated or as recommended by the reference applicable Standards.

2. Obtain, record, and provide to Engineer concurrent readings of motor voltage, amperage, capacity, vibration, and bearing temperatures for each piece of major equipment.

C. The Engineer shall witness field testing. The Contractor shall notify the Engineer of the test schedule seven days in advance.

D. In the event that any equipment fails to meet the test requirements, the equipment shall be modified and resettled until it satisfies the requirement.

END OF SECTION 43 05 01

SECTION 43 05 50 – EQUIPMENT MOUNTING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This section specifies mounts, supports, and the anchorage for equipment, tanks, piping and accessories.

1.2 REFERENCE STANDARDS

A. Federal Specifications

1.	MIL-A-907E	Antiseize Thread Compound, High Temperature

B. Commercial Standards

1.	ASTM A 48	Gray Iron Castings
2.	ASTM A 193	Alloy Steel and Stainless Steel Building Materials for High Temperature Service
3.	ASTM A 194	Carbon and Allow Steel Nuts for Bolts for High Pressure and High Temperature Service
4.	ASTM A 307	Carbon Steel Bolts and Studs, 600,000 psi Tensile Strength
5.	ASTM A 325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

1.3 SUBMITTALS

A. Calculations and shop drawings shall be submitted for all of the work required above in accordance with Section 01 33 00 – Submittal Procedures. Anchor bolt and expansion bolt submittals shall be in accordance with requirements specified herein. All calculations must be made and signed by a civil or structural engineer currently registered in the State of Idaho.

B. Inasmuch as some anchorage or equipment mounting is to be made to poured-in-place concrete elements, it is imperative that these types of anchorage be coordinated with the concrete subcontractor so that anchorage may be installed at time of pouring. If calculations and anchorage details are not submitted prior to pouring of concrete, the Contractor shall become responsible for any strengthening of concrete elements because of superimposed seismic loading.

1.4 QUALITY ASSURANCE

A. Support, anchorage and mounting of all tanks, piping and equipment shall be designed and provided by Contractor according to manufacturer's recommendation, 2018 International Building Code and industry standards requirements, unless otherwise specified. All elements required to resist the calculated forces described herein or required by the equipment manufacturer shall be provided by the Contractor.

PART 2 - PRODUCTS

2.1 GENERAL

A. Equipment mountings shall be as shown. All equipment located in floor slabs shall be mounted on concrete pads. Where a steel or cast base is shown or specified between the equipment and the concrete pedestal, it shall be hot-dip galvanized after fabrication.

B. For belt driven equipment shown as in-line and piggyback, the base shall be rectangular and the motor shall always be behind and above the driven equipment and never over the driven equipment unless approved by the Engineer. Motor mounting hardware for any belt driven configuration shall allow for belt tension adjustment.

2.2 EQUIPMENT SUPPORTS AND FOUNDATIONS

A. Steel Bases: Structural steel bases shall be rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases, which may be "T" or "L" 1 shaped where shown. Pump bases for split case pump shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the base. Beam depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Grout holes shall be provided for the bases of all equipment where vibration isolation is not specified. Where vibration isolation is required, height saving brackets shall be employed in all mounting locations to provide a base clearance of 1 inch.

2.3 CONNECTIONS

A. All pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment. Supports and hangers shall be in accordance with the requirements of Section 40 05 07 – Hangers and Supports for Process Piping.

B. Flanges and Pipe Threads: All flanges on equipment and appurtenances provided under this Section shall conform to ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise shown. All pipe threads shall be in accordance with ANSI/ASME B1.20.1, and with requirements of Section 40 05 00 – Piping, General.

C. Unless otherwise indicated, equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greater of: that noted in the general structural notes or as required by the governing building code, or 10 percent of gravity. Submitted design calculations for equipment supports shall bear the signature and seal of an engineer registered in the state wherein the project is to be built, unless otherwise indicated.

D. Equipment Foundations: Mechanical equipment, tanks, control cabinets, enclosures, and related equipment shall be mounted on minimum 4-inch high concrete bases unless otherwise indicated. Equipment foundations are indicated on Drawings. The Contractor through the equipment manufacturer shall verify the size and weight of equipment foundation to insure compatibility with equipment.

E. Couplings: Mechanical couplings shall be provided between the driver and the driven equipment. Flexible couplings shall be provided between the driver and the driven equipment to accommodate sight angular misalignment, parallel misalignment, end float, and to cushion shock loads.

1. Unless otherwise indicated or recommended by the equipment manufacturer, coupling type shall be furnished with the respective equipment as follows:

Equipment Type	Coupling Type
Horizontal and end suction pumps	Gear or flexible spring
Vertical non-clog pumps, closed coupled	Flexible disk pack
Single stage centrifugal blowers	Flexible disk pack
Air compressors	Gear or flexible pack

2. Each coupling size shall be determined based on the rated horsepower of the motor, speed of the shaft, and the load classification service factor. The Contractor shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.

3. Taper-Lock or equal bushing may be used to provide for easy installation and removal of shafts of various diameters.

2.4 ANCHOR BOLTS

A. The Contractor shall be responsible for providing anchor bolts for all owner–furnished and other equipment supplied to this project. For all bolts, nuts, and washers' requirements see Section 05 50 00 – Metal Fabrications.

B. Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 25 percent, up to a limiting maximum oversizing of 1/4 inch. Minimum anchor bolt diameter shall be 1/2 inch. Anchor bolts shall be furnished with leveling nuts, the faces of which shall be tightened against flat surfaces as shown to not less than 10 percent of the bolt's safe tensile stress.

C. Tapered washers shall be provided where mating surface is not square with the nut.

D. Adhesive anchors shall comply with requirements listed in Section 05 50 00 – Metal Fabrications.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Each piece of equipment shall be anchored to resist a minimum lateral force required by the code, the manufacturer of the equipment or a lateral seismic force of 40 percent of the operating weight of the equipment, whichever is greater. This force shall be considered acting at the center of gravity of the piece under consideration. No equipment shall be anchored to vertical structural elements without written approval of the Engineer.

B. Equipment which is not vibration isolated shall be anchored directly to the supporting floor system. In addition to the anchorage, all such equipment shall be internally designed so that all static and moving parts are anchored to the supporting framework to resist the imposed seismic force. All forces must be transmitted to the base in order to be anchored as required. Vibration isolated equipment shall be specially designed to meet these same requirements.

C. Equipment, tanks, piping supports, and anchorage located outside the building shall be designed to comply with 2018 International Building Code requirements.

D. All piping, raceways, accessories, and appurtenances, furnished with equipment shall be anchored to resist a lateral seismic force of 40 percent of its operating weight without excessive deflection. This force shall be considered acting at the center of gravity of the piece under consideration.

END OF SECTION 43 05 50

SECTION 43 05 60 – PROCESS EQUIPMENT TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes Testing of mechanical equipment and systems.

B. Related Sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. S1.4 Specification for Sound Level Meters.

B. Hydraulic Institute (HI).

1.3 SUBMITTALS

A. Schedule of factory tests and field tests as specified in Section 01 75 00 – Equipment Testing and Startup Procedures and this Section.

B. Test instrumentation calibration data.

C. Start-up plan as specified in Section 01 75 00 – Equipment Testing and Startup Procedures.

D. Test plan specified in this section.

E. Test result reports.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 QUALITY CONTROL TESTING AND REPORTING

A. Scheduling and notification:

1. Witnessed source quality control tests: Schedule test date and notify Engineer at least 30 days prior to start of test.

2. Field quality control tests: Schedule test date and notify Engineer at least 7 days prior to start of test.

B. Testing levels:

1. Test equipment based on test levels specified in the equipment section of this Project.

2. Requirements for Test Levels 1 to 4 are defined below.

3. Test levels apply for both Source (Factory) Quality Control Tests and Field Quality Control Tests as specified in the equipment sections of this Project.

4. If testing is not specified in the equipment section, provide Level 1 testing.

5. Requirements of Section 01 75 00 – Equipment Testing and Startup Procedures apply to Test Levels.

C. Witnessing: Source Quality Control Tests not witnessed unless specified otherwise in the equipment section or Section 01 75 00 – Equipment Testing and Startup Procedures; Field Quality Control Tests shall be witnessed.

D. Instrumentation: Provide necessary test instrumentation which has been calibrated within 1 year from date of test to recognized test standards traceable to the National Institute of Standards and Technology, Washington, D.C. or approved source. Properly calibrated field instrumentation permanently installed as a part of the Work may be utilized for Field Quality Control Tests.

E. Temporary facilities and labor: Provide necessary fluids, utilities, temporary piping, temporary supports, temporary access platforms or access means and other temporary facilities and labor necessary to safely operate the equipment and accomplish the specified testing. With Owner's permission, some utilities may be provided by fully tested permanently installed utilities that are part of the Work.

F. Test fluids:

1. Factory tests: Use water or air as appropriate at ambient conditions unless specified otherwise in the equipment section.

2. Field tests: Use specified process fluid at available conditions.

G. Pressure testing: Hydrostatically pressure test pressure containing parts in the factory at the appropriate standard or code required level above the equipment component specified design pressure or operating pressure, whichever is higher. Submit pressure test reports before shipping.

H. Test measurement and result accuracy:

1. Use test instruments with accuracies as recommended in the appropriate referenced standards. When no accuracy is recommended in the referenced standard, use 1 percent or better accuracy test instruments. Improved (lower error tolerance) accuracies specified elsewhere prevail over this general requirement.

2. Do not adjust results of tests for instrumentation accuracy. Measured values and values directly calculated from measured values shall be the basis for comparing actual equipment performance to specified requirements.

I. Field testing:

1. Submit test plan as specified in Section 01 75 00 – Equipment Testing and Startup Procedures and this Section. Indicate test start time and duration, equipment to be tested, other equipment involved or required; temporary facilities required, number and skill or trade of personnel involved; safety issues and planned safety contingencies; anticipated effect on Owner's existing equipment and other information relevant to the test. Provide locations of all instruments to be used for testing. Provide calibration records for all instrumentation.

2. Perform general start-up and testing procedures as specified in Section 01 75 00 – Equipment Testing and Startup Procedures.

3. Prior to testing, verify equipment protective devices and safety devices have been installed, calibrated, and tested.

J. Reports: Submit reports for source and field-testing. Submit Source Quality Control Test result reports before shipping equipment to the field. Report features:

1. Report results in a bound document in generally accepted engineering format with title page, written summary of results compared to specified requirements, and appropriate curves or plots of significant variables in English units.

2. Include appendix with a copy of raw, unmodified test data sheets indicating test value, date and time of reading, and initials of person taking the data.

3. Include appendix with sample calculations for adjustments to raw test data and for calculated results.

4. Include appendix with the make, model, and last calibration date of instrumentation used for test measurements.

5. Include in the body of report a drawing or sketch of the test system layout showing location and orientation of the test instruments relative to the tested equipment features.

3.2 EQUIPMENT TESTING, GENERAL

A. Tests for pumps, all levels of testing:

1. Test in accordance with applicable HI Standards in addition to the requirements in this and other sections.

2. Test tolerances: In accordance with appropriate HI Standards, except the following modified tolerances apply:

a. From 0 to plus 5 percent of head at the specified flows.

b. From 0 to plus 5 percent of flow at the rated design point head.

c. No negative tolerance for the efficiency at the specified flows.

d. No positive tolerance for vibration limits. Vibration limits and test methods in HI Standards do not apply, use limits and methods specified in this or other sections of the Specifications.

B. Tests for drivers: Test motors as specified in Section 40 05 93 – Common Motor Requirements for Process Equipment. Test other drivers as specified in the driver equipment section.

3.3 REQUIREMENTS FOR VIBRATION TESTING

A. Definitions:

1. Peak-to-peak displacement: The root mean squared average of the peak-to-peak displacement multiplied by the square root of 2.

2. Peak velocity: The root mean squared average of the peak velocity multiplied by the square root of 2.

3. Peak acceleration: The root mean squared average of the peak acceleration multiplied by the square root of 2.

4. High frequency enveloping: A process to extract very low amplitude time domain signals associated with impact or impulse events such as bearing or gear tooth defects and display them in a frequency spectrum of acceleration versus frequency.

a. Manufacturers: One of the following or equal:

1) Rockwell Automation, Entek Group, "Spike Energy" analysis.

2) CSI, "PeakVue."

5. Low speed equipment: Equipment or components of equipment rotating at less than 600 revolutions per minute.

6. High speed equipment: Equipment and equipment components operating at or above 600 revolutions per minute.

B. Vibration instrumentation requirements:

1. Analyzers: Use digital type analyzers or data collectors with anti-aliasing filter, 12 bit A/D converter, fast fourier transform circuitry, phase measurement capability, time wave form data storage, high frequency enveloping capabilities, 35 frequency ranges from 21 to 1,500,000 cycles per minute, adjustable fast fourier transform resolution from 400 to 6,400 lines, storage for up to one hundred 3,200 line frequency spectra, RS232C data output port, circuitry for integration of acceleration data to velocity or double integration to displacement.

   a. Manufacturers: One of the following or equal:

      1) Entek-IRD, Division of Rockwell Automation, Enpac 1200 with applicable data analysis software or Entek Model 838 analyzer with built in printer.

      2) Computational Systems Inc., (CSI) Division of Emerson Electric, Model 2120A, Data Collector/analyzer with applicable analysis software.

2. Analyzer settings:

   a. Units: English, inches/second, mils, and gravitational forces.

   b. Fast fourier transform lines: Most equipment 1,600 minimum; for motors, enough lines as required to distinguish motor current frequencies from rotational frequencies, use 3,200 lines for motors with a nominal speed of 3,600 revolutions per minute; 3,200 lines minimum for High Frequency Enveloping; 1,600 lines minimum for low speed equipment.

   c. Sample averages: 4 minimum

   d. Maximum frequency (Fmax): 40 times rotational frequency for rolling element bearings, 10 times rotational frequency for sleeve bearings.

   e. Amplitude range: Auto select but full scale not more than twice the acceptance criteria or the highest peak, whichever is lower.

   f. Fast fourier transform windowing: Hanning Window.

   g. High pass filter: Minus 3 dB at 120 cycles per minute for high speed equipment. Minus 3 dB at 21 cycles per minute for low speed equipment.

3. Accelerometers:

a. For low speed equipment: Low frequency, shear mode accelerometer, 500 millivolts per gravitational force sensitivity, 10 gravitational force range, plus/minus 5 percent frequency response from 0.5 hertz to 850 hertz, magnetic mount.

1) Manufacturers: One of the following or equal:

a) Wilcoxon Research, Model 797L.

b) PCB, Model 393C.

b. For high speed equipment: General purpose accelerometer, 100 millivolts per gravitational force sensitivity, 50 gravitational force range, plus/minus 3dB frequency response range from 2 hertz to 12,000 hertz when stud mounted, with magnetic mount holder.

1) Manufacturers: One of the following or equal:

a) Wilcoxon Research, Model 793.

b) Entek-IRD Model 943.

C. Accelerometer mounting:

1. Use magnetic mounting or stud mounting.

2. Mount on bearing housing in location with best available direct path to bearing and shaft vibration.

3. Remove paint and mount transducer on flat metal surface or epoxy mount for High Frequency Enveloping measurements.

D. Vibration testing results presentation:

1. Provide equipment drawing with location and orientation of measurement points indicated.

2. For each vibration measurement take and include appropriate data on equipment operating conditions at the time vibration data is taken; for pumps, compressors, and blowers record suction pressure, discharge pressure, and flow.

3. When Vibration Spectra Data required:

   a. Plot peak vibration velocity versus frequency in cycles per minute.

   b. Label plots showing actual shaft or part rotation frequency, bearing inner and outer race ball pass frequencies, gear mesh frequencies and relevant equipment excitation frequencies on the plot; label probable cause of vibration peaks whether in excess of specification limits or not.

   c. Label plots with equipment identification and operating conditions such as tag number, capacity, pressure, driver horsepower, and point of vibration measurement.

   d. Plot motor spectra on a log amplitude scale versus frequency.

4. For low speed equipment, plot peak vibration displacement versus frequency as well as velocity versus frequency.

5. Provide name of manufacturer and model number of the vibration instrumentation used, including analyzer and accelerometer used together with mounting type.

3.4 TESTING LEVELS

A. Level 1 Quality Control Tests:

1. Level 1 General Equipment Performance Test:

   a. For equipment, operate, rotate, or otherwise functionally test for 15 minutes minimum after components reach normal operating temperatures.

   b. Operate at rated design load conditions.

   c. Confirm that equipment is properly assembled, equipment moves or rotates in the proper direction, shafting, drive elements and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.

2. Level 1 Pump Performance Test:

   a. Measure flow and head while operating at or near the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.

   b. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Section 26 08 00 – Field Electrical Acceptance Tests, Section 40 05 93 – Common Motor Requirements for Process Equipment or the applicable equipment section. Use actual driver for field tests.

   c. Record measured flow, suction pressure, discharge pressure, and make observations on bearing temperatures and noise levels.

3. Level 1 Vibration Test:

   a. Test requirement:

      1) Measure filtered vibration spectra versus frequency in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component.

      2) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.

   b. Equipment operating condition: Test at specified maximum speed.

4. Level 1 Noise Test:

   a. Measure unfiltered overall A-weighted sound pressure level in dBA at 3 feet horizontally from the surface of the equipment and at a mid-point of the equipment height.

B. Level 2 Quality Control Tests:

1. Level 2 General Performance Test:

   a. For equipment, operate, rotate, or otherwise functionally test for at least 2 hours after components reach normal operating temperatures.

   b. Operate at rated design load conditions.

   c. Confirm that equipment is properly assembled, equipment moves or rotates in the proper direction, shafting, drive elements and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.

2. Level 2 Pump Performance Test:

   a. Test 2 hours minimum for flow and head at the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.

   b. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Section 26 08 00 – Field Electrical Acceptance Tests or Section 40 05 93 – Common Motor Requirements for Process Equipment. Use actual driver for field tests.

   c. Test for flow and head at 2 additional conditions; 1 at 25 percent below the rated flow and 1 at 10 percent above the rated flow.

   d. Record measured flow, suction pressure, discharge pressure, and observations on bearing temperatures and noise levels at each condition.

3. Level 2 Vibration Test:

   a. Test requirement:

      1) Measure filtered vibration spectra versus frequency and measure vibration phase in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component; measure actual rotational speeds for each vibration spectra measured using photometric or other tachometer input connected directly to the vibration data collector.

      2) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.

   b. Equipment operating condition: Repeat test requirements at design specified maximum speed and at minimum speed for variable speed equipment.

   c. Natural frequency test of field installed equipment:

      1) Excite the installed equipment and support system in 3 perpendicular planes, use same planes as operating vibration measurement planes, and determine the as-installed natural resonant frequency of the driven equipment, the driver, gears and supports.

      2) Perform test at each bearing housing, at each support pedestal, and for pumps on the suction and discharge piping.

      3) Perform with equipment and attached piping full of intended service or process fluid.

4. Level 2 Noise Test:

   a. Measure filtered A-weighted overall sound pressure level in dBA for each of 8 octave band mid-points beginning at 63 hertz measured at 3 feet horizontally from the surface of the equipment at mid-point height of the noise source.

C. Level 3 Quality Control Tests:

1. Level 3 General Equipment Performance Tests:

   a. For equipment, operate, rotate, or otherwise functionally test for at least 4 hours after components reach normal operating temperatures.

   b. Confirm that equipment is properly assembled, equipment rotates in the proper direction, shafting and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual noise, vibration, or temperatures are observed.

c. Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure and temperature readings using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.

d. Bearing temperatures: During maximum speed or capacity performance testing, measure and record the exterior surface temperature of each bearing versus time.

2. Level 3 Pump Performance Test:

a. Test 4 hours minimum for flow and head at or near the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.

b. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Section 26 08 00 – Field Electrical Acceptance Tests or Section 40 05 93 – Common Motor Requirements for Process Equipment. Use actual driver for field tests.

c. Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 15 minutes; for factory testing, test at other speeds may be omitted if test driver at reduced speeds is used for rated condition testing.

d. Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices are not required by the equipment section) and record observations on noise levels.

3. Level 3 Vibration Test:

a. Requirements: Same as Level 2 vibration test except data taken at each operating condition tested and with additional requirements below.

b. Perform High Frequency Enveloping Analysis for gears and bearings.

1) Measure bearing element vibration directly on each bearing cap in a location close as possible to the bearing load zone that provides a smooth surface and direct path to the bearing to detect bearing defects.

2) Report results in units of acceleration versus frequency in cycles per minute.

c. Perform Time Wave Form analysis for gears, low speed equipment and reciprocating equipment; plot true peak amplitude velocity and displacement versus time and label the period between peaks with the likely cause of the periodic peaks (relate the period to a cause).

d. Plot vibration spectra on 3 different plots; peak displacement versus frequency, peak acceleration versus frequency and peak velocity versus frequency.

4. Level 3 Noise Test: Measure filtered, un-weighted overall sound pressure level in dB at 3 feet horizontally from the surface of the equipment at mid-point height and at 4 locations approximately 90 degrees apart in plan view; report results for each of 8 octave band mid-points beginning at 63 hertz.

D. Level 4 Quality Control Tests:

1. Level 4 General Equipment Performance Test:

a. For equipment, operate, rotate, or otherwise functionally test for at least 8 hours after components reach normal operating temperatures.

b. Operate at rated design load conditions for1/2 the specified time; operate at each of any other specified conditions for a proportionate share of the remaining test time.

c. Confirm that equipment is properly assembled, equipment rotates in the proper direction, shafting and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual noise, vibration, or temperatures are observed.

d. Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure and temperature readings using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.

e. Bearing temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.

2. Level 4 Pump Performance Test:

a. Test 8 hours minimum for flow and head; begin tests at or near the rated condition; for factory and field-testing, test with furnished motor at full speed.

b. Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 20 minutes or longer as necessary to measure required performance, vibration, and noise data at each test condition.

c. Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices not required by the equipment section) and record observations on noise levels.

d. Bearing temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.

e. Perform efficiency and/or Net Positive Suction Head Required (NPSHr) and/or priming time tests when specified in the equipment section in accordance with the appropriate HI standard and as follows:

1) Perform NPSHr testing at maximum rated design speed, head, and flow with test fluids at ambient conditions; at maximum rated speed, test at 15 percent above rated design flow, and 25 percent below rated design flow.

2) Perform efficiency testing with test fluids at maximum rated speed.

3) Perform priming time testing with test fluids at maximum rated speed.

3. Level 4 Vibration Test: Same as Level 3 vibration test.

4. Level 4 Noise Test: Same as Level 3 Noise Test except with data taken at each operating condition tested.

3.5 SOURCE QUALITY CONTROL

A. Test equipment as specified for each type of test at the test levels specified in equipment sections. Prepare and submit test reports as specified.

B. Inspection and balancing:

1. Statically and dynamically balance each of the individual rotating parts as required to achieve the required field vibration limits. Statically and dynamically balance the completed equipment rotating assembly and drive shaft components.

2. Furnish copies of material and component inspection reports including balancing reports for equipment system components and for the completed rotating assembly.

C. Critical speed of rotating equipment: Satisfy the following:

1. The first lateral and torsional critical speed of all constant, variable, and 2-speed driven equipment that is considered rigid such as horizontal pumps, all non-clog pumps, blowers, air compressors, and engines shall be at least 25 percent above the equipment's maximum operating speed.

2. The first lateral and torsional critical speed of all constant, variable, and 2-speed driven equipment that is considered flexible or flexibly mounted such as vertical pumps (vertical in-line and vertical non-clog pumps excluded) and fans shall operate at least 25 percent below the equipment's lowest operating speed.

3. The second lateral and torsional critical speed of all constant, variable, and 2-speed equipment that is considered flexible or flexibly mounted shall be at least 25 percent above the maximum operating speed.

3.6 FIELD QUALITY CONTROL

A. Test equipment as specified for each type of test at the test levels specified in equipment sections. Prepare and submit test reports as specified. Comply with latest version of applicable standards.

B. For variable speed equipment, conduct test to establish performance over the entire speed range and at the average operating condition. Establish performance curves for:

1. The speed corresponding to the rated maximum capacity.

2. The speed corresponding to the minimum capacity.

3. The speed corresponding to the average operating conditions.

3.7 VIBRATION ACCEPTANCE CRITERIA

A. Testing of rotating mechanical equipment: Tests are to be performed by an experienced, factory trained, and independent authorized vibration analysis expert.

B. Vibration displacement limits: Unless otherwise specified, equipment operating at speeds 600 revolutions per minute or less is not to exhibit unfiltered readings in excess of the following:

Operating Speed (revolutions per minute)	Unfiltered (Overall) Peak-to-Peak Amplitude (mils)
	All Rotating Equipment
0 - 300	6.5
301 - 600	4.5
Note: For all equipment, axial shaft displacements not to exceed 50 percent of the maximum radial shaft displacements shown in the table relative to the casing.	

C. Vibration velocity limits: Unless otherwise specified, equipment operating at speeds greater than 600 revolutions per minute is not to exceed the following peak velocity limits:

Item	Unfiltered Overall Limit (inches per second)	Any Filtered Peak Limit (inches per second)
Non-Clog Solids Handling Centrifugal Pumps	0.35	0.25
Horizontal and Vertical In-Line Centrifugal Pumps (other than Non-Clog type)	0.18 (Input BHP 25 or less)	0.14 (Input BHP 25 or less)
	0.22 (Input BHP more than 25 but less than 100)	0.18 (Input BHP more than 25 but less than 100)
	0.25 (Input BHP 100 or more)	0.20 (Input BHP 100 or more)
Vertical Turbine, Mixed Flow, and Propeller Pumps	0.31 (Input BHP 100 or less)	0.22
	0.35 (Input BHP 125 or more)	0.25
Vertical Turbine, Mixed Flow, and Propeller Short Set Pumps	0.28 (Input BHP 100 or less)	0.21
	0.33 (Input BHP 125 or more)	0.24
Motors	See Applicable Motor Specification	
Gear Reducers, Radial	Not to exceed AGMA 6000-A88 limits	
Other Reducers, Axial	0.10	0.10
Centrifugal Fans and Blowers	0.15	0.10
Other Equipment, Radial	0.16	0.10
Other Equipment, Axial	0.10	0.10

D. Equipment operation: Measurements are to be obtained with equipment installed and operating within capacity ranges specified and without duplicate equipment running.

E. Additional criteria:

1. No narrow band spectral vibration amplitude components, whether sub-rotational, higher harmonic, or synchronous multiple of running speed, are to exceed 40 percent of synchronous vibration amplitude component without manufacturer's detailed verification of origin and ultimate effect of such excitation.

2. The presence of discernable vibration amplitude peaks in Test Level 2 or 3 vibration spectra at bearing inner or outer race frequencies shall be cause for rejection of the equipment.

3. For motors, the following shall be cause for rejection:

   a. Stator eccentricity evidenced by a spectral peak at 2 times electrical line frequency that are more than 40 percent of the peak at rotational frequency.

   b. Rotor eccentricity evidenced by a spectral peak at 2 times electrical line frequency with spectra side bands at the pole pass frequency around the 2 times line frequency peak.

   c. Other rotor problems evidenced by pole pass frequency side bands around operating speed harmonic peaks or 2 times line frequency side bands around rotor bar pass frequency or around 2 times the rotor bar pass frequency.

   d. Phasing problems evidenced by 1/3 line frequency side band spectral peaks around the 2 times electrical line frequency peak.

4. The presence of peaks in a High Frequency Enveloping spectra plot corresponding to bearing, gear or motor rotor bar frequencies or harmonics of these frequencies shall be cause for rejection of the equipment; since inadequate lubrication of some equipment may be a cause of these peaks, lubrication shall be checked, corrected as necessary and the high frequency envelope analysis repeated.

3.8 NOISE REQUIREMENTS AND CONTROL

A. Make measurements in relation to reference pressure of 0.0002 microbar.

B. Make measurements of emitted noise levels on sound level meter meeting or exceeding ANSI S1.4, Type II.

C. Set sound level meter to slow response.

D. Unless otherwise specified, maximum free field noise level not to exceed 85 dBA measured as sound pressure level at 3 feet from the equipment.

3.9 FUNCTIONAL AND OPERATIONAL TESTING OF EQUIPMENT

A. Functional testing as specified in Section 01 75 00 – Equipment Testing and Startup Procedures and this Section.

B. General checkout: Prior to operating equipment, inspect, test, and check supporting systems, including but not limited to power systems, control systems, piping systems, lubrication systems, and safety systems.

   1. Test and calibrate instrumentation and electrical devices as recommended by the manufacturer.

   2. Test and prepare piping as specified in Section 31 23 33 - Trenching and Backfilling and Section 40 05 00 - Piping, General.

3. As a minimum for control systems associated with the equipment, perform the following:

   a. Individual Loop Tests: Test from field device to intermediate terminations to controller and back to controlled element.

   b. End-to-end test: Simulate input at field device and observe control system response at the final field control element.

4. Prior to testing, provide signed and dated certificates of calibration for test instrumentation and equipment.

C. Operation of related existing equipment: Owner will operate related existing equipment or facilities necessary to accomplish the testing.

D. Acceptable tests: Demonstrate the equipment performance meets the requirements of this Section and the equipment section; when the equipment fails to meet the specified requirements, perform additional more detailed testing to determine the cause, correct, repair, or replace the causative components and repeat the testing that revealed the deficiency.

E. Operational testing: As specified in Section 01 75 00 – Equipment Testing and Startup Procedures and individual equipment specifications.

END OF SECTION 43 05 60

SECTION 43 11 33 – POSITIVE DISPLACEMENT LOBE BLOWERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide positive displacement lobe blower for the aerobic digesters in the existing digester blower building (Structure G1).

B. Furnish blowers complete with intake filter, intake and discharge silencers, pressure relief valve, motor, coupling, base plate, and all appurtenances specified. Complete unit shall be assembled at the manufacturer's factory so that testing of operation can be conducted and then disassembled for shipment to the jobsite.

C. Blower package will be installed by the Contractor.

1.2 QUALITY ASSURANCE

A. The blower shall be factory performance tested prior to shipment. A factory slip test of 1 psi shall be conducted. In addition, a performance test in accordance with ASME PTC-9 (latest revision) shall be conducted. Certified test results shall be submitted.

B. Blower and blower accessories described by this Section shall be furnished by one supplier who shall be responsible for equipment start-up and the blower warranty.

C. Warranty: Manufacturer shall warrant all parts to be free from defects in materials and workmanship for a period of three (3) years after installation. Manufacturer shall replace any items found to be defective within the three (3) year period.

1.3 SUBMITTALS

A. The following submittals shall be made in accordance with Section 01 33 00:

1. Motor data submittal information.

2. Drawings showing general dimensions and confirming blower's piping connections, construction details, wiring diagrams and weight of major components.

3. Parts list noting materials of construction.

4. Performance curves showing rated capacity, pressure, horsepower, and efficiency. Data shall include predicted temperature increase at each specified operating condition.

5. Lubrication requirements.

6. Estimation of bearing life.

7. Manufacturer's descriptive literature for valves, intake filter and inlet and discharge silencers, including dimensional drawings, materials of construction and weights. Include noise attenuation data for silencers and particle removal efficiency data for filter.

B. Operation and Maintenance Manual consistent with Section 01 78 23 – Operation and Maintenance Data and including the following information:

1. V-belt drive adjustment instructions including sheave changes to adjust blower rotary speed

PART 2 - PRODUCTS

2.1 ENVIRONMENTAL CONDITIONS

A. Outdoor Air Temperature: 10 degrees F to 105 degrees F

B. Indoor Air Temperature: 40° to 90°F

C. Relative Humidity: 32% - 85%

D. Altitude: 4,400 feet MLS datum.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. The blowers shall meet the following performance requirement: 530 scfm @ 5 psi discharge pressure to match existing blowers

B. The blower shall be of the positive displacement type and rated for continuous duty.

C. Balance: Accurately machine rotating parts and place these parts in as perfect rotational balance as practicable.

1. The mass of each unit shall be such that resonance at normal operating speeds is avoided.

2. Excessive vibration shall be sufficient cause for rejection of the equipment.

2.3 CONSTRUCTION

A. Materials

1. Casing and Impellers: Cast or ductile iron

2. Shaft: High carbon steel or ductile iron; turned, ground, and polished

3. Timing Gears: Alloy steel

4. Bearings: Antifriction, grease packed or oil lubricated. AFBMA rated L10 for 60,000 hours minimum life, continuous operation

5. Base: Fabricated steel; minimum moment of inertia 20 inches to the fourth power in X axis

6. Vibration Isolators: Rubber, Cork, or Cork-Rubber

7. Gaskets (if applicable): Durabala, Durlon 8500 Green

B. Casing

1. One piece with headplate(s).

2. Design to withstand at least twice the specified discharge pressure and reinforce with integrally cast ribs.

C. Impellers

1. Reinforced by internal ribs with outside surfaces machined.

2. Two lobe involute type, straight, and operate without rubbing.

3. Operate without liquid seals or lubrication and be positively timed by a pair of accurately machined heat-treated alloy steel, spur tooth, timing gears.

4. Statically and dynamically balance each impeller.

5. Impeller permanently fastened or part of the shaft.

D. Shaft

1. Cast integrally with the impeller or shall pass completely through the impeller, or stub shafts with impeller securely fastened.

E. Timing Gears and Lubrication

1. Mount on impeller shafts on a tapered fit and properly secured.

2. Enclosed in oil-tight housings.

3. Timing gears and bearings splash oil lubricated from oil slingers mounted on the driven shaft and dipping in oil.

4. Provide a lip type or piston ring oil seal, designed to prevent lubricant from leaking into the air stream.

5. Provide rotary piston ring shaft seals at the point where the shaft passes through the headplate.

6. Make provision to vent the impeller side of the oil seal to atmosphere to eliminate carry-over of lubrication into the air stream.

7. Provide lubricant level sight glass.

F. Drives

1. Type: Simple V-belt

2. V-belt Sheaves: Split tapered keyed hubs

3. V-belt drive guard

a. Enclose V-belt drives in a separate OSHA-approved sheet metal guard.

b. Guards of rugged design and fabricated from 16 gage steel (minimum).

c. Smooth exterior finish.

G. Base

1. Mount each blower and motor unit on a single full-length base with anchor bolt holes and jack screws for leveling.

2. If fabricated steel bases are furnished, continuously weld and grind smooth all seams and contact edges, plates and shapes. The base shall have an OSHA approved coupling guard and also anchor bolt holes and jack screws for leveling.

3. If cast iron bases are furnished, machine mounting surfaces.

4. Mount each base on suitable isolation pad.

2.4 ACCESSORIES

A. Inlet Filter: The inlet filter shall be of heavy-duty construction. The removal efficiency shall be 99.5 percent on 2-micron particles and 97 percent on 1-micron particles. The maximum initial pressure drop across the filter at the rated flow shall not exceed 2.5 inches W.C.

B. Inlet/Outlet Silencer: The inlet/outlet silencers shall be a chamber-absorptive type designed to provide pulse and noise control. The silencer shall be heavy duty, all welded construction, of carbon steel sheet and plate. Inlet and discharge nozzles shall be flanged. Exterior surfaces shall be shop-coated with a rust inhibitive primer and finish painted in the field. The silencer shall feature a drain plug. The blower inlet silencer shall be RIS series silencer and the blower discharge silencer shall be RD series silencer, both as manufactured by Universal Silencer, or preapproved equals.

C. Valves: A weight-loaded type pressure relief valve shall be provided on the blower discharge. The relief valve shall be sized to discharge 100 percent of the blower capacity and shall be set 0.5 psig above maximum blower discharge pressure.

D. Flexible Connectors: The blower shall be provided with single arch flexible connectors on the outlet and inlet to eliminate any stresses on the blower. The flexible connectors shall have flanged ends suitable for service pressure of 15 psig maximum and 300°F temperature. The connector shall be constructed of chlorobutyl with a fiberglass/Kevlar fabric and shall be specifically designed for service at elevated temperatures.

E. Pressure Gauges: Each blower shall be provided with a 0-20 psig dial type discharge pressure gauge, a 0-20 inch water column dial type inlet vacuum gauge, and a 0-350°F dial type temperature gauge connected to the discharge piping. Furnish with compatible fittings for mounting to tap in side of blower piping.

1. Pressure Gauges:

a. Inlet: Provide a Dwyer Series 2000 Magnehelic, Manotherm/Beierfeld, or preapproved equal. The range shall be a minimum of 0 to 20 inches water column vacuum and provided with vent valve.

b. Discharge: Provide a stainless steel case, stem mount gauge with a shatter resistant window and a minimum 2 ½-inch diameter face. The gauge shall be oil-filled measured units in psi and suitable for use with 275°F process air.

c. Minimum Accuracy: plus or minus 1% of full scale

d. Minimum Measurement Range: 0 to 20 psig

e. Manufacturer

1) Ashcroft Type 1009 Duralife

2) Manotherm/Beierfeld

3) Or preapproved equal

F. V-Belts and Sheaves: The blowers shall be driven by a motor utilizing a V -belt and sheaves which shall be designed for a minimum service factor of 1.5. Two sets of V-belts and one set of sheaves shall be supplied for each operating condition specified.

G. Vibration Sensor: A vibration sensor and cut-out switch shall be included to shut down the unit in the event of excessive vibration.

H. Vibration Isolation Pad: Suitable vibration isolators shall be furnished with the blower base.

2.5 MOTORS

A. Polyphase induction design, rating and speed to meet blower requirements with a 1.15 service factor. The service factor shall not be used in establishing the nameplate rating.

B. Horizontal, TEFC, 1800 rpm (nominal, maximum). Power: 480 volts, 3 phase 60 hertz. Motor shall not overload over range of inlet air temperatures and discharge pressures. Blower shall have a maximum motor size of 25 hp.

C. Motors shall be high efficiency as tested per IEEE Procedure 112A, Method B.

D. Motor shall be provided with an OSHA approved belt guard.

E. Motors shall meet requirements specified in Section 40 05 93 – Common Motor Requirements for Process Equipment.

2.6 CONTROLS

A. Provide blower control panel for new blower with disconnect, HOA, and reset button in NEMA4 panel.

2.7 SPARE PARTS

A. The following spare parts, unless not applicable to a certain blower, shall be furnished for each blower unit:

Blower Spare Parts	Quantity Furnished
Shaft Bearings	2
End Cover Oil Seal	1
Main Oil Seals	2
Gear Keys	1 pair
End Cover O-Rings	1
Gearbox Gasket	1
Gear End Bearing Carrier Gasket	1
Drive Belts	1

2.8 ANCHORAGE AND FASTENERS

A. GENERAL

1. The Contractor shall furnish all anchoring hardware for the supplied equipment.

2. The Contractor shall furnish all epoxy and dispensing equipment for chemical anchoring.

3. The Blower Supplier shall provide anchor bolt calculations sealed by a civil or structural engineer currently registered in the State of Idaho.

2.9 MANUFACTURER

A. The blower shall be furnished by one of the following manufacturers:

1. Gardner Denver

2. MD Pneumatics

3. Aerzen

4. Tuthill Vacuum & Blower Systems

5. Or approved equal.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Follow manufacturer’s recommendations for equipment storage and handling.

B. Ship with openings sealed after injection of rust inhibiting powder.

C. Protect equipment, materials and accessories form exposure to the elements and keep thoroughly dry.

D. Store blowers, blower accessories, motors, and electrical equipment in a weather-tight warehouse or comparable enclosure.

E. Box, crate and properly wrap and protect all spare parts.

F. Label spare parts containers indicating contents.

G. Hand rotate motor and blower shafts at frequency required by manufacturer to keep bearings properly lubricated and prevent flat spots form forming.

3.2 INSTALLATION

A. Manufacturer's representative shall visit the site to certify that the equipment specified herein has been properly installed.

B. The manufacturer shall provide the services of a qualified factory representative for two (2) trips including a total of four (4) workdays to advise the Contractor on proper installation, setting, piping, wiring procedures, and provide operator training.

C. Manufacturer shall provide a written field test / start up report after completion of testing.

D. The manufacturer’s representative shall provide onsite operation and maintenance training to the Owner’s personnel for a minimum of two (2) hours. The Contractor shall video tape the training session and provide an electronic copy to the Owner.

END OF SECTION 41 11 33

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SECTION 43 20 00 – PUMPS, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide and install all pumps and pumping appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section apply to all pumps and pumping equipment except where otherwise indicated in the Contract Documents.

C. Unit Responsibility: The pump manufacturer shall be made responsible for furnishing the Work and for coordination of design, assembly, testing, and installation of the Work of each pump section; however, the Contractor shall be responsible to the Owner for compliance with the requirements of each pump section.

D. Single Manufacturer: Where two (2) or more pump systems of the same type or size are required, the pumps shall all be produced by the same manufacturer.

1.2 REFERENCE STANDARDS

A.	ANSI/IEEE 112	Test Procedure for Polyphase Induction Motors and Generators
B.	ANSI/IEEE 115	Test Procedure for Synchronous Machines
C.	ANSI/HI 9.6.4	Centrifugal and Vertical Pumps – Vibration Measurements and Allowable Values
D.	ANSI/HI 14.6	Rotodynamic Pumps for Hydraulic Performance Acceptance Tests
E.	ASTM A 48	Gray Iron Castings
F.	ASTM B 62	Composition Bronze or Ounce Metal Castings,
G.	ASTM B 584	Copper Alloy Sand Castings for General Applications
H.	ANSI/ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
I.	ANSI/ASME B16.5	Pipe Flanges and Flanged Fittings

1.3 SUBMITTALS

A. Shop Drawings shall be submitted in accordance with Section 01 33 00 – Submittal Procedures. At a minimum, the following information shall be submitted with each pump supplied:

1. Pump name, identification number, and specification section number.

2. Performance data curves showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump. The equipment manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions and the maximum and minimum flow conditions. Performance curves at intervals of 100 rpm from minimum speed to maximum speed shall be furnished for each centrifugal pump equipped with a variable speed drive.

3. The Contractor shall require the manufacturer to indicate the limits on the performance curves recommended for stable operation without surge, cavitation, or excessive vibration. The stable operating range shall be as wide as possible based on actual hydraulic and mechanical tests.

4. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

5. Data, in accordance with Section 40 05 93 – Common Motor Requirements Process Equipment, for the electric motor proposed for each pump.

6. Elevation of proposed local control panel showing panel-mounted devices, details of enclosure type, single line diagram of power distribution, and current draw of panel, and list of all terminals required to receive inputs or to transmit outputs from the local control panel.

7. Wiring diagram of field connections with identification of terminations between local control panels, junction terminal boxes, and equipment items.

8. Complete electrical schematic diagram.

B. Technical Manual: The Technical Manual shall contain the required information for each pump section in accordance with Section 01 78 23 – Operation and Maintenance Data.

C. Spare Parts List: A spare parts list shall contain the required information for each pump section.

D. Factory Test Data: Signed, dated, and certified factory test data for each pump system which requires factory testing, submitted before shipment of equipment.

E. Certifications: The Contractor shall provide Manufacturer's certification of proper installation and certification of satisfactory field testing.

1.4 FACTORY TESTING

A. Motors: Electric motors shall be tested in accordance with Section 40 05 93 – Common Motor Requirements for Process Equipment.

B. The following minimum test results shall be submitted:

1. At maximum speed, a minimum of five hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, recorded on data sheets as defined by the Hydraulic Institute. For variable speed driven pumps, each pump shall be tested between maximum and minimum speed at 100 rpm increments.

2. Pump curves showing head, flow, bhp, and efficiency requirements. Include calculated NPSH required curve and certification that the pump shaft horsepower demand did not exceed the rated motor horsepower of 1.0 service rating at any point on the curve.

C. Acceptance: In the event of failure of any pump to meet any of the requirements, the Contractor shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and the pump shall be retested until found satisfactory.

PART 2 - PRODUCTS

2.1 GENERAL

A. All components that are in contact with potable water shall be certified to NSF Standard 61.

B. Compliance with the requirements of the individual pump sections may necessitate modifications to the manufacturer's standard equipment.

C. Performance Curves: All centrifugal pumps shall have a continuous rising curve or the system operating range shall not cross the pump curve at two different capacities or "dip region." Unless indicated otherwise, the required pump shaft horsepower at any point on the performance curve shall not exceed the rated horsepower of the motor or engine or encroach on the service factor.

D. Each unit of pumping equipment shall incorporate all basic mechanisms, couplings, electric motors or engine drives, variable speed controls, necessary mountings, and appurtenances.

E. Redundancy: Unless otherwise specified, the Contractor shall provide pumps for each intended service in a “1 x 2” lead/lag configuration. For each service a minimum of two pumps shall be provided, unless otherwise specified, each sized to meet design flow conditions.

2.2 MATERIALS

A. All materials shall be suitable for the intended application; materials not indicated shall be high-grade, standard commercial quality, free from all defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements.

Casings and Bowls	Cast iron pump casings and bowls shall be of close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or equal.
Impellers	Bronze pump impellers shall conform to ASTM B 62 - Composition Bronze or Ounce Metal Castings, or B 584 - Copper Alloy Sand Castings for General Applications, where dezincification does not occur.
Shafts	Stainless steel pump shafts shall be Type 416 or 316. Miscellaneous stainless steel parts shall be Type 316.
Anchor Bolts	Anchor bolts, washers, and nuts in non-corrosive areas, shall be galvanized steel. Anchor bolts, washers, and nuts in corrosive or submerged conditions shall be stainless steel.

2.3 PUMP COMPONENTS - GENERAL

A. Flanges and Bolts: Suction and discharge flanges shall conform to ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800 or ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings dimensions.

B. Lubrication: Vertical pump shafts of clean water pumps shall be product water lubricated, unless otherwise indicated. Deep-well pumps and pumps with dry barrels shall have water- or oil-lubricated bearings and seals and enclosed line shafts. Pumps for sewage, sludge, and other process fluids shall be lubricated as indicated.

C. Handholes: Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.

D. Drains: All gland seals, air valves, cooling water drains, and drains from variable speed drive equipment shall be piped to the nearest floor sink or drain, with galvanized steel pipe or copper tube, properly supported with brackets.

E. Mechanical Seals: Mechanical seals shall be fresh water-flushed unless indicated otherwise; in which case product water cleaned by a solids separator as manufactured by Lakos, or equal.

1. Mechanical seals shall be as manufactured by the following, or equal:

Potable and Raw Water Pumps	Double Seals	John Crane Type 3710, Flowserve Type PSS2, Chesterton Type 442
	Single Seals	John Crane Type 88SRS, Flowserve Type ISCPX, Chesterton Type UV, GSS or 155

2. Mechanical seals for all services shall be equipped with non-clogging, flexible-mounted seats with elastomer secondary seals. Wetted metal parts shall be Type 316 stainless steel, Alloy 20, or Hastelloy B or C, whichever has the best corrosion resistance to the pumped fluid. Dual cartridge seals shall be double balanced to allow for seal integrity in case of flush water pressure reversal. All single and double seals shall have springs in the non-wetted end of the seal.

3. Fresh water shall be delivered to the seals through appropriate size piping with plug valves, strainers, pressure regulators, electrically operated solenoid valves, and rotameters. Wiring shall comply with Division 26 and solenoid control shall comply with Division 40.

2.4 PUMP APPURTENANCES

A. Nameplates: Each pump shall be equipped with a stainless steel nameplate indicating serial numbers, rated head and flow, impeller size, pump speed, and manufacturer's name and model number.

B. Solenoid Valves: The pump manufacturer shall provide solenoid valves on the water or oil lubrication lines and on all cooling water lines. Solenoid valve electrical ratings shall be compatible with the motor control voltage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Pumping equipment shall be installed in accordance with the manufacturers' written recommendations.

B. Alignment: All equipment shall be field tested to verify proper alignment and freedom from binding, scraping, shaft runout, or other defects. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.

C. Lubricants: The Contractor shall provide the necessary oil and grease for initial operation.

3.2 SERVICES OF MANUFACTURER

A. Instruction of the Owner's Personnel: An authorized training representative of the manufacturer shall visit the Site for the number of days as indicated in the individual pump specification to instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.

1. The representative shall have at least two (2) years' experience in training. A resume for the representative shall be submitted a minimum of 4 weeks prior to the site visit.

2. Training shall be scheduled a minimum of three (3) weeks in advance of the first session.

3. Proposed training material and a detailed outline of each lesson shall be submitted for review. Comments shall be incorporated into the material.

4. The training materials shall remain with the trainees. The Owner may videotape the training for later use with the Owner's personnel.

3.3 FIELD TESTING

A. Test Protocols: Startup, check, and operate the pump system over its entire speed range. If the pump is driven by a variable speed drive, the pump and motor shall be tested at 100 RPM increments. If the pump is driven at constant speed, the pump and motor shall be tested at max RPM. Unless otherwise indicated, vibration shall be within the amplitude limits recommended by the Hydraulic Institute Standards at a minimum of four pumping conditions defined by the Engineer.

1. Obtain concurrent readings of motor voltage, amperage, pump suction head, and pump discharge head for at least 4 pumping conditions at each pump rotational speed if variable speed at 100 RPM increment or at max RPM if constant speed. Check each power lead to the motor for proper current balance.

2. Determine bearing temperatures by contact type thermometer. A run time until bearing temperatures have stabilized shall precede this test unless insufficient liquid volume is available.

3. Electrical and instrumentation tests shall conform to the requirements of the sections under which that equipment is specified.

4. Field testing will be witnessed by the Engineer. The Contractor shall furnish 3 days advance notice of field testing.

B. In the event any pumping system fails to meet the indicated requirements, the pump shall be modified or replaced and re-tested as above until it satisfies the requirements.

C. After each pumping system has satisfied the requirements, the Contractor shall certify in writing that it has been satisfactorily tested and that all final adjustments have been made. Certification shall include the date of the field tests, a listing of all persons present during the tests, and the test data.

D. The Contractor shall be responsible for all costs of field tests, including related services of the manufacturer’s representative, except for power and water, which the Owner will bear. If available, the Owner's operating personnel will provide assistance in field testing.

3.4 PROTECTIVE COATING

A. Materials and equipment shall be coated according to the Manufacturer’s written instructions.

END OF SECTION 43 20 00

43 23 57.01 – PROGRESSING CAVITY SLUDGE PUMPS (THIN SLUDGE)

PART 1 - GENERAL

1.1 DESCRIPTION

A. SCOPE: This section specifies positive displacement progressing cavity pumps, complete with electric motors, and all specified appurtenances, as shown on the plans and specified herein. Pumps shall be used to pump aerobically digested waste activated sludge from a solid holding tank to a dewatering press.

B. The pumps shall be controlled by the screw press control panel.

C. TYPE: The pumping units shall be of the self-priming, positive displacement, progressing cavity type specifically designed for pumping the specified wastewater sludge.

D. EQUIPMENT LIST

Item	Equipment Number
Dewatering Feed Pumps	P-8001, P-8002

E. PERFORMANCE AND DESIGN REQUIREMENTS

1. Sludge handling pumps shall be specifically designed and selected for continuous duty pumping of liquids with the following properties:

Percent Solids	1% - 3%
Specific Gravity	Approx. 1.0
Solids Size	<1”
pH	5.5-8.0
Temperature	50-80 F

2. The pumps shall be of the compact, close-coupled design. The gear reducer shall be sized for a minimum service factor of 1.5 and designed with a thrust load capability of 150 percent of the actual thrust load.

3. The pumps, along with associated drive appurtenances, shall be mounted on common fabricated steel baseplates.

4. Manufacturers must currently have installations for the same liquids and of the same size pump unit, in service for a minimum of three years. Manufacturers not named in this specification must also provide a pre-submittal package to the engineer no less than three weeks prior to the bid date for approval. The pre-submittal package must include, at minimum, the following: dimensional drawing, performance curve, O&M manual, electrical/drive details, installation list (for the same liquids as specified) with minimum three contacts and phone numbers.

F. OPERATING CONDITIONS:

The progressing cavity pumps shall have the following operating characteristics:

Equipment Service	Rated Capacity, gpm	Differential Pressure psi	Maximum pump speed, rpm	Suction and discharge port size, in	Motor hp	Drive
Dewatering Feed Pumps	17 - 60	55	328	3” Suction, 4” Discharge	7.5	Variable Speed from inverter

1.2 REFERENCES

A. This section contains references to the following documents. They are part of this section as specified and modified. In case of conflict between the requirements of the section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
AGMA 6010-E-88	Spur, Helical, Herringbone, and Bevel Enclosed Drive
AGMA 6019-E-89	Gear Motors Using Spur, Helical, Herringbone, Straight Bevel, or Spiral Bevel Gears
AGMA 6023-A88	Design Manual for Enclosed Epicyclic Gear Drives

1.3 ENVIRONMENTAL CONDITIONS

A. Pumps to be provided under this section will be installed indoors in a heated building.

1.4 SUBMITTALS

A. The following information shall be provided.

1. Manufacturer's data including materials of construction and equipment weight.

2. Predicted performance curves.

3. Motor data.

4. Universal joint warranty.

5. A copy of this specification section with addenda updates, and all referenced sections with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.

1.5 QUALITY ASSURANCE

A. Pump, motor, and controls shall be coordinated by the Contractor to provide operable pumping systems as indicated by the drawings and specifications. The motor horsepower shall not be exceeded when the pump is operating anywhere on its curve.

B. Manufacturers: Firms regularly engaged in manufacture of pumping equipment of types required, whose equipment has been in satisfactory use in similar service for not less than 5 years.

C. Provide pumps in this Section from the same manufacturer.

D. Witnessing: Factory testing shall not be witnessed by the Engineer or Owner.

E. Equipment performance test: Test level as scheduled; test as specified in Section 43 05 60 – Process Equipment Testing.

F. Vibration test: Test level as scheduled; test as specified in Section 43 05 60 – Process Equipment Testing.

G. Noise test: Test level as scheduled; test as specified in 43 05 60 – Process Equipment Testing.

H. Hydrostatic pressure tests: As specified for components in this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 43 05 01 – Equipment General Provisions.

1.7 WARRANTY

A. A written manufacturer warranty shall be provided. The warranty shall be for a minimum period of one (1) year from the date of Substantial Completion. Manufacturer shall repair or replace all defects of materials or workmanship in the equipment during the warranty period.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Seepex BN-6LS

B. Or approved equal.

2.2 MATERIALS

Component	Material - Sludge Pumps
Rotor	1.0503 (C45)/AISI 1045 – Ductile chromium coating
Stator	Buna N
Pump Body	Cast iron
Shaft Sealing	Seepex single bellows seal

2.3 EQUIPMENT

A. ROTOR AND STATOR:

Each pump shall be a one stage design employing a convoluted rotor operating in a similarly convoluted stator. The convolutions shall be configured to form a cavity between the rotor and stator, which shall progress from the pump's inlet to discharge port with the operation of the rotor. The fit between the rotor and stator at the point of contact shall compress the stator material sufficiently to form a seal and to prevent leakage from the discharge back to the inlet end of the pumping chamber. Stators for sludge pumps shall have Buna elastomer. The sludge pump rotors shall be constructed of hardened tool steel. Additionally, the sludge pump rotors shall have a chromium nitride coating (Duktil process) with a minimum thickness of (.0108").

1. Stators shall be replaceable without dismantling the pump suction or discharge flanges or any associated piping. Pumps that require additional space for axial/horizontal removal of the stator shall not be allowed. Stator designs shall additionally incorporate a re-tensioning feature to compensate for wear in lieu of increasing pump speed.

2. Rotors shall be replaceable without dismantling the pump suction or discharge flanges or associated piping. Pumps that require additional space for axial/horizontal removal of the rotor shall not be allowed. The rotor design shall include provisions so that rotor replacement does not require the disassembly of either universal joint.

B. DRIVE TRAIN:

The drive train shall be warranted for one (1) year from acceptance and shall consist of the following:

1. Each pump rotor shall be driven through a positively sealed and lubricated pin joint. The pin joint shall have replaceable bushings, constructed of air-hardened tool steel of 57-60 HRc, in the rotor head and coupling rod. The pin shall be constructed of high speed steel, air hardened to 60-65 HRc. The joint shall be grease lubricated with a high temperature (450° F), PTFE filled synthetic grease, covered with Buna N sleeve, and positively sealed with hose clamps constructed of 304 stainless steel.

C. CASINGS: A 150-pound (ANSI B16.5 RF) flanged connection shall be provided at both the inlet and discharge ports. The suction casing shall employ two opposed cleanout openings to facilitate removal of debris without dismantling the pump or pipework.

D. BEARINGS: Each pump shall be provided with oil lubricated thrust and radial bearings, located in the gearmotor, designed for all loads imposed by the specified service. Minimum bearing L-10 shall be 50,000 hrs.

E. SHAFT SEALING: Shaft shall be sealed using a single internal mechanical seal as specified in Section 2.02. The shaft shall be solid through the sealing area, but of a two part design which allows the rotating unit to be removed from the pump without disassembly of the gearmotor bearings. Seal materials shall be solid silicon carbide faces with 316 stainless steel metal parts and Viton elastomers.

F. MOTOR AND DRIVE UNIT:

1. Gear motors or gear reducers shall be designed in accordance with AGMA 6019-E (Class II). Unless otherwise noted, motors shall be energy-efficient, TEFC motors. Where shown on the drawings, pumps shall be provided with right angle gearboxes.

2. Pumps that require variable frequency drives (VFDs) are noted in paragraph 1.1.F. VFDs shall be constant torque type. For VFD-driven units, the pump supplier shall be responsible for the provision of the fixed reduction between the motor and pump. The reduction ratio shall be that required to operate the pump at its maximum operating speed when the motor is operating at its nominal rated full speed in accordance with the schedule in paragraph 1.1.F. VFD-driven units may be operated at up to 60 Hz at the maximum speed.

2.4 ACCESSORIES:

A. RUN DRY PROTECTION: The stator shall be fitted with a sensor sleeve and thermistor sensor. A controller shall also be provided and shall be installed by the contractor in the motor control center. The controller shall monitor the stator temperature and activate a shutdown and alarm sequence if the stator temperature reaches the adjustable limit on the controller. The controller shall include a manual local and remote reset function. Input to the controller shall be 1x115VAC/60 Hz.

2.5 STANDBY COMPONENTS

A. One set of special tools shall be provided to service the pumps.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer’s instructions and as specified in Section 43 20 00 – Pumps, General

B. General installation requirements shall be as specified for “Execution” in Section 43 20 00 – Pumps, General.

3.2 COMMISSIONING

A. The manufacturer shall provide the services of a qualified factory representative for one (1) trip including a total of three (3) workdays to advise the Contractor on proper installation, setting, piping, wiring procedures, and provide operator training as specified in Section 01 75 16 – Startup Procedures.

B. Contractor shall demonstrate to Owner and Engineer that the pump system meets the service conditions and provide a short report showing the flows and pressures and a red-lined pump curve with the flow, pressure, efficiency, and horsepower indicated.

C. Manufacturer shall inspect system before initial start-up and certify that system has been correctly installed and prepared for start-up as specified in this Section, Section 43 05 01 – Equipment General Provisions, and Section 43 20 00 – Pumps, General.

D. Training: Manufacturer shall provide training to Owner's staff. Training shall be for a minimum of 3 hours and shall cover standard operating and preventive maintenance procedures. The Contractor shall videotape the training and provide a copy to Owner.

END OF SECTION 43 23 57.01

SECTION 43 25 00 – SUBMERSIBLE NON-CLOG PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install submersible non-clog pumping equipment, associated appurtenances and controls as specified herein and as shown on the Drawings.

1.2 REFERENCE STANDARDS

A.	ASTM - A36/A36M-04	Standard Specification for Carbon Structural Steel
B.	ASTM A 48/A 48M	(2008) Standard Specification for Gray Iron Castings
C.	NFPA 820	Standard for Fire Protection in Wastewater Treatment and Collection Facilities

D. NEMA Standards Publication MG 1-1998 (latest version) Motors and Generators

E. National Electric Code (NEC)

1.3 SUBMITTALS

A. Shop Drawings, at a minimum, shall have the following information and be submitted with each pump supplied:

1. Pump performance curves showing the following:

   a. Head, capacity, horsepower demand, NPSH required, pump efficiency over the entire operating range of the pump, performance curves at intervals of 5 Hz from minimum speed to maximum speed for each centrifugal pump equipped with a variable speed drive; the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions and the maximum and minimum flow conditions; and

   b. The limits on the performance curves recommended for stable operation without surge, cavitation, or excessive vibration with the stable operating range as wide as possible based on actual hydraulic and mechanical tests.

2. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights

3. Bearing life calculations

4. Rail system

5. Typical installation guides

6. Electrical motor data

7. Technical manuals and parts list

8. Printed warranty

9. Management system certificate ISO 9001

10. Manufacturer’s equipment storage recommendations

B. Factory Test Data shall be signed, dated, and certified factory test data for each pump system which requires factory testing, submitted before shipment of equipment.

C. The Contractor shall provide Manufacturer's Certification of proper installation and certification of satisfactory field testing.

D. Submit Owner’s Manual as specified in Special Provisions, to include operation and maintenance data and other information for the equipment.

1.4 QUALITY ASSURANCE

A. Pump, motor, and controls shall be coordinated by the Contractor to provide operable pumping systems as indicated by the Drawings and Specifications.

B. The motor horsepower shall not be exceeded when the pump is operating anywhere on its curve.

C. Pump seals shall be designed for complete water-tightness at 65 feet submergence for 30 minutes, and data on factory testing and quality control shall be submitted with the Shop Drawings.

D. Firms regularly engaged in manufacturing of pumping equipment of types required whose equipment has been in satisfactory use in similar service for not less than 5 years. Manufacturer shall have authorized factory warranty service for pumps supplied available within 50-mile driving distance of the Owner.

E. The Contractor shall correct all defects in the pumping system upon notification from the Owner within 1 year from the date of Substantial Completion. Corrections shall be completed within 5 days after notification.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. Submersible Wastewater Pumps shall be submersible non-clog wastewater pumps capable of pumping secondary effluent sewage in a NEC Class 1, Division 1, Group D hazardous location. Pumps are to be furnished and installed at the following locations:

1. (3) Three identical pumps shall be furnished and installed in the tertiary lift station (Structure D1).

2. (2) Two identical pumps shall be furnished and installed in the decant lift station (Structure G2).

B. The submersible pumps shall have a semi open multi vane self-cleaning impeller designed to transport wastewater with fibrous materials like wet wipes. Pumps shall be capable of pumping sewage under the following conditions of service:

C. Operating Conditions

P-4301, P-4302, P-4303		
Criteria	Unit	Value
Design Flow Capacity (per pump) Max. point	gpm	601
Design Flow Pump Head, TDH	ft	35.5
Design Flow minimum efficiency (wire-to-water)	Percent	71.9
Max Net Positive Suction Head Required	ft	13
Driver		
Duty	Continuous	
Drive	Variable Speed	
Maximum Pump Speed	rpm	1745
Maximum Motor Speed	rpm	1745
Maximum Motor Size	hp	10
Service Conditions		
Fluid Service	Wastewater-Secondary Effluent	
Ambient Environment	Wet well, submerged	
Ambient Temperature	Degrees F	30 to 120
Ambient Relative Humidity	Percent	30 to 100
Fluid Temperature	Degrees F	40 to 80
Fluid pH Range		5 to 8.5
Fluid Specific Gravity		1.0
Project Site Elevation	Feet	4384

P-7010, P-7020		
Criteria	Unit	Value
Design Flow Capacity (per pump) Max. point	gpm	350
Design Flow Pump Head, TDH	ft	18.0
Design Flow minimum efficiency (wire-to-water)	Percent	71.9
Max Net Positive Suction Head Required	ft	13
Driver		
Duty	Continuous	
Drive	Constant Speed	
Maximum Pump Speed	rpm	1745
Maximum Motor Speed	rpm	1745
Maximum Motor Size	hp	3
Service Conditions		
Fluid Service	Digester decant, filter backwash	
Ambient Environment	Wet well, submerged	
Ambient Temperature	Degrees F	30 to 120
Ambient Relative Humidity	Percent	30 to 100
Fluid Temperature	Degrees F	40 to 80
Fluid pH Range		5 to 8.5
Fluid Specific Gravity		1.0
Project Site Elevation	Feet	4384

D. The Contractor shall ensure the pump vendor examines the site conditions, intended application, and operation of the pump system and recommends the pump that will best satisfy the indicated requirements.

E. Pumps shall be designed and provided to be raised, lowered, and supported on a vertical stainless steel guide rail system.

2.2 MATERIALS OF CONSTRUCTION

A. Unless otherwise specified elsewhere, all non-clog submersible pumps shall be constructed of the following materials:

Item	Material	Construction
Pump Casing	Casing and motor housing shall be close-grain cast iron conforming to ASTM A-48 Class 40 standards. Insert rings shall be made of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron)	Casing shall form the volute and shall be a single piece with smooth flow passages. A replaceable bottom plate assembly shall be used to seal between the impeller and the casing. The casing shall have a centerline discharge to allow for guide rails.
Connections	Machined metal-to-metal quick disconnect type	The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two parallel guide bars extending from the top of the station to the wet well mounted discharge connection. The material of the guide bars shall Stainless steel AISI 316.
Impeller	Impeller shall be of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron)	Impellers shall be dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller shall have vanes hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater.
Shaft	ASTM A479 S43100-T	The shaft shall be totally isolated from the liquid being pumped and shall have a maximum deflection at the lower seal of .002 inches.
Shaft Seals	Stainless steel, Tungsten carbide or silicon carbide rings	The pump shall have two mechanical shaft seals. The upper seal shall be a corrosion resistant Tungsten carbide WCCR mechanical seal running in an oil bath below the stator housing. The lower seal shall be the primary seal and consist of a corrosion resistant Tungsten carbide WCCR mechanical seal. Seals shall contain one stationary and one positively driven

Item	Material	Construction
		tungsten-carbide seal ring. A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a float type switch that will signal if the chamber should reach 50% capacity.
Bearings		The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated and have a nominal L10 lifetime of 50.000 hours. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.
Oil Chamber		To supply oil for lubrication and cooling of shaft seals. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside.
Pump Base	For each pump the contractor shall supply and install a discharge connection made of cast iron ASTM A-48, Class 35B	The sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be accepted. The entire weight of the pump/motor unit shall be borne by the pump discharge elbow. No portion of the pump/motor unit shall bear on the sump floor directly or on a sump floor mounted stand.
Fasteners	Type 316 stainless steel	All exposed fasteners
Pump Coating	All castings must be blasted before coating. All wet surfaces	All metal surfaces (except stainless steel) coming into

Item	Material	Construction
	are to be coated with two-pack oxyrane ester Duasolid 50. The total layer thickness should be at least 120 microns. Zink dust primer shall not be used.	contact with pumped media shall be protected by specified coating
Cable Entry		The cable entry shall consist of dual cylindrical elastomer sleeves, flanked by washers, all having a close tolerance fit against the cable and the cable entry. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

2.3 LIFTING SYSTEM

A. Provide dual 316 SS guide rails extending from the base to the top of the wet well to provide for removal of the pump by lifting the pump without entering the wet well. The guide rail system shall be non-sparking.

B. Each pump shall be furnished with a stainless-steel bracket permanently mounted to the top of the pump, with a large loop for accommodating a lift hook. Each pump shall be fitted with a stainless steel lifting chain or lifting cable of adequate length. The working load of the lifting system shall be 50% greater than the pump unit weight.

C. The guide rail system shall include a sliding guide bracket that allows removal of the pump without binding, and properly aligns the pump to automatically seat with the pump discharge connection. Each pump shall have permanently installed discharge elbow that seats against the pump discharge connection by a machined metal to metal contact. The use of a diaphragm, O-ring, or profile gasket will not be accepted.

2.4 ELECTRICAL REQUIREMENTS

A. Pump Controls

1. Tertiary Lift Station: Provide VFD for each pump as specified in Section 26 29 23 – Variable-Frequency Motor Controllers. The VFD shall include H-O-A-Reverse selector switch, and I/O to the PLC (in the SCADA cabinet provided by the Owner's system integrator) that will provide the control capabilities specified in Section 40 61 96 – Control Strategies. In addition, provide outputs to PLC for hour meter display and alarm lights for moisture and thermal switches and pump failure for each pump.

2. Decant Lift Station: Provide motor starters for each pump as specified in Section 26 29 13.13 – Across-the-Line Motor Controllers. The motor starter shall include H-O-A selector switch, indicator lights and I/O to the PLC, as shown on the drawings, that will provide the control capabilities specified in Section 40 61 96 – Control Strategies. In addition, provide outputs to PLC for hour meter display and alarm lights for moisture and thermal switches and pump failure for each pump.

B. Motor

1. Pump motors shall be of explosion-proof design conforming to NFPA 820 requirements. In addition, pump motors shall conform to NEMA MG-1 Part 31 requirements and shall be a premium efficiency squirrel cage induction NEMA Design B electric motor conforming to the following:

Item	Value
Installation Environment	Submersible, Air Filled
Enclosure	Explosion Proof
Insulation Class	NEMA Class H or higher
Insulation	Non-Hygroscopic Polyester
Service Factor	1.15 Minimum
Synchronous Speed	1745 RPM Maximum (Variable)
Voltage	460
Phase	3
Frequency	60 Hz

C. Moisture Sensor

1. Provide moisture sensor in the seal oil chamber to detect moisture leakage through the outer shaft seal. The moisture sensor shall be wired to the pump control system to provide seal failure protection indication for the pump. Provide a moisture detection relay for each pump suitable for connection to SCADA network for detection of moisture in the seal chamber. The moisture detection relay shall be powered by 24-volt AC/DC and shall close a set of contacts in the relay when moisture is present in the pump seal chamber.

D. Thermal Sensors

1. Thermal sensors shall be used to monitor stator temperatures by the use of 3 thermal switches embedded in the coils of the stator winding. The thermal sensors shall be wired to the pump control system to provide overheat protection for the motors and be connected to the SCADA network similar to moisture sensor.

E. Electric Cable

1. The pump motor cable and control cable shall be FM-approved for use with motors for Class 1, Division 1, Group C & D Locations.

2.5 SPARE PARTS

A. Parts to be furnished include

1. 2 sets of mechanical shaft seals

2. 2 sets of bearings each for pump and motor

3. 3 sets of O-rings

4. 1 submersible cable of required length

2.6 MANUFACTURER

A. Flygt (Basis-of-Design)

B. KSB

C. Equal

PART 3 - EXECUTION

3.1 DELIVERY AND STORAGE

A. All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt or dust, or other contaminants.

B. All parts shall be properly lubricated and protected so that no damage or deterioration will occur even during a prolonged delay from the time of shipment until installation is completed and the pumps are ready for operation. Pump impellers shall be rotated at least every 30 days.

C. Finished ferrous surfaces not painted shall be properly protected to prevent rust and corrosion.

D. The finished surface of exposed flanges shall be protected by strong wooden blind flanges.

E. Each pump shall be properly created to protect against damage during shipment.

3.2 INSTALLATION

A. Install pump as shown in the drawings and as recommended by the Pump Manufacturer.

B. The Contractor shall ensure that anchor bolts are set only after the discharge piping has been properly installed, to ensure an exact fit with embedded piping components.

3.3 SERVICES OF MANUFACTURER

A. Secure start-up service for the pump as specified below:

Schedule of Field Service Representative on Site Time		
Service	On Site Time (Days)	Trips to Site
Equipment delivery verification and installation instruction	1	1
Installation verification, start-up and instruction of the Owner’s personnel	1	1

B. A “Day on Site” is defined as a conventional 8-hour workday excluding travel time. A “Trip to Site” is defined as complete round trip travel from the Manufacturer’s factory. All expenses including salary, local/long distance travel, lodging, meals and any other per diem or miscellaneous expenses of the authorized service representative shall be the responsibility of the Contractor.

C. A factory representative of the pumping equipment shall be present to supervise start-up and ensure proper operation of all components. The Contractor shall obtain and pay for the factory representative start-up service.

D. The Contractor shall video tape the training session and provide a DVD to the Owner.

END OF SECTION 43 25 00

SECTION 43 41 43 – POLYETHYLENE TANKS (SINGLE WALL)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide one (1) polyethylene tank and accessories, complete and in place, in accordance with the Contract Documents. The tanks shall be suitable for above ground, vertical installation and capable of containing ALUM at atmospheric pressure, respectively.

B. Unit Responsibility: The Contractor shall assign responsibility for furnishing the tank system as indicated to the tank manufacturer.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

1.	ASTM C 177	Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hat-Plate Apparatus
2.	ASTM C 273	Test Method for Shear Properties of Sandwich Core Materials
3.	ASTM D 638	Test Method for Tensile Properties of Plastics
4.	ASTM D 746	Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
5.	ASTM D 790	Test Methods for Flexural Properties of Unreinforced and Reinforced Electrical Insulating Materials
6.	ASTM D 883	Standard Definitions of Terms Relating to Plastics
7.	ASTM D 1505	Test Methods for Density of Plastics by the Density-Gradient Technique
8.	ASTM D 1525	Test Method for Vicat Softening Temperature Plastics
9.	ASTM D 1622	Test Method for Apparent Density of Rigid Cellular Plastics
10.	ASTM D 1623	Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics
11.	ASTM D 1693	Test Method for Environmental Stress-Cracking of Ethylene Plastics
12.	ASTM D 1998	Polyethylene Upright Storage Tanks

13. ASTM D 2856 Test Method for Open Cell Content of Rigid Cellular Plastics by the Air Pycnometer

14. ASTM F412 Standard Terminology Relating to Plastic Piping Systems

15. ANSI Standards B-16.2, Pipe Flanges and Flanged Fittings

16. UBC Code Uniform Building Code, [1997 Edition]

17. ARM Low Temperature Impact Resistance (Falling Dart Test Procedure).

18. NSF/ANSI Standard 61, AWWA - Drinking Water System Components

19. 2021 International Building Code

1.3 SUBMITTALS

A. Submit the following in compliance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings shall include, but not be limited to, the following items:

1. Tank manufacturer's data and dimensions showing locations of all openings, locations of level indicators, seismic support structure and anchoring system details, and location of tank accessories.

2. Details on inlet and outlet fittings, manways, flexible connections, vents and level indicators.

3. Tank pad requirements such as pads and blockouts.

4. Resin Manufacture Data Sheet.

5. Calculations shall be stamped and signed by a registered, third party engineer licensed in the State of Idaho.

a. Wall thickness: Hoop stress shall be calculated using 600 psi @ 100 degrees F.

6. Manufacturer’s warranty.

C. Owner’s Manual: Provide technical manual that outlines recommended installation procedures, fitting installation and adjustment procedures and repair procedures for typical situations including small holes, pinholes, and minor cracks in the tank.

D. Documentation: Provide certification signed by the manufacturer that the tanks have been factory tested and meet the requirements indicated. Certification shall include calculations used to determine wall thickness, hoop stress shall be indicated, and calculations shall be signed by a Registered Structural Engineer in the State of Idaho.

1. A representative of the manufacturer shall certify in writing that the tank has been installed in accordance with the manufacturer's recommendations and is chemically compatible with stored chemicals.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: The tank manufacturer shall have a record of at least ten installations during the previous 5 years for the tank sizes indicated. The manufacturer shall furnish names and telephone numbers of locations that can be visibly inspected.

B. Special Warranty Requirements: The tank shall be warranted for 5 years to be free of defects in material and workmanship. The warranty may be prorated over the last 3 years.

C. Tanks shall be manufactured from virgin materials.

D. Factory Testing: Following fabrication, the tanks, including factory applied inlet and outlet fittings, shall be hydraulically tested with water. The factory test shall compensate for the difference in specific gravity between the test water and chemical stored to simulate actual maximum operating pressures. Test methods may include adding a 2.5 psi air pad to a filled tank or filling the tank with standpipes and raising the maximum water surface approximately 5 feet higher than the normal maximum tank level. The test duration shall be 24 hours. Following successful testing, the tank shall be emptied and dried prior to shipment.

1. Material taken from each tank shall be impacted tested per ASTM D 1998 requirements. Minimum tests results shall be greater than 120 ft-lb.

2. A statement letter signed by the tank manufacturer shall be furnished indicating that the quality tests have been performed and the indicated conditions have been met.

PART 2 - PRODUCTS

2.1 GENERAL

A. Tanks shall be circular in cross-section, vertical, complete with piping inlets and outlets, drains, overflows, and anchoring system. Covered tanks shall be vented, and shall be provided with entrance manways, fill connection, and level indicators. Tanks shall be marked to identify the manufacturer, date of manufacture, serial number, and capacity. Tanks shall meet the requirements of ASTM D 1998 unless otherwise indicated.

2.2 DESIGN REQUIREMENTS

A. The minimum required wall thickness of the cylindrical sheet shall be determined per ASTM D 1998. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation but shall not be less than 0.187 inches thick.

$$T = P \times O.D./2\,SD = 0.433 \times S.G. \times H \times O.D./2\,SD$$

Where:

T	=	wall thickness, in
SD	=	hydrostatic design stress, PSI
P	=	pressure (.433 x S.G. x H).), PSI
H	=	fluid head, ft.
S.G.	=	specific gravity. gm/cc
O.D.	=	outside diameter, ft.

1. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM 02837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress is 600 PSI at 73 degrees Fahrenheit for Type I 8 11 material. In accordance with the formula in 2.2.A, the tank shall have a stratiform (tapered wall thickness) wall.

2. The hydrostatic design stress shall be aerated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.

3. The standard design specific gravity shall be 1.9.

B. The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support. Rat areas shall be provided to allow locating large filings on the cylinder straight shell. The bottom knuckle radius of flat bottom tanks shall be a minimum of 2 inches.

C. The top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall. The top head of tanks with 2,000 or more gallons of capacity shall be designed to provide a minimum of 1,300 square inches of flat area for fitting locations.

D. Tanks with 2,000 or more gallons of capacity shall have a minimum of 3 lifting lugs integrally molded into the top head. The lifting lugs shall be designed to allow erection of an empty tank.

E. The tank shall be designed to provide a minimum of 4 tie-down lugs integrally molded into the top head. The tie-down lugs shall be designed to allow tank retention for seismic zone of the project site without tank damage. All tank tie-down restraint systems shall be compliant with 2021 IBC requirements and be stamped by a licensed Professional Engineer in the State of Idaho.

F. All hardware shall be resistant to liquid chemical being stored and associated off gasses.

2.3 MATERIALS OF CONSTRUCTION

A. The tank shall be made of high density linear or high density cross-linked polyethylene as recommended by the tank manufacturer based upon chemical compatibility.

B. The material used shall be virgin polyethylene resin as compounded and certified by the Manufacturer. Resin used in the tank shall be HD-866018661 polyethylene resin as manufactured by Exxon Chemical, or resin of equal physical and chemical properties, and shall contain a minimum of 0.25 percent ultraviolet stabilizer as recommended by the manufacturer.

C. Cross-linked polyethylene shall meet or exceed the criteria listed in Table 1.

Table 1 – Materials

Parameter	Units	ASTM Test Method	Value
Density	gm/cc	D 1505	1.9
Tensile strength at yield	psi minimum	D 638	2600
Elongation at break	min percent	D 638	400
Stress-crack resistance	min hours for F_{50}	D 1693	1000
Vicat softening temperature	Deg F	D 1525	230
Brittleness temperature (Max)	Deg F	D 746	-180
Flexural modulus	psi	D 790	100,000

D. Linear Polyethylene:

1. High density linear polyethylene in accordance with ASTM D1998.

2. Resin: 100 percent virgin, UV-stabilized, manufactured by Exxon Chemical, or Equal.

3. Ultra Violet Stabilizer: Add 0.5 percent stabilizer, in the type and amount recommended by the resin manufacturer.

4. Pigment as selected by the owner from manufacturer's standard selection.

5. Free of holes, blisters, crazing, cracking, delamination, undispersed raw materials and any sign of contamination from foreign matter.

6. Resin shall meet or exceed the following properties:

Table 2 – Resin

Property	ASTM Test	Nominal Value
Density	D 1505	Between 0.940 and 0.947 grams per cubic centimeter
Environmental Stress Cracking Resistance 100% lgepal, Cond A, F50	D 1693	400-1,000 hours
Environmental Stress Cracking Resistance 10% lgepal, Cond A, F50	D 1693	200-500 hours
Ultimate Tensile Strength	D 638	2,700 pounds per square inch at 2 inch/minute
Property	ASTM Test	Nominal Value
Flexural Modulus	D 790	97,000 to 103,000 pounds per square inch
Elongation at Break	D 638	350 percent at 2 inch/minute maximum
Vicat Softening Point	D 1525	235 degrees Fahrenheit minimum
Brittleness Temperature	D 746	Minus 130 degrees Fahrenheit maximum
Dart Impact Resistance	D 1998	190 foot pounds at minus 40 degrees Fahrenheit

2.4 OPERATING CONDITIONS

A. Chemical storage tanks shall be suitable for the operating conditions specified in Table 3:

Table 3 – Operating Conditions

Parameter	Units	TANK-4101
Chemical stored		Aluminum Sulfate (ALUM)
Concentration	%	48
Design specific gravity	at 60 deg. F	1.335
Maximum fluid temperature	Deg. F	85
Minimum fluid temperature	Deg. F	35
Minimum ambient air temperature	Deg. F	55

2.5 TANK SCHEDULE

A. Tanks shall have the characteristics shown on the Contract Drawings:

2.6 TANK FITTINGS

A. Tank fittings shall be according to the fitting schedule below. Fittings shall be installed by tank manufacturer in the locations indicated on the Contract Drawings. Gasket material shall be Viton or EPDM, or other equivalent material. PVC and CPVC fittings shall be compression type Schedule 80 long shank high-torque design with minimum of 85 percent threaded contact. Any screwed fitting shall use American Standard Pipe Threads. No metals shall be exposed to tank contents.

Table 4 – Tank Fittings

Parameter	Fitting Type (See Note 1)
Fill	2” PVC
Vent	6” CPVC
Outlet to Pumps	1” IMFO
Level Indication	2” PVC
Gasket Material	Viton
Overflow	3” CPVC
Tank Drain	2” CPVC

Note 1: Refer to Drawings for fitting size and location. Abbreviations for fittings are:

BF-H: Bolted flanged with Hastelloy-C studs and polyethylene encapsulated heads.

BF-SS: Bolted flanged fitting with 316 stainless steel studs, and polyethylene encapsulated heads.

IMFO: Integrally molded flanged outlet.

DB-SD: Double bolt with siphon drain, 316 stainless steel, and polyethylene encapsulated heads.

PVC: Double-nut PVC fittings.

2.7 LEVEL INDICATION

A. Reverse Float Level Indication: The level indicator shall be assembled on the tank to act inversely to the tank contents and at no time shall allow tank contents into the exterior sight tube. The indicator shall be neon orange for visual ease. The level indication assembly shall include a PVC float, neon orange indicator, polypropylene rope, 4-inch interior perforated pipe, PVC roller guide elbows, 2-inch clear UV resistant PVC EnviroKing® sight tube (C.F. Harvel) and all required pipe supports.

B. Ultrasonic Sensor: An ultrasonic level sensor as specified in Section 40 72 00 – Level Measuring System shall be provided with each tank.

2.8 TANK ACCESSORIES

A. Restraint System: Metal components shall be galvanized, and tension ring with stainless steel or galvanized cables and clamps. Professional Engineer stamped seismic calculations shall be required per part 2.02.E.

B. Ladder: Fiberglass access ladders shall be provided with the vertical polyethylene chemical storage tanks at locations as shown. Use proper chemical resistant materials when anchoring to tank dome or sidewall. Safety cages shall be added to ladders as required. Ladders must be secured to the tank and secured to the concrete to allow for tank expansion/contraction due to temperature and loading changes. All ladders shall be designed to meet applicable OSHA standards.

2.9 MANUFACTURER, OR EQUAL

A. Poly Processing

B. Snyder-Crown

C. ASSMAN

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the Manufacturer's recommendations

3.2 FIELD TESTING

A. After installation of tank and all fittings, the tank shall be water tested by filling the entire tank with water and monitoring the tank as well as all fitting connections for at least 24 hours. Any leaks shall be corrected prior to acceptance. Following successful field testing, the tank shall be completely emptied and dried.

END OF SECTION 43 41 43

SECTION 46 21 35 - ROTARY DRUM FINE SCREEN

PART 1 - GENERAL

1.1 SCOPE

A. The Contractor shall furnish, install, and place into satisfactory operating condition one (1) rotary perforated plate fine screens (SCR-2) for removing floating, particulate, or fibrous material and to transport washed and dewatered screenings to an auger conveyor as shown on the Drawings and described in the Specifications.

B. All equipment called for under this Section shall be supplied by a single manufacturer.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM) Publications:

1. Section A322: Carbon and Alloy Steel Bar Specifications.

2. Section A507-10: Standard Specification for Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold Rolled

B. Anti-Friction Bearing Manufacturers Association (AFBMA) Publications:

1. Standard 9-90 Load Ratings and Fatigue Life for Ball Bearings.

2. Standard 11-90 Load Ratings and Fatigue Life for Roller Bearings.

C. American Institute of Steel Construction (AISC) Publications

D. American Welding Society (AWS) Publications

E. American Structures Painting Council (ASPC) Publications

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 00 – Submittal Procedures. Submittals shall include but not be limited to the following:

1. A complete set of drawings, specifications, catalog cut-sheets, and detailed descriptive material. This information shall identify all technical and performance requirements stipulated on the drawings and in the specification.

2. Detailed information shall be submitted for all items such as hardware, motors, reducers, motor controllers, and instrumentation (field devices, major control panel devices, and anticipated control panel layout).

3. Vendor data shall be furnished to confirm the torque and thrust rating of the drive.

4. List showing materials of construction of all components.

5. Manufacturer's recommended spare parts.

6. Provide product literature for bagging system.

7. Information on equipment field erection requirements including total weight of assembled components and weight of each sub-assembly.

8. A maintenance schedule showing the required maintenance, frequency of maintenance, lubricants and other items required at each regular preventive maintenance period, including all buy-out items.

9. Process equipment electrical requirements and schematic diagrams.

10. Functional description of controls.

11. Complete list of deviations from the drawings and specifications.

B. Submit Operation and Maintenance Data in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 FEATURES

A. The rotary perforated plate screen shall be a rotary basket, perforated plate screen with an integral screw conveyor and press. The perforated plate screen shall use a single drive for screening, conveying, dewatering and compressing screening material. Systems other than rotary perforated plate screens with integral screening, screenings washing, transport, and compaction/dewatering using a single motor drive system, will not be considered for this project.

B. The screen design shall minimize solids deposition in the tank.

C. Operation of the rotating basket perforated plate screen and spray bar shall be automatically initiated at a preset high liquid level. Screens which operate continuously or via timer only will not be acceptable. The brush and spray bar which are mounted above the rotating basket shall remove solids from the screening basket and deposit them into the concentric screw conveyor trough as the basket rotates. The screenings shall be transported up the screw conveyor and through a compression chamber.

D. The screen basket shall be intermittently cleaned as required by the upstream water level in order to always present a clean screening surface to the flow to ensure minimum headloss and rapid cleaning of the screen. All open spaces of the screen shall be positively cleaned via brush bristles which pass through the full depth of the perforations during the continuous cleaning cycle.

E. The control system shall be designed so that the cleaning characteristics of the screen and spray wash systems can be changed via the programmable controller. Systems which do not offer this feature will not be considered for this project.

F. Enclosures

1. To minimize odors and nuisance insect populations, the rotary perforated plate screen transport system and compaction/dewatering system shall be completely enclosed.

2. The spray wash systems shall be completely enclosed to prevent spray, aerosols, and leakage from coming in contact with the operating floor.

1.5 QUALITY ASSURANCE

A. The equipment manufacturer shall, in addition to the Contractor, assume the responsibility for proper installation and functioning of the equipment.

B. The Contract Documents represent the minimum acceptable standards for the screening equipment for this project. All equipment shall conform fully in every respect to the requirements of the respective parts and sections of the drawings and specifications. If not named, equipment which is a "standard product" with that manufacturer shall be modified, redesigned from the standard mode, and shall be furnished with special features, accessories, materials of construction or finishes as may be necessary to conform to the quality mandated by the technical and performance requirements of the specification. The entire unit shall be manufactured from AISI 304L stainless steel shapes.

C. Manufacturer shall provide screen, wash press, motors, gear reducers, controls, control panels, and lifting attachments as a complete integrated package to ensure proper coordination, compatibility, and operation of the system. The manufacturer shall test-run the fully assembled machine in his factory before shipment.

D. A written manufacturer warranty shall be provided. The warranty shall be for a minimum period of one (1) year from the date of Substantial Completion. Manufacturer shall repair or replace all defects of materials or workmanship in the equipment during the warranty period. Corrections shall be completed within five (5) days after notification.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Each rotary perforated plate screen unit shall consist of a rotating screen basket, basket cleaning brush, basket cleaning spray bar, concentric screw conveyor, dewatering screw, and screening press with drive unit.

B. The screening system shall be complete with local controls, main control panel, and level sensor.

C. All fabricated parts of the screen shall be stainless steel.

D. Screen Design Summary (based on Huber Model ROTAMAT® RPPS 1000/3):

1.	Number of Screens	1
2.	Average Flow per screen, GPM	250
3.	Maximum Flow per screen, GPM	1,201
4.	Maximum Upstream Water Level per screen, inches	26.18
5.	Screening Perforation size, inches	0.118 (3 mm)
6.	Nominal Screening Basket Diameter, inches	39.37 (1000 mm)
7.	Nominal Screw Conveyor Section Diameter, inches	9.6
8.	Drive Motor Size, hp	2
9.	Wash Water Flow Rate, gal/min	36
10.	Wash Water Pressure, psig	75

2.2 PERFORMANCE

A. The perforated plate screen shall be designed to handle the maximum flow rate noted in paragraph 2.1.D.3 with the maximum upstream liquid level noted in paragraph 2.1.D.4.

B. The average perforated plate screen flow through velocity shall not exceed 3.3 ft/sec (1.0 m/sec) under any flow condition up to the maximum hydraulic capacity noted in paragraph 2.1.D.3.

C. The screening equipment shall produce dewatered screenings capable of passing the EPA Paint Filter Test as described in Method 9095 of EPA Publication SW-486.

2.3 ROTARY PERFORATED PLATE SCREEN

A. Screen

1. The rotary perforated plate screen shall be designed and built to withstand static and hydraulic forces exerted by the liquid to the screen. All structural and functional parts shall be sized for the loads encountered during the screening, conveying, and pressing operations. All submerged components and all components of the rotary perforated plate screen in contact with the screened solids shall be of stainless steel construction.

2. The screen basket shall be of a cylindrical shape. The perforations shall go around the entire basket.

3. The nominal perforation size shall be 3 mm. Bar screens or wedge wire will not be an acceptable screen media.

4. The rotating screen basket upper support ring shall be a minimum of $^{3}/_{8}$ inch thick and shall be machined to match the transport tube main support flange to ensure proper alignment of the basket in accordance with paragraph 2.8.F. The main screen basket lower support ring shall be $^{6}/_{10}$ inch minimum.

5. The minimum diameter of the screening basket shall be as noted above. The basket diameter shall be matched with a sufficient number of clear openings to ensure the maximum flow rate is achieved.

6. The width of the channel shall be as required for the equipment provided and as shown on the drawings.

7. A seal plate shall be provided to enclose the circular screen in the channel. The seal plate shall be one-piece fabricated of 11 gauge minimum stainless steel and shall bolted to the tank wall with an angle profile on each side. The sealing plate shall be of sufficient height to prevent bypassing of flow around the screen at the maximum screen hydraulic capacity.

B. Rotating Basket and Cleaning Brush

1. The rotating basket assembly shall be cleaned by a stainless steel high pressure spray bar and a backed nylon brush with bristles that penetrate the depth of the perforated screen to ensure positive screenings removal. Brush bristles shall be high-strength nylon for superior life.

2. The screen basket shall continuously rotate in one direction and pass through the topmost position where it shall be cleaned by the stainless steel backed cleaning brush and the spray bar. The brush shall be designed to ensure cleaning of the spaces to the full depth of the perforations. The cleaning brush shall be mounted upon a holding device which keeps the brush in constant contact with the basket and will automatically adjust to allow for brush wear.

3. The rotating basket and the screw conveyor shall be fixed to the same shaft and driven by a common drive.

4. A stainless steel backed nylon brush shall be attached to the rotating basket and positioned to make contact with the screening trough to sweep material caught on the edges of the trough.

C. Screenings Conveyor and Screenings Dewatering Press

1. The screenings screw conveyor transport tube nominal diameter shall be as noted above with a minimum wall thickness of $^{1}/_{10}$ inch. A minimum of two (2) anti-rotation bars with ¼ inch minimum thickness and 1 $^{1}/_{5}$ inch wide shall be welded to the inside of the transport tube along the longitudinal axis. The screenings screw conveyor shall not depend on support from the anti-rotation bars during normal operation.

2. A $^{4}/_{5}$ inch minimum thickness basket support plate flange shall be attached to the screenings transport tube to attach the screen basket rollers and to provide for attachment of the screenings collection hopper. A ½ inch minimum thickness drive support flange shall be welded to the upper end of the screenings transport tube for attachment of the drive assembly. The basket shall be mounted to the machine via a solid support arm at the lower end of the basket which bolts directly to the screenings transport shaft. A series of roller bearings will support the top end of the basket.

3. The dewatering screw shall be designed to transport and dewater the screened material. Screw flights shall be of decreasing pitch approaching the compaction zone to provide a pre-dewatering stage and shall have a minimum thickness of 3/16 inch.

4. The upper and lower screw conveyor torque tube shall be fitted with solid stub shafts. Stub shaft and screw conveyor torque tube shall be accurately machined to allow a shrink-fit design.

5. The lower end of the screenings conveyor shall be supported by a sealed, self-lubricated lower bearing with a bronze wear sleeve. The lower bearing shall not take any thrust load from the screw conveyor. (Grease lubricated lower bearings will be used from size >2000)

6. The lower bearing shaft and arm shall be designed to minimize material wrapping around the shaft. A seal plate shall be furnished to mate between the stationary lower bearing support and the rotating arm to prevent material intrusion into the bearing seals.

7. A compaction zone shall be an integral part of the screenings screw conveyor and transport tube design. The compaction zone shall be designed to form a screenings plug of material and to return water released from the screened material back to the tank through circular holes that are machined into the screenings transport tube.

8. The compaction zone housing shall be furnished with a bolted access cover with gasket, as well as a bolted dewatering section panel, to allow access to the screw conveyor.

D. Drive

1. The basket mechanism and transport screw shall be driven by a shaft-mounted geared motor. The geared motor shall have a minimum service factor of 1.0 equivalent to an AGMA Class I rating.

2. The gear reducer shall be bolted to a machined flange welded to the upper end of the transport tube.

3. The gear reducer shall be driven by a 1,650 rev/min, 3 phase, 60 Hertz, 230/460 volt, Class 1, Division 1, Group D continuous-duty, totally-enclosed, fan-cooled motor which leads to a conduit box for outdoor operation. Motor size shall be a minimum of 2 HP.

E. Spray Wash Systems

1. Each screen shall be supplied with two spray bars.

2. The automatic spray wash systems shall be provided for the screen and shall be constructed of 1 1/4-inch diameter minimum piping and flexible reinforced PVC hose. Spray wash systems shall be operated only while the screen basket is rotating. The spray wash system shall include a solenoid valve for flow control.

3. The screenings spray wash systems shall be designed for water supply noted in paragraph 2.1.D.

4. The screen shall incorporate a screenings washing system (IRGA) consisting of two washing points, one being in the rising tube of the screen and the second being in the screenings collection hopper. The screenings wash zone in the conveyor tube shall be provided with three nozzles located equidistant around the circumference to maximize the washing performance. A lower wash system shall be located over the open top of the screen and shall utilize a spray bar with a minimum of 2 spray nozzles. The screenings washing system shall include a 1-inch solenoid valve for flow control.

5. The screen compaction zone shall be provided with a wash nozzle designed to flush the entire interior surface of the compaction zone housing to ensure no debris buildup can occur. The compaction zone flushing system shall include a single 1-inch solenoid valve for flow control.

6. The solenoid valves shall be operated via the programmable controller and/or manually.

7. Solenoid valves shall be stainless steel body, 2-way, and designed for 110 VAC operation with an explosion-proof rating. Solenoid valves shall be normally closed and rated for a minimum of 600 psig.

8. A stainless steel body, Y-strainer shall be provided for the incoming plant water supply to each spray wash system.

F. Elevated Platform

1. The rotary perforated plate screen shall be mounted on stainless steel supports provided by the screen manufacturer. The supports shall be designed to be anchored in concrete on the sides of the channel. The Manufacturer shall be responsible for providing a design adequate to support all live loads encountered during operation.

2.4 CONTROL SYSTEM

A. All controls necessary for the fully automatic operation of the screen shall be provided including a NEMA 4X main control panel, and a NEMA 7 local control station. The control strategy shall be as described in Section 40 61 96 – Control Strategies.

B. The electrical control system shall provide for automatic control of the screen via a high liquid level using a differential liquid level control system in connection with an adjustable time clock. The screen shall operate at a high liquid level or a pre-determined time sequence to provide a variable time between cleaning operations.

C. The electrical control system shall provide for automatic control of the screen via a high liquid level using a Siemens Milltronic MultiRanger 200 ultrasonic controller and 2 XRS-5 level sensors in combination with an adjustable timer.

D. The main control panel shall be wall mounted in the electrical room and include the following items to control both screens:

1. Door-interlocked and fused disconnect

2. 600 VAC terminal block

3. Control power transformer with 120 VAC transient voltage surge compressor (TVSC) and fused primary and secondary

4. Programmable logic controller (PLC), Allen Bradley Micro, MicroLogix or CompactLogix with on-board Ethernet/IP communications.

5. At minimum, provide the following for two screens and provisions for the third screen:

   a. Pilot lights for Control Power On (White), Screen Running x3 (green), Screen high level x3 (amber), Screen fault x3 (red)

   b. MCP type circuit breaker, contactor and electronic overloads sized for screen motor

   c. Door-mounted elapsed time meter and HMI for screen drive

   d. Remote dry contact outputs for the following for each screen:

      i. Screen Running/Call Conveyor

      ii. Malfunction alarm

      iii. High water level alarm

6. White phenolic nameplates with black lettering

7. U.L. 508 label

8. Electrical enclosure shall be provided in accordance with NEMA 4X stainless steel

E. A local operator station shall be provided for each screen, and shall be suitable for wall-mounting. Enclosure shall be NEMA 7 cast aluminum, and shall include the following:

1. Hand-Off-Auto selector switches for the screen drive.

2. Forward-Off-Reverse selector switch (spring return to center) for screen drive

3. Spray wash pushbuttons (push to test) for the spray bar, screenings washing system (IRGA), and compaction zone flushing

4. E-stop pushbutton (red)

5. Running pilot light (Green)

6. General fault pilot light (Red)

7. White phenolic nameplates with black lettering

8. 5-hole cast aluminum enclosure rated for Class I Division I environment

2.5 ANCHOR BOLTS

A. Equipment manufacturer shall furnish all anchor bolts of ample size and strength required to securely anchor each item of equipment. Anchor bolts, hex nuts, and washers shall be 316 stainless-steel unless noted otherwise. Anchor bolts shall be wedge or epoxy type.

B. Anchor bolts shall be set by the Contractor. Equipment shall be placed on the foundations, leveled, shimmed, bolted down, and grouted with a non-shrinking grout.

2.6 BAGGER SYSTEM

A. A continuous bagging system shall be provided for each screen discharge to abate odors and to seal dewatered screenings to prevent direct contact. The discharge bagging system shall provide a clean, odor-free means of collecting and containing the material discharged from the conveyor.

B. The bagging system components shall be attached to the screen auger discharge. An accordion-folded plastic cassette bag shall be fitted to the end of the bagging system and will collect any discharged material. The end of the cassette bag will be tied in a knot. When the dumpster must be emptied, the cassette bag shall be cut and the exposed ends tied in knots to seal.

C. A stainless steel adapter flange and an ABS plastic cassette bag holder shall be utilized to mount to the end of the conveyor discharge. The adapter flange shall be fitted to the discharge chute such that it is positioned as close to horizontal as possible.

D. The adapter flange shall be stainless steel. The holder shall be of ABS plastic or equivalent and shall consist of two parts, a tube and brim, which shall be held together by a stainless steel ring. The cassette bag shall be 295 ft (90 meters) long, non-porous, three-ply, co-extruded polyethylene with a thickness not to exceed 1.5 mils and a dart drop of not less than 1.65 lbs.

E. Provide Paxxo Longofill bagging system or equal.

2.7 SHOP SURFACE PREPARATION AND PAINTING

A. Electric motors, speed reducers, and other self-contained or enclosed components shall have an acrylic enamel finish.

B. The stainless steel parts of the unit specified in this Section shall be fully submerged into a pickling bath for at least 8 hours to remove welding spots and to protect the stainless steel against corrosion.

2.8 SOURCE QUALITY CONTROL

A. All structural stainless steel components shall be fabricated according to ISO 9001 and ISO 14001.

B. Fabricate all parts and assemblies from sheets and plates of 304 stainless-steel with a finish conforming to AISI 304 and ASTM A240 or A666, unless noted otherwise. Fabricate all rolled or extruded shapes to conform to ASTM A276. Fabricate all tubular products and fittings to conform to ASTM A269, A351 or A403.

C. All welding in the factory shall use shielded arc, inert gas, MIG or TIG method. Add filler wire to all welds to provide for a cross section equal to or greater than the parent metal. Fully penetrate butt welds to the interior surface and provide gas shielding to interior and exterior of the joint.

D. Bolts, nuts and washers shall be AISI 316 stainless steel furnished.

E. All surfaces that are specified to be machined shall be designed and fabricated to provide a run out of not more than 0.005 inches and concentricity to within 0.005 inches.

2.9 SPARE PARTS

A. 1 Complete bottom bearing assembly

B. 1 set of basket cleaning brushes

C. 2 solenoid valves

D. 2 solenoid valve rebuild kits

E. 4 Plastic rollers

2.10 MANUFACTURER, OR EQUAL

A. Huber Technology, Inc., Huntersville, NC.

B. Equal must be pre-approved during the bidding process.

PART 3 - EXECUTION

3.1 FIELD PREPARATION AND PAINTING

A. Finish field preparation and painting shall be performed as specified in Section 00 90 00 – Painting and Coating.

B. The Contractor shall touch-up all shipping damage to the paint and stainless steel as soon as the equipment arrives on the job site.

C. The Contractor shall supply paint for field touch-up and field painting.

D. The Contractor shall finish paint electrical motors, speed reducers, and other self-contained or enclosed components with oil-resistance enamel.

E. Prior to assembly all stainless steel bolts and nut threads shall be coated with a non-seizing compound by the Contractor.

3.2 INSTALLATION, START-UP AND OPERATOR TRAINING

A. Contractor shall verify all dimensions in the field to ensure compliance of equipment dimensions with the drawings. Contractor shall notify Engineer of significant deviations.

B. Installation of the equipment shall be in strict accordance with the contract documents and the manufacturer's instructions and shop drawings. Manufacturer shall supply anchor bolts for the equipment. Contractors shall install the anchor bolts in accordance with the manufacturer's recommendations.

C. Perform Level 2 Testing in accordance with Section 40 05 60 – Process Equipment Testing.

D. Manufacturer shall furnish the services of a factory-trained service engineer for two (2) trips including three (3) days to inspect the installation, carry-out the equipment start-up procedures, and provide training to the operators in how to effectively operate and maintain the equipment.

1. Equipment shall not be energized, or "bumped" to check the electrical connection for motor rotation without the service engineer present.

2. The service engineer shall make all necessary adjustments and settings to the controls. In particular, the service engineer shall verify the measurement relay setting and the initial water level setting for the screen.

3. The service engineer shall demonstrate proper operation of screen and screenings washer. The screen shall operate automatically based on the water level.

4. Training shall be for a minimum of 3 hours and shall cover standard operating and preventive maintenance procedures. The Contractor shall videotape the training and provide a copy to Owner on DVD.

END OF SECTION 46 21 35

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SECTION 46 30 00 – CHEMICAL FEED EQUIPMENT, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide chemical solution feed equipment, complete and operable, in accordance with the Contract Documents.

B. Equipment shall be from manufacturers with several years of experience in the manufacture and assembly of similar products, with a record of successful installations. Such manufacturers shall maintain a well-established, authorized, local service agency with sufficient spare parts and personnel to respond within 48 hours to any service calls.

C. Unless indicated otherwise, the requirements of this Section apply to all chemical feeding equipment in the Contract Documents.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Complete fabrication, assembly, foundation, and installation drawings, together with detailed specifications and data covering materials used, parts, devices, supports, and other accessories forming a part of the equipment.

C. Certification: The supplier shall obtain written certification from the manufacturer, addressed to the Owner, stating that the equipment will efficiently and thoroughly perform the required functions in accordance with these Specifications and the Drawings, that the materials are best suited for the chemicals handled, and that the manufacturer accepts joint responsibility with the supplier for coordination of equipment, including motors, variable speed drives, controls, and services required for proper installation and operation of the completely assembled and installed unit.

D. Technical Manuals: Furnish complete operations and maintenance manuals prior to start-up. Printed instructions relating to proper maintenance, including lubrication, and parts lists indicating the various parts by name, number, and diagram where necessary, shall be furnished with each unit or set of identical units.

E. Spare Parts List: The supplier shall obtain from the manufacturer a list of suggested spare parts for each piece of equipment subject to wear, such as seals, packing, gaskets, nuts, bolts, washers, wear rings, etc.

F. Field Procedures: Instructions for field procedures for erection, adjustments, inspection, and testing shall be furnished prior to installation of the equipment.

1.3 QUALITY ASSURANCE

A. After completion, the supplier shall furnish to the Owner the manufacturer's written guarantees that the equipment will operate with the published efficiencies, heads, criteria, and flow ranges and meet these specifications. The supplier shall also furnish the manufacturer's warranties as published in its literature.

PART 2 - PRODUCTS

2.1 GENERAL

A. Wherever it is required, a single Manufacturer shall be responsible for the compatible and successful operation of the various components of any equipment unit. It shall be understood to mean that the supplier shall provide only such equipment as the designated manufacturer will certify is suitable for use with its equipment and with the further understanding that this in no way constitutes a waiver of any indicated requirements.

B. Manufactured items provided under this Section shall be, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.

C. Where two (2) or more units of the same type or size of equipment are required, all such units shall be produced by the same manufacturer.

D. Chemical dosing equipment shall be skid mounted indicated in the Construction Drawings. Skid components shall be provided as outlined in this Section.

2.2 MATERIALS

A. General: Materials employed in the equipment shall be suitable for the intended application; materials not specifically called for shall be high-grade, standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended.

B. Corrosion Resistance: Materials used in the construction of chemical feeding equipment shall be resistant to corrosive attacks from the chemicals. The following lists some of the suitable materials for the construction of the corresponding chemicals. Unless the manufacturer proposes more suitable materials, the list shall be adhered to:

Chemical	Suitable Handling Material
Sodium Hydroxide	316 Stainless Steel Hastelloy C (fair) Titanium (fair) PVC FRP (suitable grade) Saran Teflon
Alum	EPDM FRP (Suitable Grade) Hastelloy C Nitrile (Buna N) Polyethylene Polypropylene PVC, CPVC PVDF Teflon Titanium

2.3 CHEMICAL DOSING SKID SYSTEM

A. Refer to specific dosing pump specifications for more information, see 46 33 42 - Diaphragm Metering Pumps.

B. Nameplate: Each piece of equipment shall be provided with a stainless steel nameplate, indicating equipment characteristics, capacity, manufacturer, model number, and serial number.

C. Equipment Supports: Chemical feeding equipment and piping shall be firmly anchored. Fabricated supports exposed to chemical spills shall be of FRP. All anchor bolts, nuts, and washers of such supports shall be of non-metallic type. The containment shall be self-supporting and capable of being wall, shelf or floor mounted as indicated in the Construction Drawings.

D. Piping: The system shall be pre-plumbed with all piping, valves and fittings to provide a complete operable system. Piping shall be sized appropriately based on demand.

E. Skid Connections: Skid shall be provided with the number of inlets and outlets as indicated in the Construction Drawings. Connections shall be union type. Seals may be FKM or EPDM. Provide a Y-type strainer near all inlet connections.

F. Pump Connections: Shall be flexible, reinforced braided PVC tubing rated for 200 psi maximum continuous duty and terminated to half unions with stainless steel hose clamps. The tubing shall be NSF listed.

G. Flow Indicator: Provide flow indicator for each pump. The indicator shall be clear PVC with a ball indicator and shall be securely mounted to the skid.

H. Spill Containment: Shall be provided with a drain port to drain fluid.

I. Valves: Provide isolation and check valves for each pump in the skid as indicated in the Construction Drawings.

J. Pressure Relief: Provide pressure relief valves on the discharge of each pump discharge line. The relief line shall connect to the low pressure side of the pump. Relief valve shall be adjustable at increments from 10 to 150 psi.

K. Pressure Gauges: All chemical metering pumps, and other equipment, where shown, shall be equipped with pressure gauges with diaphragm seals in accordance with Division 40 that the size of gauges on small metering pumps may be smaller than specified in the above section.

L. Safety Equipment: Where required by Code, all chemical unloading, storage, and feeding equipment shall be furnished with the necessary safety devices and warning signs, clearly visible.

M. Calibration Columns: Provide Calibration Columns as indicated on the Contract Drawings. Each Calibration Column shall be an acrylic tube with PVC heads. The columns shall be calibrated for 30 second sampling periods and shall have the capacity as indicated in the table below and shall have a maximum height of 30 inches. Each column shall be securely supported at both top and bottom.

2.4 CHEMICAL STORAGE

A. Chemical Tank Pipe Connection Expansion Joints: Provide a custom flexible connection for each chemical tank horizontal connection shown on the contract drawings. The flexible connection shall be manufactured by Harrington Plastics or equal. The flexible connection shall consist of all nonmetallic materials: polypropylene braided overwrap, convoluted PTFE liner, and PVDF flanges. The flexible connection shall be a minimum length of 6-inches and shall allow for minimum horizontal and vertical defection of 4%.

B. Flexible Tubing: Provide a custom flexible connection with quick connects as shown on the contract drawings. The flexible connection shall be manufactured by Harrington Plastics or equal. The flexible connection shall consist of all 316 stainless steel, polypropylene braided overwrap, convoluted PTFE liner, and quick connects. The flexible connection shall be a minimum length of 2’-6” and shall allow for minimum horizontal and vertical deflection of 4%.

2.5 APPURTENANCES

A. Tote Spill Pallets: Provide two (2) tote spill pallets (2 for polymer totes) for dewatering building. The spill pallets shall have a containment sump and deck surface for storing the totes and containing any leaks or spills. The spill pallets shall be 62” by 62” by 28” high with a 52” by 52” full, flat grate deck surface and shall be 100% polyethylene. The spill pallet shall have 2-way forklift entry for easy movement. The sump capacity shall be 360 gallons with a drain and cap. The load capacity shall be 8500 pounds. The tote spill pallet shall be USABluebook 12283 or approved equal. Provide one (1) bucket shelfs, USABlueBook item 12284, or equal.

B. Provide one (1) pallet jack for the dewatering building. Pallet jack shall be Uline Industrial Pallet Truck – Long Fork, 72” x 27” with a 5,500 lb. load capacity or qual.

2.6 TOOLS AND SPARE PARTS

A. Tools: Special tools necessary for maintenance and repair of the equipment and one pressure grease gun for each type of grease required for the equipment shall be furnished as a part of the Work; such tools shall be suitably stored in metal toolboxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

B. Spare Parts: Furnish spare seals, and gaskets, as required by the feed equipment sections.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Chemical feeding equipment shall be installed in accordance with governing safety standards, the Shop Drawings, and as indicated.

B. Test all chemical feed equipment in accordance with manufacturer recommendations prior to placing it in service.

END OF SECTION 46 30 00

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SECTION 46 33 44 - PERISTALTIC METERING PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide chemical peristaltic metering pumps and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Submit certifications and testing consistent with Section 01 33 00 – Submittal Procedures and Section 43 05 01 – Equipment General Provisions.

B. At a minimum, shop drawings shall include complete fabrication, assembly, foundation, and installation drawings, together with detailed specifications and data covering materials used, parts, devices, supports and other accessories forming a part of the equipment. In addition, shop drawings shall include the following information:

1. Pump name, identification number, and specification section number.

2. Performance data curves showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump.

3. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

4. Elevation of proposed local control panel showing panel-mounted devices, details of enclosure type, single line diagram of power distribution, and current draw of panel, and list of all terminals required to receive inputs or to transmit outputs from the local control panel.

5. Wiring diagram of field connections with identification of terminations between local control panels, junction terminal boxes, and equipment items.

6. Complete electrical schematic diagram.

C. Technical Manual: The Technical Manual shall contain the required information for each pump section as specified in Section 01 33 00 – Submittal Procedures.

D. Spare Parts List: A spare parts list shall contain the required information for each pump section.

1.3 QUALITY CONTROL

A. Factory Test Data: Signed, dated, and certified factory test data for each pump system which requires factory testing, submitted before shipment of equipment.

B. Pump shall be 24-hour continuous duty rated.

C. Manufacturer's Experience: The chemical feeding equipment shall be the product of a manufacturer who has designed and manufactured similar equipment and has a record of at least 5 years of successful operation of this type of process. The Supplier may be required to submit evidence to this effect together with a representative list of installations. The pump manufacturer shall maintain a permanent, local service department and a spare parts department.

D. Pumps shall be manufactured in compliance with ISO 9001-2008 standards and meet CE, NSF 61 and applicable electrical standards.

E. To ensure proper function and quality, pumphead, tubing, and drive shall be manufactured by the same company. Tubing purchased by the pump manufacturer from a third party is not acceptable.

1.4 WARRANTY

A. A written manufacturer warranty shall be provided. The warranty shall be for a minimum period of three (3) years from the date of Substantial Completion. Manufacturer shall provide parts to replace all defects of materials or workmanship in the equipment during the warranty period.

PART 2 - PRODUCTS

2.1 GENERAL

A. The pumps shall be positive displacement type complete with self-contained variable speed drive as specified. Pumps shall be self-priming and shall have a maximum suction lift of up to 30 feet vertical water column.

B. Pump Schedule:

Chemical	Equipment Number	Feed Range (gph)	Continuous Operating Pressure (psi)
ALUM (48.0% solution)	P-4101, P-4102	0.0 – 19	4.3-21
ALUM (48.0% solution)	P-4103, P-4104	0.0 – 19	4.3-21
NaOH (50.0% solution)	P-4201, P-4202	0.0 – 19	4.3-21

2.2 OPERATING CONDITIONS

A. The work of this section shall be suitable for long-term operation under the conditions listed in the table below:

Parameter	P-4101, 4102, 4103, 4104
Ambient Environment	Indoors
Ambient Temperature. (deg F)	55 to 100
Ambient Relative Humidity, (%)	20 to 100
Fluid Service	ALUM (48.0% solution)
Fluid Temperature, (deg F)	35 to 60
Fluid pH Range	1.9-2.5
Specific Gravity	1.335@ 60 Deg F
Project Elevation, (ft)	4,385
Maximum Suction Lift, (ft)	3

Parameter	P-4201, P-4202
Ambient Environment	Indoors
Ambient Temperature. (deg F)	55 to 100
Ambient Relative Humidity, (%)	20 to 100
Fluid Service	Sodium Hydroxide (50%)
Fluid Temperature, (deg F)	35 to 60
Fluid pH Range	14
Specific Gravity	1.53@ 60 Deg F
Project Elevation, (ft)	4,385
Maximum Suction Lift, (ft)	3

2.3 PERFORMANCE REQUIREMENTS

A. The pumps specified in this section shall satisfy the performance requirements listed in the table below:

Parameter	P-4101, 4102, 4103, 4104
Duty	Continuous
Drive	Variable
Pump Head	Std. pump head for max performance
Continuous Operating Pressure (psi)	80
Control Range	20:1
Maximum Motor Speed (rpm)	1425
Minimum Motor Size (Hp)	1/4

Parameter	P-4201, 4202
Duty	Continuous
Drive	Variable
Pump Head	Std. pump head for max performance
Continuous Operating Pressure (psi)	80
Control Range	20:1
Maximum Motor Speed (rpm)	1425
Minimum Motor Size (Hp)	1/4

2.4 CONSTRUCTION

A. Pumps shall be constructed of materials that satisfy requirements listed in Section 46 30 00 – Chemical Feed Equipment, General.

B. Materials: Wetted parts of metering pumps shall be selected by the manufacturer to ensure optimum, corrosion-free, and erosion-free operation for the chemicals involved.

C. Rotor: Pumphead rotor shall be constructed of glass filled Nylon, sealed within the track housing, and supported by its own bearings. The Peristaltic occlusion level shall be factory set to ensure flow accuracy of +/- 1% and repeatability performance of +/- 0.5% and shall not require any field adjustment. Corrosion-resistant valox thermoplastic is an acceptable alternative material for the pump head and rotor.

D. Provide tool-free peristaltic pump head via a single flip latch or removable thumb screws for access to and removal of the tubing and pumphead.

E. Housing construction: corrosion resistant and high impact resistant glass filled PPS or PPE/PS. Polyester power coated aluminum housing is also acceptable.

F. Geometry: Pumphead shall consist of sealed track housing with in-line porting.

G. Contact Materials: All pumphead components in the fluid path shall be NSF61 listed and shall be of materials specified by the manufacturer as compatible with the process fluid.

H. Leak containment/detection: In the event of peristaltic element failure, the leak sensor shall shut the pump down immediately with all process fluid contained within the sealed pumphead.

1. Sensor type: Utilize non-contacting optical sensor. Sensor shall not come in contact with the process fluid, shall contain no moving parts, shall not depend on the capacitance of the process fluid, shall not require fluid to leak out of the pump housing for engagement, nor shall require any sensitivity or calibration adjustment. A conductive-style leak detector that can be adjusted for a specific chemical is also acceptable.

2. Alarm: Sensor shall shut down the pump and give a visual indication on the drive controller.

2.5 ACCESSORIES

A. Accessories shall be provided as outlined in Section 46 30 00 - Chemical Feed Equipment, General.

2.6 SPARE PARTS

A. Provide manufacturer's recommended spare parts, including at a minimum:

1. A complete set of extra compression fittings shall be furnished with each pump.

2. One (1) replacement tube for each pump.

3. One spare pumphead for each pump skid.

2.7 PUMP DRIVE

A. Mounting: Drive shall be self-supporting and shall not require anchoring.

B. Each pump shall be provided with the following drives:

Rating	Continuous 24 hour operation, 55°-100°F ambient
Supply	110-120V 50/60 Hz; 1-Phase with an internal switch-mode power supply. Supply nine-foot length power cord with standard 115VAC three-prong plug.
Enclosure	NEMA 4X
Housing	Impact resistant engineering plastic, 20% glass filled PPE/PS. Polyester powder-coated aluminum is acceptable for the pump housing.
Drive Motor	Direct coupled pumphead with fully protected drive. Brushless DC motor with integral gearbox and closed loop tachometer feedback. Motor shall include overload protection.

2.8 PUMP CONTROLS

A. Operator membrane keypad:

1. Increase/Decrease Speed

2. Start/Stop

3. Auto/Manual selector

4. Programmable keypad disabled to prevent changes from incidental contact.

5. Programmable automatic restarting for resumed pumping after recovery from power interruption.

6. LED display of RPM

B. Remote Features:

1. Analog input of 0-32mA or 0-30VDC for speed control in Auto mode. Signal response may be scaled over any part of the drive speed range. Contractor to ensure analog signals being sent to the pump for automatic speed control from other devices are isolated signals. An analog input of 4-20 mA is acceptable for speed control.

2. The SCADA system will provide run and speed signals to the ferric chloride pumps based on flow meter signals from the primary sludge pump station according to operator dosing inputs.

3. Dry contact closure input for remote start/stop - functional in both the Auto and Manual modes.

4. Analog output of 4-20 mA to provide pump speed for use by SCADA to calculate flow in gph.

2.9 MANUFACTURERS OR EQUAL

A. Blue-White M3S Series Peristaltic Pump (Basis-of-Design)

B. Watson-Marlow QDOS 60 Universal+ 24V

PART 3 - EXECUTION

3.1 INSTALLATION

A. Chemical feed systems shall be installed in accordance with accepted procedures submitted with the shop drawings and as indicated on the drawings, unless otherwise accepted.

3.2 FIELD QUALITY CONTROL

A. Manufacturer shall employ and pay for services of their field service representative(s) to:

1. Inspect equipment covered by these Specifications.

2. Supervise pre-start adjustments and installation checks.

3. Conduct initial startup of equipment and perform operational checks.

4. Provide a written statement certifying that manufacturer's equipment has been installed properly, started up and is ready for operation.

B. Instruct Owner personnel for 8 hours at the job site per Section 01 78 23 – Operation and Maintenance Data. Contractor shall video training and provide a copy on DVD to Owner.

END OF SECTION 46 33 44

APPENDIX A

Geotechnical Report

- A.1 Geotechnical Report 2022
- A.2 Geotechnical Report 2022

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APPENDIX A.1

Geotechnical Report 2022

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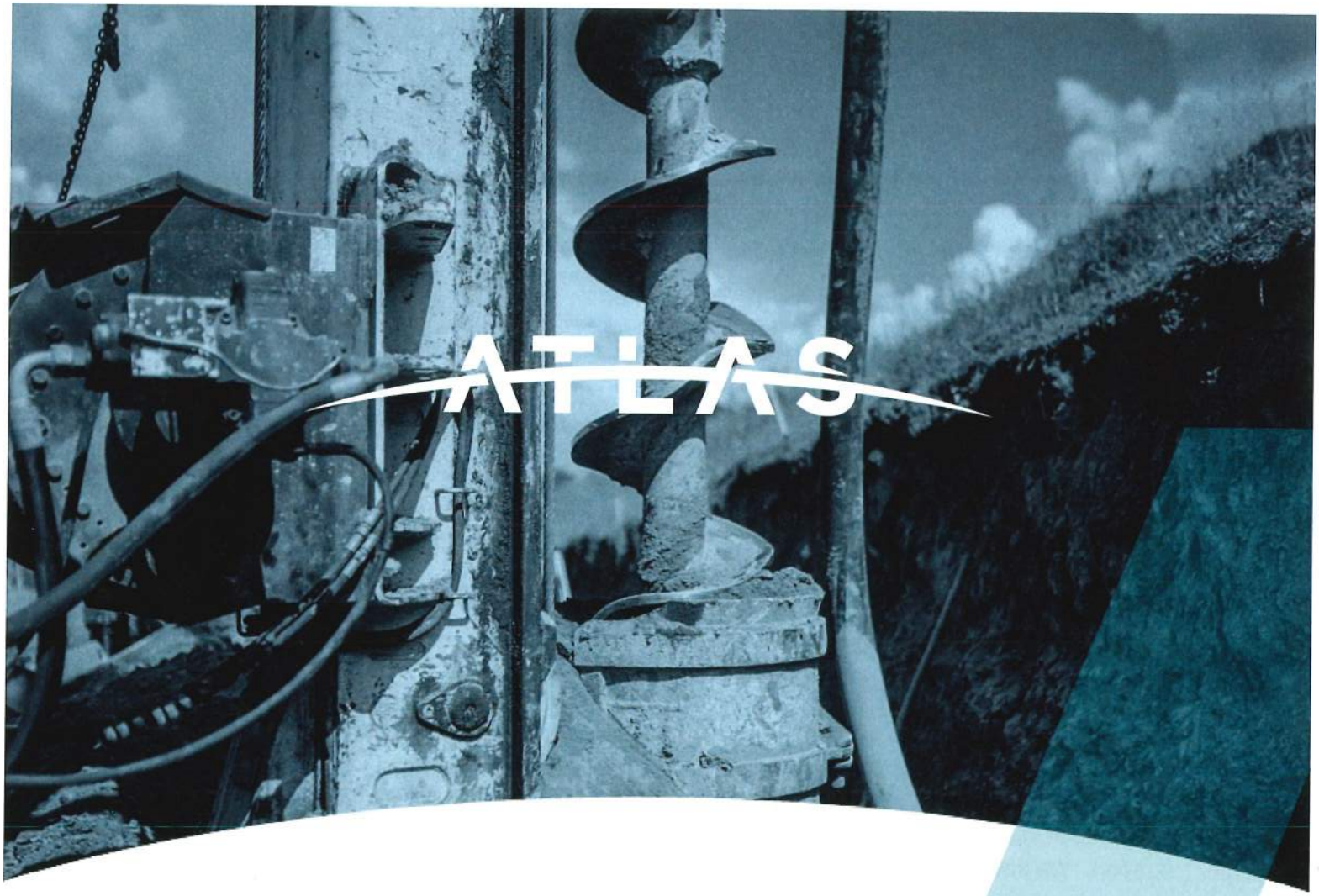

GEOTECHNICAL INVESTIGATION

ABERDEEN WWTP UPGRADES

2683 West 1750 South
Aberdeen, ID

PREPARED FOR:

Mr. Matthew Hill
Keller Associates, Inc.
305 North 3rd Avenue, Suite A
Pocatello, ID 83201

PREPARED BY:

Atlas Technical Consultants, LLC
149 McKinley Avenue
Pocatello, ID 83201

December 2, 2022
P222374g

149 McKinley Avenue
Pocatello, ID 83201
(208) 233-9500 | oneatlas.com

December 2, 2022

Atlas No. P222374g

Mr. Matthew Hill
Keller Associates, Inc.
305 North 3rd Avenue, Suite A
Pocatello, ID 83201

Subject: **Geotechnical Investigation**
Aberdeen WWTP Upgrades
2683 West 1750 South
Aberdeen, ID

Dear Mr. Hill:

In compliance with your instructions, Atlas has conducted a soils exploration and foundation evaluation for the above referenced development. Fieldwork for this investigation was conducted on October 27, 2022. Data have been analyzed to evaluate pertinent geotechnical conditions. Results of this investigation, together with our recommendations, are to be found in the following report. We have provided a PDF copy for your review and distribution.

Often, questions arise concerning soil conditions because of design and construction details that occur on a project. Atlas would be pleased to continue our role as geotechnical engineers during project implementation.

If you have any questions, please call us at (208) 233-9500.

Respectfully submitted,

PROFESSIONAL ENGINEER LICENSED 18739 12/2/2022 STATE OF IDAHO ETHAN SALOVE

Ethan Salove, PE
Geotechnical Engineer

Elizabeth Brown

Elizabeth Brown, PE
Geotechnical Services Manager

Keaton Ward

Keaton Ward
Staff Geologist

ATLAS

CONTENTS

TABLES

APPENDICES

1. INTRODUCTION

This report presents results of a geotechnical investigation and analysis in support of data utilized in design of structures as defined in the 2018 International Building Code (IBC). Information in support of groundwater and stormwater issues pertinent to the practice of Civil Engineering is included. Observations and recommendations relevant to the earthwork phase of the project are also presented. Revisions in plans or drawings for the proposed structures from those enumerated in this report should be brought to the attention of the soils engineer to determine whether changes in the provided recommendations are required. Deviations from noted subsurface conditions, if encountered during construction, should also be brought to the attention of the soils engineer.

1.1 Project Description

The proposed development is in the eastern portion of the City of Aberdeen, Bingham County, ID, and occupies a portion of the NW¼SW¼ of Section 34, Township 5 South, Range 31 East, Boise Meridian. This project will consist of the following:

- Administration/Control/Dewatering building that is expected to be 2,520 square-feet in size. A footing depth of 3 feet below existing ground surface and wall loads of up to 10,000 pounds per foot are anticipated.
- A blower building that is estimated to be 480 square-feet in size. A footing depth of 3 feet below existing ground surface and wall loads of up to 10,000 pounds per foot are expected.
- A tertiary filtration building that is expected to be 2,790 square feet in size. This structure is anticipated to extend 8 feet below existing ground surface and have wall loads up to 10,000 pounds per foot.
- A lift station will be constructed to extend a maximum of 18 feet below existing ground surface. Estimated wall loads up to 4,000 pound per lineal foot were assumed for wall footings.
- A splitter box that is expected to extend 4 feet below existing ground surface. Loads of up to 4,000 pounds per lineal foot for wall footings were assumed.

Retaining walls are anticipated as part of the project.

1.2 Authorization

Authorization to perform this exploration and analysis was given in the form of a written authorization to proceed from James P. Mullen of Keller Associates, Inc. to Ethan Salove of Atlas Technical Consultants (Atlas), on October 24, 2022. Said authorization is subject to terms, conditions, and limitations described in the Professional Services Contract entered into between Keller Associates, Inc. and Atlas. Our scope of services for the proposed development has been provided in our proposal dated October 21, 2022 and repeated below.

1.3 Scope of Investigation

The scope of this investigation included review of geologic literature and existing available geotechnical studies of the area, visual site reconnaissance of the immediate site, subsurface exploration of the site, field and laboratory testing of materials collected, and engineering analysis and evaluation of foundation materials.

2. SITE DESCRIPTION

2.1 Site Access

Access to the site may be gained via Highway 39 towards Aberdeen, ID. Proceed south on Highway 39 to its intersection with Central Avenue within Aberdeen, ID. Continue east on Central Avenue for approximately 0.68 mile to its intersection with the wastewater treatment plant access road. Continue south on the plant access road for 0.2 mile to arrive at the project site. The location is depicted on site maps included in the **Appendix**.

2.2 Regional Geology

The subject site is located in the City of Aberdeen, in an area known as the Snake River Plain. Sediments deposited here were derived from Cretaceous sediments from the Blackfoot Mountains, which are immediately east of the Snake River Plain. These sediments compose the underlying horizons throughout the region. Surficial sediments were deposited as mixed alluvium during the Tertiary Period (1.6 to 66 million years ago) and generally consist of weakly to moderately indurated gravels, cobbles, and sand lenses underlying sandy silts and silty clays. Since their deposition, these have been dissected in the Blackfoot area (Alt and Hyndman, 1998).

2.3 General Site Characteristics

The site to be re-developed is approximately 4.25 acres in size. The site currently exists as a municipal wastewater treatment facility. Current onsite structures are composed of shop and office use structures and existing wastewater infrastructure. Gravel roads are also currently present throughout. Agricultural land borders the project site to the east and south. A creek, Little Hole Draw, is present flowing from northeast to southwest along the north and west margin of the project site.

Vegetation on the site consists primarily of landscape grasses adjacent to existing structures. Mature trees are present along the creek banks to the west and north of the project site. The site is relatively flat and level. However, a slight drop in elevation occurs from north to south.

Regional drainage is south and east toward the American Falls Reservoir and Snake River. Stormwater drainage for the site is achieved by percolation through surficial soils. The site is situated so that it is unlikely that it will receive any drainage from off-site sources. Stormwater drainage collection and retention systems were not noted on the project site during the time of our investigation.

2.4 Regional Site Climatology and Geochemistry

Average precipitation for the Bingham County region is on the order of 13 to 17 inches per year. Annual average temperature ranges from 16°F to 88°F, with daily extremes ranging from -24°F to 98°F. Average wind speed ranges to 10 miles per hour, with a prevailing direction from the southwest. Soils and sediments in the area are primarily derived from siliceous materials and exhibit low electro-chemical potential for corrosion of metals or concretes, and local aggregates are generally appropriate for Portland cement and lime cement mixtures. Surface water, groundwater, and soils in the region typically have pH levels ranging from 7 to 8.

3. SEISMIC SITE EVALUATION

3.1 Geoseismic Setting

Soils on site are classed as Site Class D in accordance with Chapter 20 of the American Society of Civil Engineers (ASCE) publication ASCE/SEI 7-16. Structures constructed on this site should be designed per IBC requirements for such a seismic classification. Our investigation did not reveal hazards resulting from potential earthquake motions including: slope instability, liquefaction, and surface rupture caused by faulting or lateral spreading. Incidence and anticipated acceleration of seismic activity in the area is low.

3.2 Seismic Design Parameter Values

The United States Geological Survey National Seismic Hazard Maps (2008), includes a peak ground acceleration map. The map for 2% probability of exceedance in 50 years in the Western United States in standard gravity (g) indicates that a peak ground acceleration of 0.173 is appropriate for the project site based on a Site Class D.

The following section provides an assessment of the earthquake-induced earthquake loads for the site based on the Risk-Targeted Maximum Considered Earthquake (MCE_R). The MCE_R spectral response acceleration for short periods, S_{MS}, and at 1-second period, S_{M1}, are adjusted for site class effects as required by the 2018 IBC. Design spectral response acceleration parameters as presented in the 2018 IBC are defined as a 5% damped design spectral response acceleration at short periods, S_{DS}, and at 1-second period, S_{D1}.

The USGS National Seismic Hazards Mapping Project includes a program that provides values for ground motion at a selected site based on the same data that were used to prepare the USGS ground motion maps. The maps were developed using attenuation relationships for soft rock sites; the source model, assumptions, and empirical relationships used in preparation of the maps are described in Petersen and others (1996).

Table 1 – Seismic Design Values

Seismic Design Parameter	Design Value
Site Class	D "Default"
S_s	0.255 (g)
S_1	0.108 (g)
F_a	1.596
F_v	2.385
S_{MS}	0.406
S_{M1}	0.257
S_{DS}	0.271
S_{D1}	0.171

4. SOILS EXPLORATION

4.1 Exploration and Sampling Procedures

Field exploration conducted to determine engineering characteristics of subsurface materials included a reconnaissance of the project site and investigation by soil boring. Borings were located in the field by means of a Global Positioning System (GPS) device and are reportedly accurate to within ten feet. Borings were advanced by means of a truck-mounted drilling rig equipped with continuous flight hollow-stem augers. At specified depths, samples were obtained using a standard split-spoon sampler and a modified California sampler, and Standard Penetration Test (SPT) blow counts were recorded. Uncorrected SPT blow counts are provided on logs, which can be found in the **Appendix**. Delayed water level observations were made in open borings to evaluate groundwater levels. At completion of exploration, borings were backfilled with loose excavated materials and bentonite holeplug.

Samples have been visually classified in the field by professional staff, identified according to boring number and depth, placed in sealed containers, and transported to our laboratory for additional testing. Subsurface materials have been described in detail on logs provided in the **Appendix**. Results of field and laboratory tests are also presented in the **Appendix**. Atlas recommends that these logs **not** be used to estimate fill material quantities.

4.2 Laboratory Testing Program

Along with our field investigation, a supplemental laboratory testing program was conducted to determine additional pertinent engineering characteristics of subsurface materials necessary in an analysis of anticipated behavior of the proposed structures. Laboratory tests were conducted in accordance with current applicable American Society for Testing and Materials (ASTM) and American Association of State Highway and Transportation Officials (AASHTO) specifications, and results of these tests are to be found in the **Appendix**.

The laboratory testing program for this report included: Atterberg Limits Testing – ASTM D4318, Grain Size Analysis – ASTM C117/C136, pH of Soil For use in Corrosion Testing – AASHTO T289, Laboratory Soil Resistivity – AASHTO T288, Water-Soluble Sulfate Ion Content in Soil – AASHTO T290, One-Dimensional Consolidation of Soils Using Incremental Loading – ASTM D2435.

4.3 Soil and Sediment Profile

The profile below represents a generalized interpretation for the project site. Note that on site soils strata, encountered between boring locations, may vary from the individual soil profiles presented in the logs, which can be found in the **Appendix**.

Sandy silt soils were encountered at ground surface within boring 3 and were noted to be brown, slightly moist to moist, and soft to stiff, with fine-grained sand. Silty sand with gravel fill materials were noted at the surface of boring 4. They were light brown to brown, dry to slightly moist, and medium dense, with fine to coarse-grained sand and trace fine gravels. Soils encountered throughout the remainder of boring locations consisted of lean clay soils. These fine-grained soils were brown, slightly moist to moist, and soft to very stiff, with trace fine-grained sand. At depth, basalt rock and basalt gravel/fractured basalt was noted within all borings.

During excavation, test pit sidewalls were generally stable. However, moisture contents will affect wall competency with saturated soils having a tendency to readily slough when under load and unsupported.

4.4 Electrical Resistivity, pH, and Water Soluble Sulfate Analysis

A grab sample of native lean clay was collected on October 27, 2022 at a depth ranging from 3.0 to 5.0 feet bgs in boring 2. This location is illustrated on the Site Map included in the **Appendix**. Analysis results are given in the following table:

Table 2 – Soil Analysis Results

Analysis	Results
Resistivity	14,783 Ohms-cm
pH	7.9
Water Soluble Sulfate Content	Less than 200 ppm

For soils, electrical resistivity is a function of soil chemistry and moisture content. Galvanic currents, which tend to increase the possibility of corrosion, are more likely to develop in low resistivity soils. The resistivity value obtained is characteristic of soils classified as mildly corrosive to unprotected iron, steel, cast iron, ductile iron, galvanized steel, and dielectric steel or iron. The pH of the sample (7.9) indicates a moderately alkaline soil. A water soluble sulfate content of less than 200 ppm was determined and corresponds to a Class S1 soil per American Concrete Institute (ACI) 318, Table 19.3.1.1. This investigation is limited in scope and is not intended to represent a comprehensive analysis of corrosivity potential of near-surface native soils. However, based on the evidence of this investigation, conventional Type II cement is acceptable and recommended for this project per ACI 318, Table 19.3.2.1.

4.5 Volatile Organic Scan

No environmental concerns were identified prior to commencement of the investigation. Therefore, soils obtained during on-site activities were not assessed for volatile organic compounds by portable photoionization detector. Samples obtained during our exploration activities exhibited no odors or discoloration typically associated with this type of contamination. No evidence of groundwater contamination was noted during the site visit.

5. SITE HYDROLOGY

Existing surface drainage conditions are defined in the **General Site Characteristics** section. Information provided in this section is limited to observations made at the time of the investigation. Either regional or local ordinances may require information beyond the scope of this report.

5.1 Groundwater

During this field investigation, groundwater was encountered in borings 3 and 4 at depths ranging from 11.1 to 13.8 feet bgs. Groundwater was not encountered in borings 1 and 2 to depths of 11.2 feet bgs. Soil moistures in borings were generally slightly moist to moist throughout. However, soil moistures graded from moist to saturated as the water table was approached and penetrated. In the vicinity of the project site, groundwater levels are controlled in large part by agricultural irrigation activity and leakage from nearby canals. Maximum groundwater elevations likely occur during the later portion of the irrigation season.

According to Idaho Department of Water Resources (IDWR) monitoring well data within approximately ½-mile of the project site, groundwater was measured at depths ranging between 8 and 24 feet bgs. Based on evidence of this investigation and background knowledge of the area, Atlas estimates groundwater depths to remain greater than approximately 8 feet bgs throughout the year. This depth can be confirmed through long-term groundwater monitoring.

5.2 Construction Dewatering

Dewatering will be required for construction of below grade elements. General dewatering information and several dewatering options have been provided in the following section. However, this section is not a specific dewatering plan and the information provided is based on estimates of hydraulic conductivity derived from laboratory testing and experience with similar soil types. All structures founded below the water table should be constructed with a pressure relief valve. Further design and development will be required based on needs of the design team and the contractor's specific capabilities, experience, and equipment. Atlas is available to provide further design assistance and development of a dewatering system for this project.

5.2.1 Hydraulic Conductivity

Hydraulic conductivity is the measure of a soil's capacity to transmit water. This is a critical parameter in a dewatering analysis. Based on published data and the laboratory test data of the onsite soils, the following estimated hydraulic conductivity values should be used for the onsite soils: 1) 2.8×10^{-6} to 1.3×10^{-3} feet per day for lean clay soils and 2) 5.7×10^{-6} to 0.1 feet per day for basalt rock. Specific pump tests should be performed onsite to determine actual hydraulic conductivity values.

5.2.2 Dewatering Options

A specific dewatering system will need to be developed that takes into account construction schedule, groundwater levels during construction, and the contractor's specific capabilities, experience, and equipment. Two options for dewatering systems could include a trench drain or deep draw-down wells. Whichever dewatering system is chosen should be implemented at least 2 weeks prior to start of excavation. The groundwater level should be dewatered to a depth of at least 2 feet below the lowest planned excavation depth. The proximity of the Little Hole Draw creek will influence the dewatering and may provide further challenges. Dewatering close to the creek could heavily influence the groundwater levels and amount of water to be pumped.

5.3 Soil Infiltration Rates

Soil permeability, which is a measure of the ability of a soil to transmit a fluid, was not tested in the field. Given the absence of direct measurements, for this report an estimation of infiltration is presented using generally recognized values for each soil type and gradation. Of soils comprising the generalized soil profile for this study, lean clay soils generally offer little permeability, with typical hydraulic infiltration rates of less than 2 inches per hour. Sandy silt soils will commonly exhibit infiltration rates from 2 to 4 inches per hour. Infiltration rates through basalt rock can be highly variable, ranging from nearly zero to greater than 6 inches per hour in some cases. Movement of water through the basalt may be more characteristic of fracture flow. Infiltration testing is required to determine site-specific infiltration rates for drainage design once proposed locations of infiltration facilities are determined.

6. LATERAL EARTH PRESSURES

Retaining, below-grade, or basement walls will be subject to lateral earth pressures. The magnitude of earth pressure is a function of both type and compaction of backfill behind walls within the "active" zone, and allowable rotation of the top of the wall. The active zone is defined as the wedge of soil between the surface of the wall and a plane inclined 31 degrees from vertical passing through the base of the wall. All clayey soils must be completely removed from within the active zone. The following recommendations should be used when dealing with lateral earth pressures on a gravity block: 1) a sliding frictional coefficient of 0.35 is appropriate considering native lean clay soils and sandy silt soils, and 2) a sliding frictional coefficient of 0.45 is appropriate considering granular structural fill under typical conditions.

A state of plastic equilibrium is when the subject material is considered to be 1) homogeneous and unbounded and 2) at the point of incipient instability. This state is evaluated on the basis of unit weight, mechanical properties, and the definition of instability. For the purpose of this report, it is assumed that native sandy silt soils and imported granular fill material will be the materials of concern regarding lateral earth pressures. If other materials are considered for use, Atlas must be contacted to provide alternate lateral earth pressure information. Furthermore, changes in natural soil moisture, such as can be imposed by site stormwater systems, can change the values listed below.

Below-grade restrained walls, such as basement walls, should be designed based on at-rest pressures. Active pressures are appropriate under conditions where the wall moves or rotates away from the soil mass at failure. Passive pressures are used for conditions where the wall moves toward the soil mass at failure. Rotation, or lateral movement, of the top of the wall equal to 0.002 times the height of the wall will be necessary for on-site soil backfill to achieve an "active" loading condition. Lateral movement of the top of the wall equal to 0.001 times the height of the wall will be necessary for the "active" pressure condition for imported granular structural backfill.

6.1 Retaining Wall Backfill Materials

For lateral earth pressure analysis, Atlas anticipates that the soils of interest will be the onsite native sandy silt soils compacted structural fill. Clayey soils are not suitable for use as backfill on the soil side of walls. Seismic lateral earth pressures have also been provided in the following tables, and were calculated per the Whitman method. For sandy silt soils, the following values are applicable under non-surcharged conditions.

Table 3 – Lateral Earth Pressure Values for Native Soil – Drained Conditions

Soil Type: Sandy Silt			
Internal Friction Angle:	28 °	Dry Unit Weight:	105 pcf
Cohesion:	100 psf	Bouyant Unit Weight:	68 pcf
Natural Void Ratio:	0.7	Natural Moisture:	17 %
Ground Acceleration[2]:	0.173	Backfill Slope:	0 °
At rest lateral earth pressure:	65 pcf[1]		K_0= 0.53
Active lateral earth pressure:	44 pcf[1]		K_a= 0.36
Passive lateral earth pressure:	340 pcf[1]		K_p= 2.77
Seismic active lateral earth pressure:	60 pcf[1]		K_{ae}= 0.49
Seismic passive lateral earth pressure:	281 pcf[1]		K_{pe}= 2.29

[1]Lateral earth pressure values are in pounds per square foot, per foot of wall (psf/ft). Alternately, the values presented may also be considered as equivalent fluid with units of pounds per cubic foot (pcf).
[2]Ground acceleration obtained from the USGS Seismic Design Maps.

Table 4 – Lateral Earth Pressure Values for Native Soil – Undrained Conditions

Soil Type: Sandy Silt			
Internal Friction Angle:	28 °	Dry Unit Weight:	105 pcf
Cohesion:	100 psf	Bouyant Unit Weight:	68 pcf
Natural Void Ratio:	0.7	Natural Moisture:	NA
Ground Acceleration[2]:	0.173	Backfill Slope:	0 °
At rest lateral earth pressure:	118 pcf[1]		K_0= 0.53
Active lateral earth pressure:	100 pcf[1]		K_a= 0.36
Passive lateral earth pressure:	353 pcf[1]		K_p= 2.77
Seismic active lateral earth pressure:	114 pcf[1]		K_{ae}= 0.49
Seismic passive lateral earth pressure:	303 pcf[1]		K_{pe}= 2.29

[1]Lateral earth pressure values are in pounds per square foot, per foot of wall (psf/ft). Alternately, the values presented may also be considered as equivalent fluid with units of pounds per cubic foot (pcf).
[2]Ground acceleration obtained from the USGS Seismic Design Maps.

Imported, compacted, structural material, which is used to backfill the soil side of walls, must demonstrate the following characteristics:

Table 5 – Lateral Earth Pressure Values for Fill Materials – Drained Conditions

Soil Type: Compacted Sandy Gravel Fill			
Internal Friction Angle:	35 °	Dry Unit Weight:	128 pcf
Cohesion:	N/A	Bouyant Unit Weight:	83 pcf
Natural Void Ratio:	0.4	Natural Moisture:	5 %
Ground Acceleration[2]:	0.173	Backfill Slope:	0 °
At rest lateral earth pressure:	57 pcf[1]		K_0= 0.43
Active lateral earth pressure:	36 pcf[1]		K_a= 0.27
Passive lateral earth pressure:	496 pcf[1]		K_p= 3.69
Seismic active lateral earth pressure:	54 pcf[1]		K_{ae}= 0.40
Seismic passive lateral earth pressure:	410 pcf[1]		K_{pe}= 3.05

[1]Lateral earth pressure values are in pounds per square foot, per foot of wall (psf/ft). Alternately, the values presented may also be considered as equivalent fluid with units of pounds per cubic foot (pcf).
[2]Ground acceleration obtained from the USGS Seismic Design Maps.

Table 6 – Lateral Earth Pressure Values for Fill Materials – Undrained Conditions

Soil Type: Compacted Sandy Gravel Fill			
Internal Friction Angle:	35 °	Dry Unit Weight:	128 pcf
Cohesion:	N/A	Bouyant Unit Weight:	83 pcf
Natural Void Ratio:	0.4	Natural Moisture:	NA
Ground Acceleration[2]:	0.173	Backfill Slope:	0 °
At rest lateral earth pressure:	117 pcf[1]		K_0= 0.43
Active lateral earth pressure:	97 pcf[1]		K_a= 0.27
Passive lateral earth pressure:	535 pcf[1]		K_p= 3.69
Seismic active lateral earth pressure:	114 pcf[1]		K_{ae}= 0.40
Seismic passive lateral earth pressure:	453 pcf[1]		K_{pe}= 3.05

[1]Lateral earth pressure values are in pounds per square foot, per foot of wall (psf/ft). Alternately, the values presented may also be considered as equivalent fluid with units of pounds per cubic foot (pcf).
[2]Ground acceleration obtained from the USGS Seismic Design Maps.

Please note that the values for seismic lateral earth pressures are calculated using both the static and seismic coefficients. The effect of seismic conditions alone is the difference between the static and seismic lateral earth pressures presented above.

In the case that another material is used for backfill, Atlas should be consulted for alternate lateral earth pressure values. Granular structural fill should consist of 4-inch-minus select, clean, granular soil with no more than 30 percent oversize (greater than ¾-inch) material and no more than 5 percent non-plastic fines (passing the No. 200 sieve). Retaining wall and basement backfill must be placed in accordance with recommendations in the **Structural Fill** section of this report and must be properly compacted and tested.

Lateral earth pressure values do not incorporate specific factors of safety, and are only applicable for non-surcharged, drained conditions. Factors of safety, if applicable, should be integrated into the structural design of the wall. The preceding values are presented for idealized conditions relating to simple shallow structures. For complex structures, deep structures, or structures with significant perimeter landscaping, a soils engineer should be retained as part of the design team in developing appropriate project design parameters and construction specifications.

6.2 Retaining Wall Drainage

Atlas recommends that a drainage system be incorporated into the retained soil mass. This can be accomplished by installing wall and toe drains as a part of each soil-supporting wall system. In areas where there is potential for significantly high soil moistures within the supported soil mass, installation of drains within the soil mass is recommended. Particular consideration of roof drain effluent and irrigation water must be made. Further, these drainage systems must be separate from other retaining wall/foundation systems. If the granular structural fill option to reduce lateral pressures is used, a compacted low permeability soil cap is recommended within the upper 2 feet of the surface to limit surface water infiltration behind the walls.

7. FOUNDATION AND SLAB DISCUSSION AND RECOMMENDATIONS

Various foundation types have been considered for support of the proposed structure. Two requirements must be met in the design of foundations. First, the applied bearing stress must be less than the ultimate bearing capacity of foundation soils to maintain stability. Second, total and differential settlement must not exceed an amount that will produce an adverse behavior of the superstructure. Allowable settlement is usually exceeded before bearing capacity considerations become important; thus, allowable bearing pressure is normally controlled by settlement considerations.

7.1 Foundation Design Recommendations

7.1.1 Admin/Control/Dewatering Building, Blower Building, and Tertiary Filtration Building

Because of the presence of deep zones of soft lean clay soils, settlement of the heavier structures is likely to occur and could be on the order of multiple inches. The following foundation options have been provided to mitigate the amount of potential settlement, and have been listed in an order of increasing risk for settlement.

Option 1: Deep Foundation System (Least Risk)

Atlas recommends that the structures be founded upon a deep foundation system. The deep foundation system should consist of a pier element to allow for penetration of the soft lean clay soils and extend to the basalt rock that is expected to be present beneath the clays. This should consist of rammed earth aggregate piers, micropiles, or concrete caissons. Atlas is available for further design and development if this option is selected.

Option 2: Raft or Mat Slab

Atlas recommends that a raft or mat foundation be constructed for support of the structures. This type of foundation element will provide for reduced soil contact pressures, bridging of week soils from mat rigidity, and an increase in tolerable amounts of settlement. This option will require the following:

1. A net allowable bearing pressure of 1,500 pounds per square foot shall be used for the design of the mat foundation system.
2. The existing subgrade below the mat foundation shall be excavated to a depth of at least 3 feet. All existing fill materials (if encountered) must be completely removed from below the mat foundation.
3. Compact the native lean clay soils to at least 95% of the maximum dry density as determined by ASTM D1557.
4. A separation fabric must be installed over the native, compacted subgrade. Then at least 3 feet of compacted, granular structural fill must be placed beneath the mat foundation. Fill must meet the requirements of and be placed in accordance with the **Structural Fill** section of this report.

For raft or mat slabs bearing on 3 feet of compacted granular structural fill material, a *k* value of 225 pci may be used for the slab design based on correlation to values typically resulting from a 1 foot by 1 foot plate load test. However, depending on how the slab load is applied, the value will need to be geometrically modified. The values should be adjusted for larger areas using the following expression(s):

Modulus of Subgrade Reaction for Square Mat Slabs: $k_s = k\left(\frac{B+1}{2B}\right)^2$

where: k_s = coefficient of vertical subgrade reaction for loaded square area,
k = coefficient of vertical subgrade reaction for a 1 square foot area, and
B = effective width of area loaded, in feet.

Modulus of Subgrade Reaction for Rectangular Mat Slabs: $k' = \frac{k_s(1+0.5\left(\frac{B}{L}\right))}{1.5}$

where: k' = coefficient of vertical subgrade reaction for the loaded rectangular area,
k_s = coefficient of vertical subgrade reaction for loaded square area,
B = effective width of area loaded, in feet,
L = effective length of area loaded, in feet.

Option 3: Conventional Spread Foundations on Geogrid Reinforced Prism (Most Risk)

Based on data obtained from the site and test results from various laboratory tests performed, Atlas recommends the following guidelines for the net allowable soil bearing capacity:

Table 7 – Soil Bearing Capacity

Footing Depth	ASTM D1557 Subgrade Compaction	Net Allowable Soil Bearing Capacity
Footings must bear on at least 3 feet of compacted structural fill (ISPWC Type 1 crushed aggregate base) reinforced with two layers of Tensar TX 160 geogrid. Geogrid reinforced fill must bear on compacted, native lean clay soils.[1] The exposed subgrade should be prepared as follows: 1. Compact the native lean clay soils to at least 95% of the maximum dry density as determined by ASTM D1557. 2. A separation fabric (Contech C-200 or equivalent) should be installed over the exposed, compacted subgrade. Twelve inches of structural fill should be placed over the separation fabric and be compacted to at least 95% of the maximum dry density as determined by ASTM D1557. 3. A layer of Tensar TX 160 geogrid should be placed over the compacted structural fill followed by 12 inches of compacted structural fill. This process should be continued until two layers of geogrid are in place. At least 12 inches of compacted structural fill should be placed over the top layer of geogrid. Geogrid should extend a minimum of 2 feet beyond the footings on all sides. Geogrid should be overlapped a minimum distance of 24 inches between splices. See the attached Figure 3 for graphical representation of this system. The recommendations provided apply to maximum column and wall footings of 8 feet in width.	95% for Native Soils and Structural Fill	2,000 lbs/ft^2

[1]It will be required for Atlas personnel to verify the bearing soil suitability for each structure at the time of construction.
[2]Depending on the time of year construction takes place, the subgrade soils may be unstable because of high moisture contents. If unstable conditions are encountered, over-excavation and replacement with granular structural fill and/or use of geotextiles may be required.

7.1.2 Lift Station Structure

Based on data obtained from the site and test results from various laboratory tests performed, Atlas recommends the lift station structure be founded upon a raft/mat slab foundation structure and the following guidelines for the net allowable soil bearing capacity:

Table 8 – Lift Station Structure Soil Bearing Capacity

Slab Depth	ASTM D1557 Subgrade Compaction	Net Allowable Soil Bearing Capacity
The raft or mat slab must bear on at least 12 inches of compacted structural fill bearing on competent, compacted, native lean clay soils or compacted structural fill. Existing fill materials (if encountered) must be completely removed from below foundation elements.[1] It is Atlas' understanding that these elements will be founded approximately 18 feet below existing grade.[2] Dewatering will be required prior to compaction of native soils and placement of structural fill.	95% for Native Soils and Structural Fill	3,000 lbs/ft^2
The raft or mat slab must bear on competent, intact basalt formations (separation with a 6 inch thick minimum sand or aggregate base layer is required) or compacted structural fill bearing on competent, intact basalt formations. Existing lean clay soils and fill materials (if encountered) must be completely removed from below foundation elements.[1] It is Atlas' understanding that these elements will be founded approximately 18 feet below existing grade.[2] Dewatering will be required prior to placement of structural fill.	95% Structural Fill	4,000 lbs/ft^2

[1]It will be required for Atlas personnel to verify the bearing soil suitability for each structure at the time of construction.
[2]Depending on the time of year construction takes place, the subgrade soils may be unstable because of high moisture contents. If unstable conditions are encountered, over-excavation and replacement with granular structural fill and/or use of geotextiles may be required.

7.1.3 Splitter Box Structure

Based on data obtained from the site and test results from various laboratory tests performed, Atlas recommends the splitter box structure be founded upon a raft/mat slab foundation structure and the following guidelines for the net allowable soil bearing capacity:

Table 9 – Splitter Box Structure Soil Bearing Capacity

Slab Depth	ASTM D1557 Subgrade Compaction	Net Allowable Soil Bearing Capacity
The raft or mat slab must bear on at least 12 inches of compacted structural fill bearing on competent, compacted, native lean clay soils or compacted structural fill. Existing fill materials (if encountered) must be completely removed from below foundation elements.[1] It is Atlas' understanding that these elements will be founded approximately 4 feet below existing grade.[2]	95% for Native Soils and Structural Fill	1,500 lbs/ft^2 A ⅓ increase is allowable for short-term loading, which is defined by seismic events or designed wind speeds.

[1]It will be required for Atlas personnel to verify the bearing soil suitability for each structure at the time of construction. [2]Depending on the time of year construction takes place, the subgrade soils may be unstable because of high moisture contents. If unstable conditions are encountered, over-excavation and replacement with granular structural fill and/or use of geotextiles may be required.

7.1.4 Additional Foundation Information

For raft or mat slabs bearing on at least 12 inches of compacted granular structural fill material, a *k* value of 200 pci may be used for the slab design based on correlation to values typically resulting from a 1 foot by 1 foot plate load test. However, depending on how the slab load is applied, the value will need to be geometrically modified. The values should be adjusted for larger areas using the following expression(s):

Modulus of Subgrade Reaction for Square Mat Slabs: $k_s = k\left(\frac{B+1}{2B}\right)^2$

where: k_s = coefficient of vertical subgrade reaction for loaded square area,
k = coefficient of vertical subgrade reaction for a 1 square foot area, and
B = effective width of area loaded, in feet.

Modulus of Subgrade Reaction for Rectangular Mat Slabs: $k' = \frac{k_s(1+0.5(\frac{B}{L}))}{1.5}$

where: k' = coefficient of vertical subgrade reaction for the loaded rectangular area,
k_s = coefficient of vertical subgrade reaction for loaded square area,
B = effective width of area loaded, in feet,
L = effective length of area loaded, in feet.

The following sliding frictional coefficient values should be used: 1) 0.35 for footings bearing on native lean clay soils and 2) 0.45 for footings bearing on granular structural fill. A passive lateral earth pressure of 340 pounds per square foot per foot (psf/ft) should be used for sandy silt soils. For compacted sandy gravel fill, a passive lateral earth pressure of 496 psf/ft should be used.

Footings should be proportioned to meet either the stated soil bearing capacity or the 2018 IBC minimum requirements. Total settlement should be limited to approximately 1 inch, and differential settlement should be limited to approximately ½ inch. Objectionable soil types encountered at the bottom of footing excavations should be removed and replaced with structural fill. Excessively loose or soft areas that are encountered in the footings subgrade will require over-excavation and backfilling with structural fill. To minimize the effects of slight differential movement that may occur because of variations in the character of supporting soils and seasonal moisture content, Atlas recommends continuous footings be suitably reinforced to make them as rigid as possible. For frost protection, the bottom of external footings should be 30 inches below finished grade.

7.2 Floor Slab-on-Grade

Uncontrolled fill was encountered in boring 4. Atlas recommends that these fill materials be compacted to at least 95 percent of the maximum dry density as determined by ASTM D1557. Once final grades have been determined, Atlas is available to provide additional recommendations.

Organic, loose, or obviously compressive materials must be removed prior to placement of concrete floors or floor-supporting fill. In addition, the remaining subgrade should be treated in accordance with guidelines presented in the **Earthwork** section. Areas of excessive yielding should be excavated and backfilled with structural fill. Fill used to increase the elevation of the floor slab should meet requirements detailed in the **Structural Fill** section. Fill materials must be compacted to a minimum 95 percent of the maximum dry density as determined by ASTM D1557.

A free-draining granular mat should be provided below slabs-on-grade to provide drainage and a uniform and stable bearing surface. This should be a minimum of 4 inches in thickness and properly compacted. The mat should consist of a sand and gravel mixture, complying with Idaho Standards for Public Works Construction (ISPWC) specifications for ¾-inch (Type 1) crushed aggregate. The granular mat should be compacted to no less than 95 percent of the maximum dry density as determined by ASTM D1557. A moisture-retarder should be placed beneath floor slabs to minimize potential ground moisture effects on moisture-sensitive floor coverings. The moisture-retarder should be at least 15-mil in thickness and have a permeance of less than 0.01 US perms as determined by ASTM E96. Placement of the moisture-retarder will require special consideration with regard to effects on the slab-on-grade and should adhere to recommendations outlined in the ACI 302.1R and ASTM E1745 publications. Upon request, Atlas can provide further consultation regarding installation.

8. CONSTRUCTION CONSIDERATIONS

8.1 Earthwork

Excessively organic soils, deleterious materials, or disturbed soils generally undergo high volume changes when subjected to loads, which is detrimental to subgrade behavior in the area of pavements, floor slabs, structural fills, and foundations. Thick grasses with associated root systems were noted at the time of our investigation. It is recommended that organic or disturbed soils, if encountered, be removed to depths of 1 foot (minimum), and wasted or stockpiled for later use. Stripping depths should be adjusted in the field to assure that the entire root zone or disturbed zone or topsoil are removed prior to placement and compaction of structural fill materials. Exact removal depths should be determined during grading operations by Atlas personnel, and should be based upon subgrade soil type, composition, and firmness or soil stability. If underground storage tanks, underground utilities, wells, or septic systems are discovered during construction activities, they must be decommissioned then removed or abandoned in accordance with governing Federal, State, and local agencies. Excavations developed as the result of such removal must be backfilled with structural fill materials as defined in the **Structural Fill** section.

Atlas should oversee subgrade conditions (i.e., moisture content) as well as placement and compaction of new fill (if required) after native soils are excavated to design grade. Recommendations for structural fill presented in this report can be used to minimize volume changes and differential settlements that are detrimental to the behavior of footings, pavements, and floor slabs. Sufficient density tests should be performed to properly monitor compaction. For structural fill beneath building structures, one in-place density test per lift for every 5,000 square feet is recommended. In parking and driveway areas, this can be decreased to one test per lift for every 10,000 square feet.

8.2 Dry Weather

If construction is to be conducted during dry seasonal conditions, many problems associated with soft soils may be avoided. However, some rutting of subgrade soils may be induced by shallow groundwater conditions related to springtime runoff or irrigation activities during late summer through early fall. Solutions to problems associated with soft subgrade soils are outlined in the **Soft Subgrade Soils** section. Problems may also arise because of lack of moisture in native and fill soils at time of placement. This will require the addition of water to achieve near-optimum moisture levels. Low-cohesion soils exposed in excavations may become friable, increasing chances of sloughing or caving. Measures to control excessive dust should be considered as part of the overall health and safety management plan.

8.3 Wet Weather

If construction is to be conducted during wet seasonal conditions (commonly from mid-November through May), problems associated with soft soils must be considered as part of the construction plan. During this time of year, fine-grained soils such as silts and clays will become unstable with increased moisture content, and eventually deform or rut. Additionally, constant low temperatures reduce the possibility of drying soils to near optimum conditions.

8.4 Soft Subgrade Soils

Shallow fine-grained subgrade soils that are high in moisture content should be expected to pump and rut under construction traffic. During periods of wet weather, construction may become very difficult if not impossible. The following recommendations and options have been included for dealing with soft subgrade conditions:

- Track-mounted vehicles should be used to strip the subgrade of root matter and other deleterious debris. Heavy rubber-tired equipment should be prohibited from operating directly on the native subgrade and areas in which structural fill materials have been placed. Construction traffic should be restricted to designated roadways that do not cross, or cross on a limited basis, proposed roadway or parking areas.
- Soft areas can be over-excavated and replaced with granular structural fill.
- Construction roadways on soft subgrade soils should consist of a minimum 2-foot thickness of large cobbles of 4 to 6 inches in diameter with sufficient sand and fines to fill voids. Construction entrances should consist of a 6-inch thickness of clean, 2-inch minimum, angular drain-rock and must be a minimum of 10 feet wide and 30 to 50 feet long. During the construction process, top dressing of the entrance may be required for maintenance.
- Scarification and aeration of subgrade soils can be employed to reduce the moisture content of wet subgrade soils. After stripping is complete, the exposed subgrade should be ripped or disked to a depth of 1½ feet and allowed to air dry for 2 to 4 weeks. Further disking should be performed on a weekly basis to aid the aeration process.
- Alternative soil stabilization methods include use of geotextiles, lime, and cement stabilization. Atlas is available to provide recommendations and guidelines at your request.

8.5 Frozen Subgrade Soils

Prior to placement of structural fill materials or foundation elements, frozen subgrade soils must either be allowed to thaw or be stripped to depths that expose non-frozen soils and wasted or stockpiled for later use. Stockpiled materials must be allowed to thaw and return to near-optimal conditions prior to use as structural fill.

The onsite, shallow clayey and silty soils are susceptible to frost heave during freezing temperatures. For exterior flatwork and other structural elements, adequate drainage away from subgrades is critical. Compaction and use of structural fill will also help to mitigate the potential for frost heave. Complete removal of frost susceptible soils for the full frost depth, followed by replacement with a non-frost susceptible structural fill, can also be used to mitigate the potential for frost heave. Atlas is available to provide further guidance/assistance upon request.

8.6 Structural Fill

Soils recommended for use as structural fill are those classified as GW, GP, SW, and SP in accordance with the Unified Soil Classification System (USCS) (ASTM D2487). Use of silty soils (USCS designation of GM, SM, and ML) as structural fill may be acceptable. However, use of silty soils (GM, SM, and ML) as structural fill below footings is prohibited. These materials require very high moisture contents for compaction and require a long time to dry out if natural moisture contents are too high and may also be susceptible to frost heave under certain conditions. Therefore, these materials can be quite difficult to work with as moisture content, lift thickness, and compactive effort becomes difficult to control. If silty soil is used for structural fill, lift thicknesses should not exceed 6 inches (loose), and fill material moisture must be closely monitored at both the working elevation and the elevations of materials already placed. Following placement, silty soils must be protected from degradation resulting from construction traffic or subsequent construction.

Recommended granular structural fill materials, those classified as GW, GP, SW, and SP, should consist of a 6-inch minus select, clean, granular soil with no more than 50 percent oversize (greater than ¾-inch) material and no more than 12 percent fines (passing No. 200 sieve). These fill materials should be placed in layers not to exceed 12 inches in loose thickness. Prior to placement of structural fill materials, surfaces must be prepared as outlined in the **Construction Considerations** section. Structural fill material should be moisture-conditioned to achieve optimum moisture content prior to compaction. For structural fill below footings, areas of compacted backfill must extend outside the perimeter of the footings for a distance equal to the thickness of fill between the bottom of foundation and underlying soils, or 5 feet, whichever is less. All fill materials must be monitored during placement and tested to confirm compaction requirements, outlined below, have been achieved.

Each layer of structural fill must be compacted, as outlined below:

- Below Structures and Rigid Pavements: A minimum of 95 percent of the maximum dry density as determined by ASTM D1557.
- Below Flexible Pavements: A minimum of 92 percent of the maximum dry density as determined by ASTM D1557 or 95 percent of the maximum dry density as determined by ASTM D698.

The ASTM D1557 test method must be used for samples containing up to 40 percent oversize (greater than ¾-inch) particles. If material contains more than 40 percent but less than 50 percent oversize particles, compaction of fill must be confirmed by proof rolling each lift with a 10-ton vibratory roller (or equivalent) until the maximum density has been achieved. Density testing must be performed after each proof rolling pass until the in-place density test results indicate a drop (or no increase) in the dry density, defined as maximum density or "break over" point. The number of required passes should be used as the requirements on the remainder of fill placement. Material should contain sufficient fines to fill void spaces, and must not contain more than 50 percent oversize particles.

8.7 Backfill of Walls

Backfill materials must conform to the requirements of structural fill, as defined in this report. For wall heights greater than 2.5 feet, the maximum material size should not exceed 4 inches in diameter. Placing oversized material against rigid surfaces interferes with proper compaction, and can induce excessive point loads on walls. Backfill shall not commence until the wall has gained sufficient strength to resist placement and compaction forces. Further, retaining walls above 2.5 feet in height shall be backfilled in a manner that will limit the potential for damage from compaction methods and/or equipment. It is recommended that only small hand-operated compaction equipment be used for compaction of backfill within a horizontal distance equal to the height of the wall, measured from the back face of the wall.

Backfill should be compacted in accordance with the specifications for structural fill, except in those areas where it is determined that future settlement is not a concern, such as planter areas. In nonstructural areas, backfill must be compacted to a firm and unyielding condition.

8.8 Pipe Bedding

Atlas recommends that ISPWC Division 300 be followed for trenching excavation, trench foundation stabilization, pipe bedding, and trench backfill requirements. It is anticipated that dewatering will be required. The excavation should be kept reasonably free from water and the water should be drawn down at least 1 foot below the trench bottom. Water should not be allowed to rise into the unbackfilled trench. It should be anticipated that the native saturated soft soils and native granular sediments will readily slough and that temporary shoring will be required.

Unstable soil conditions at the trench bottom will require over-excavation, as determined by Atlas personnel. If the trench bottom is over-excavated, place replacement fill in maximum 6 inch thick lifts and compact each lift to 95% of the maximum dry density as determined by AASHTO T99/ASTM D698 prior to placement of the bedding or foundation stabilization material. Replacement fill shall consist of Type II Aggregate as defined in ISPWC Section 304.2.2 A.

All pipe bedding materials must meet the requirements of and be placed in accordance with ISPWC Section 305. The onsite native soils may be used as trench backfill material provided they meet the requirements of ISPWC Section 306.2.2. It should be anticipated that the native soils will be above optimum moisture contents. Native soils used as backfill material must be at or below optimum moisture content prior to placement. Imported backfill material may also be used and must be in accordance with ISPWC Sections 306.2.3 and 306.2.4.

8.9 Excavations

Shallow excavations that do not exceed 4 feet in depth may be constructed with side slopes approaching vertical. Below this depth, it is recommended that slopes be constructed in accordance with Occupational Safety and Health Administration (OSHA) regulations, Section 1926, Subpart P. Based on these regulations, on-site soils are classified as type "C" soil, and as such, excavations within these soils should be constructed at a maximum slope of 1½ feet horizontal to 1 foot vertical (1½:1) for excavations up to 20 feet in height. Excavations in excess of 20 feet will require additional analysis. Note that these slope angles are considered stable for short-term conditions only, and will not be stable for long-term conditions.

During the subsurface exploration, boring sidewalls generally exhibited little indication of collapse. For deep excavations, native granular sediments cannot be expected to remain in position. These materials are prone to failure and may collapse, thereby undermining upper soil layers. This is especially true when excavations approach depths near the water table. Care must be taken to ensure that excavations are properly backfilled in accordance with procedures outlined in this report.

8.10 Groundwater Control

Groundwater was encountered during the investigation but is anticipated to be below the depth of most construction. Excavations below the water table will require a dewatering program. Dewatering will be required prior to placement of fill materials. Placement of concrete can be accomplished through water by the use of a treme. It may be possible to discharge dewatering effluent to remote portions of the site, to a sump, or to a pit. This will essentially recycle effluent, thus eliminating the need to enter into agreements with local drainage authorities. Should the scope of the proposed project change, Atlas should be contacted to provide more detailed groundwater control measures.

Special precautions may be required for control of surface runoff and subsurface seepage. It is recommended that runoff be directed away from open excavations. Silty and clayey soils may become soft and pump if subjected to excessive traffic during time of surface runoff. Ponded water in construction areas should be drained through methods such as trenching, sloping, crowning grades, nightly smooth drum rolling, or installing a French drain system. Additionally, temporary or permanent driveway sections should be constructed if extended wet weather is forecasted.

9. GENERAL COMMENTS

Based on the subsurface conditions encountered during this investigation and available information regarding the proposed structures, the site is adequate for the planned construction. When plans and specifications are complete, and if significant changes are made in the character or location of the proposed structures, consultation with Atlas must be arranged as supplementary recommendations may be required. Suitability of subgrade soils and compaction of structural fill materials must be verified by Atlas personnel prior to placement of structural elements. Additionally, monitoring and testing should be performed to verify that suitable materials are used for structural fill and that proper placement and compaction techniques are utilized.

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U.S. Department of Labor, Occupational Safety and Health Administration. CFR 29, Part 1926, Subpart P: Safety and Health Regulations for Construction, Excavations (1986). [Online] Available: <www.osha.gov> (2021).

Appendix I WARRANTY AND LIMITING CONDITIONS

Atlas warrants that findings and conclusions contained herein have been formulated in accordance with generally accepted professional engineering practice in the fields of foundation engineering, soil mechanics, and engineering geology only for the site and project described in this report. These engineering methods have been developed to provide the client with information regarding apparent or potential engineering conditions relating to the site within the scope cited above and are necessarily limited to conditions observed at the time of the site visit and research. Field observations and research reported herein are considered sufficient in detail and scope to form a reasonable basis for the purposes cited above.

Exclusive Use

This report was prepared for exclusive use of the property owner(s), at the time of the report, and their retained design consultants ("Client"). Conclusions and recommendations presented in this report are based on the agreed-upon scope of work outlined in this report together with the Contract for Professional Services between the Client and Atlas Technical Consultants ("Consultant"). Use or misuse of this report, or reliance upon findings hereof, by parties other than the Client is at their own risk. Neither Client nor Consultant make representation of warranty to such other parties as to accuracy or completeness of this report or suitability of its use by such other parties for purposes whatsoever, known or unknown, to Client or Consultant. Neither Client nor Consultant shall have liability to indemnify or hold harmless third parties for losses incurred by actual or purported use or misuse of this report. No other warranties are implied or expressed.

Report Recommendations are Limited and Subject to Misinterpretation

There is a distinct possibility that conditions may exist that could not be identified within the scope of the investigation or that were not apparent during our site investigation. Findings of this report are limited to data collected from noted explorations advanced and do not account for unidentified fill zones, unsuitable soil types or conditions, and variability in soil moisture and groundwater conditions. To avoid possible misinterpretations of findings, conclusions, and implications of this report, Atlas should be retained to explain the report contents to other design professionals as well as construction professionals.

Since actual subsurface conditions on the site can only be verified by earthwork, note that construction recommendations are based on general assumptions from selective observations and selective field exploratory sampling. Upon commencement of construction, such conditions may be identified that require corrective actions, and these required corrective actions may impact the project budget. Therefore, construction recommendations in this report should be considered preliminary, and Atlas should be retained to observe actual subsurface conditions during earthwork construction activities to provide additional construction recommendations as needed.

Since geotechnical reports are subject to misinterpretation, **do not** separate the soil logs from the report. Rather, provide a copy of, or authorize for their use, the complete report to other design professionals or contractors. Locations of exploratory sites referenced within this report should be considered approximate locations only. For more accurate locations, services of a professional land surveyor are recommended.

This report is also limited to information available at the time it was prepared. In the event additional information is provided to Atlas following publication of our report, it will be forwarded to the client for evaluation in the form received.

Environmental Concerns

Comments in this report concerning either onsite conditions or observations, including soil appearances and odors, are provided as general information. These comments are not intended to describe, quantify, or evaluate environmental concerns or situations. Since personnel, skills, procedures, standards, and equipment differ, a geotechnical investigation report is not intended to substitute for a geoenvironmental investigation or a Phase II/III Environmental Site Assessment. If environmental services are needed, Atlas can provide, via a separate contract, those personnel who are trained to investigate and delineate soil and water contamination.

Vicinity Map

Figure 1

MAP NOTES:

- Not to Scale

LEGEND

Approximate Site Location

Aberdeen WWTP Upgrades
Aberdeen, ID

Modified by: KEW
November 15, 2022
Drawing: P222374g

ATLAS

149 McKinley Avenue
Pocatello, ID 83201

Phone: (208) 233-9500
Fax: (208) 233-9900
Web: oneatlas.com

Site Map

Figure 2

NOTES:

- Not to Scale

LEGEND

Approximate Site Boundary

Approximate Atlas Boring Location

Aberdeen WWTP Upgrades
2683 West 1750 South
Aberdeen, ID

Drawn by: KEW
October 27, 2022
Drawing: P222374g

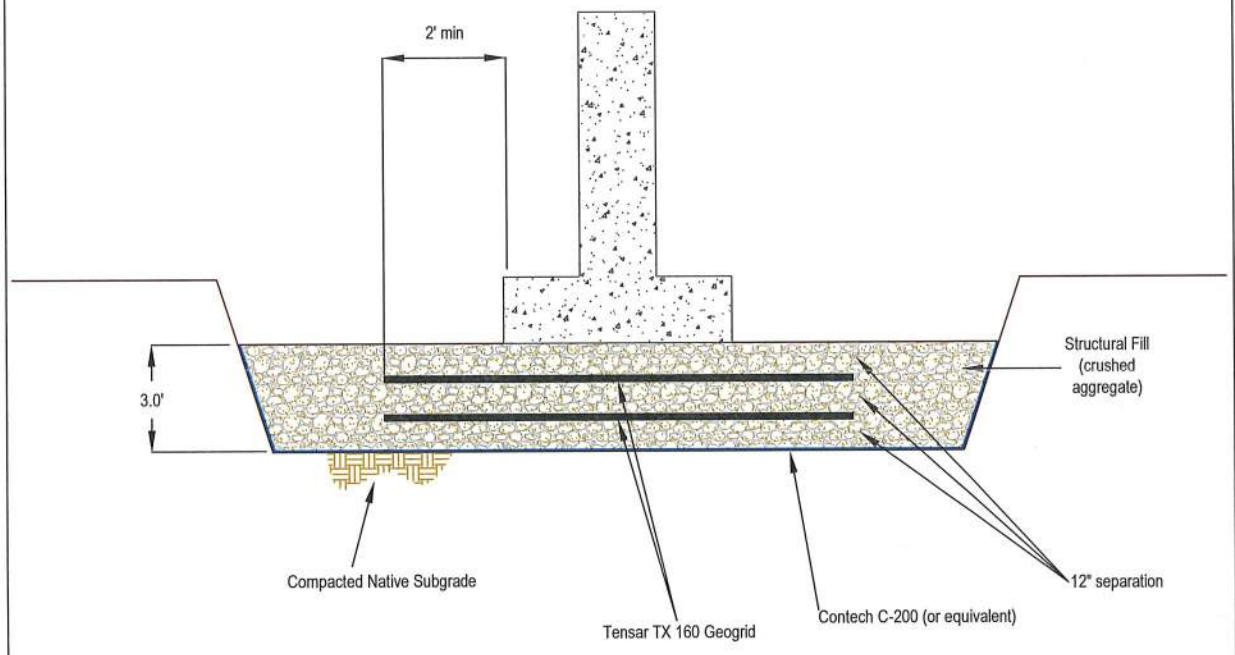
ATLAS
450 East Day St, Suite B
Pocatello, ID 83201
Phone: (208) 233-9500
Fax: (208) 233-9900
Web: oneatlas.com

Foundation Cross Section

Figure 3

NOTES:

- Structural fill must consist of ISPWC 3/4" Type 1 crushed aggregate.
- Fill material must be compacted to at least 95% of the maximum dry density as determined by ASTM D1557.
- Native subgrade soils must be compacted to at least 95% of the maximum dry density as determined by ASTM D1557.
- Geogrid to be installed in accordance with manufacturers recommendations.



NOTES:

- Not to Scale

Aberdeen WWTP Upgrades
2683 West 1750 South
Aberdeen, ID

Modified by: EJS
November 30, 2022
Drawing: P222374g

ATLAS

149 McKinley Avenue
Pocatello, ID 83301

Phone: (208) 233-9500
Fax: (208) 233-9900
Web: oneatlas.com

FIELD BORING LOG

BORING NO.: B-1
TOTAL DEPTH: 10.1'
GROUNDWATER DEPTH: None

PROJECT INFORMATION

PROJECT: Aberdeen WWTP Upgrades
LOCATION: 2683 West 1750 South
Aberdeen, ID
JOB NO.: P222374g
LOGGED BY: Keaton Ward

DRILLING INFORMATION

DRILLING CO.: Haztech Drilling, Inc.
METHOD OF DRILLING: 6" Hollow Stem Auger
SAMPLING METHODS: Split Spoon
DATES DRILLED: October 27, 2022
LATITUDE/LONGITUDE: 42.941090, -112.825639

Water level during drilling | Standard Split Spoon | Auger Sample | California Sampler

DEPTH	SOIL TYPE	DESCRIPTION	MOISTURE (%)	LL/PI	% < #4	% < #200	SAMPLE	BLOWS	BLOWS PER FOOT (N)
0		LEAN CLAY (CL): Brown, slightly moist to moist, soft to stiff, with trace fine-grained sand. --Organics noted to a depth of 0.2 foot bgs.						3,4,5	
								0,1,1	
5								5,6,6	
								1,3,3	
10		BASALT GRAVEL/FRACTURED BASALT: Dark gray, highly weathered, closely fractured, weak to moderately strong. --Refusal at 10.1 feet bgs.						50 for 1"	

0 30 60

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oneatlas.com

FIELD BORING LOG

BORING NO.: B-2
TOTAL DEPTH: 11.2'
GROUNDWATER DEPTH: None

PROJECT INFORMATION

PROJECT: Aberdeen WWTP Upgrades
LOCATION: 2683 West 1750 South
Aberdeen, ID
JOB NO.: P222374g
LOGGED BY: Keaton Ward

DRILLING INFORMATION

DRILLING CO.: Haztech Drilling, Inc.
METHOD OF DRILLING: 6" Hollow Stem Auger
SAMPLING METHODS: Split Spoon
DATES DRILLED: October 27, 2022
LATITUDE/LONGITUDE: 42.940655, -112.825609

Water level during drilling | Standard Split Spoon | Auger Sample | California Sampler

DEPTH	SOIL TYPE	DESCRIPTION	MOISTURE (%)	LL/PI	% < #4	% < #200	SAMPLE	BLOWS	BLOWS PER FOOT (N)
0		LEAN CLAY (CL): Brown, slightly moist to moist, soft to stiff, with trace fine-grained sand. --Organics noted to a depth of 0.2 foot bgs.						4,4,4	
								2,2,3	
5								1,1,3	0 30 60
			26.4	28/12	100	96.8		1,1,1	
10		--Refusal on basalt rock at 11.2 feet bgs.						0,1, 50 for 2"	0 30 60

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oneatlas.com

FIELD BORING LOG

BORING NO.: B-3
TOTAL DEPTH: 20.5'
GROUNDWATER DEPTH: 11.1'

PROJECT INFORMATION

PROJECT: Aberdeen WWTP Upgrades
LOCATION: 2683 West 1750 South, Aberdeen, ID
JOB NO.: P222374g
LOGGED BY: Keaton Ward

DRILLING INFORMATION

DRILLING CO.: Haztech Drilling, Inc.
METHOD OF DRILLING: 6" Hollow Stem Auger
SAMPLING METHODS: Split Spoon
DATES DRILLED: October 27, 2022
LATITUDE/LONGITUDE: 42.940903, -112.826393

▼ Water level during drilling | Standard Split Spoon | Auger Sample | California Sampler

DEPTH	SOIL TYPE	DESCRIPTION	MOISTURE (%)	LL/PI	% < #4	% < #200	SAMPLE	BLOWS	BLOWS PER FOOT (N)
0		SANDY SILT (ML): Brown, slightly moist to moist, soft to stiff, with fine-grained sand. --Organics noted to a depth of 0.2 foot bgs.	16.8	NP	100	59.1		2,4,4	
5								2,6,8	
								2,1,1	
		LEAN CLAY (CL): Brown, slightly moist to saturated, medium stiff to very stiff, with trace fine-grained sand.						2,4,10	
10								3,10,10	
▼									
15								1,2,3	
20		BASALT GRAVEL/FRACTURED BASALT: --Dark gray, highly weathered, closely fractured, weak to moderately strong. --Refusal at 20.5 feet bgs.						50 for 5"	

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oneatlas.com

FIELD BORING LOG

BORING NO.: B-4
TOTAL DEPTH: 15.5'
GROUNDWATER DEPTH: 13.8'

PROJECT INFORMATION

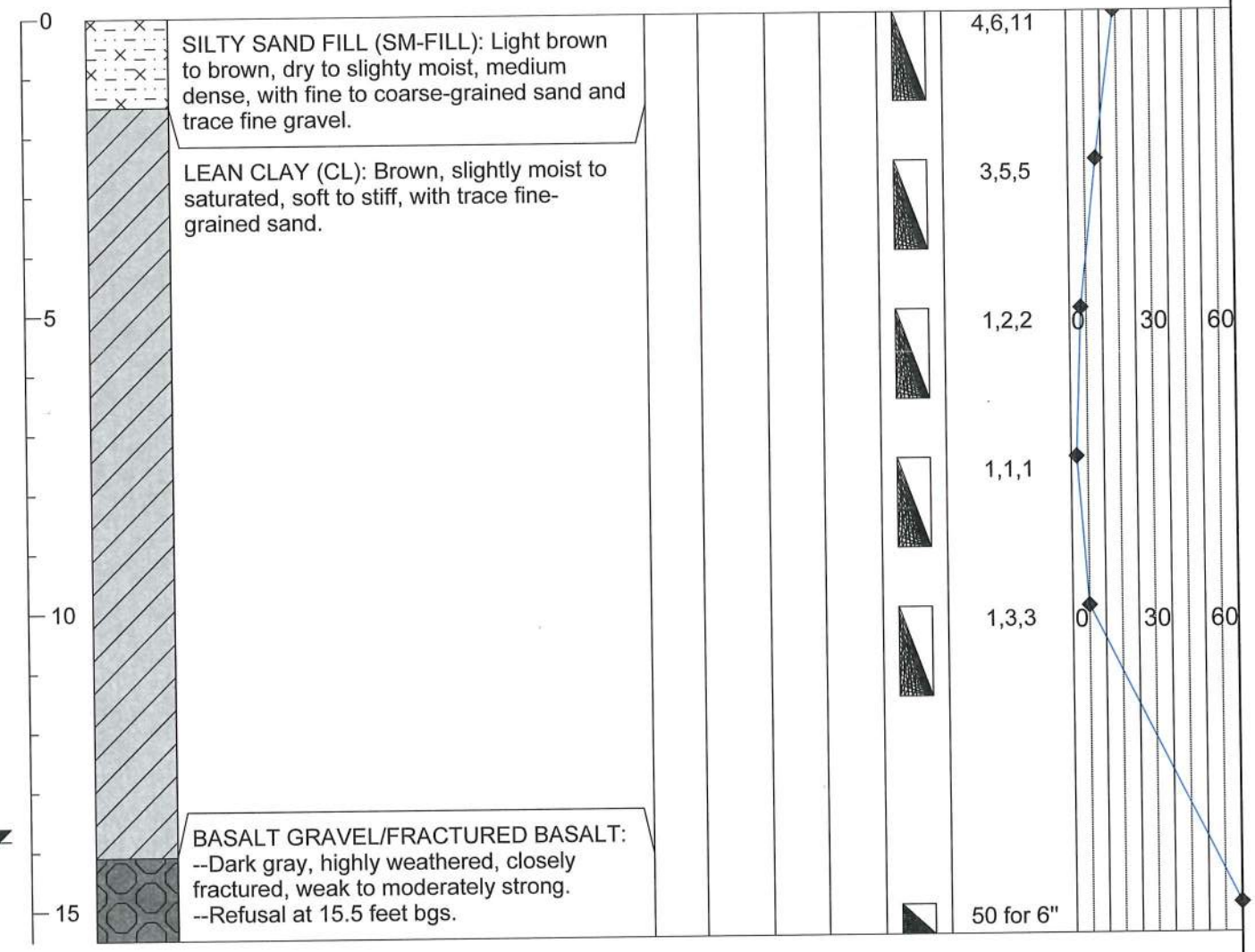
PROJECT: Aberdeen WWTP Upgrades
LOCATION: 2683 West 1750 South
Aberdeen, ID
JOB NO.: P222374g
LOGGED BY: Keaton Ward

DRILLING INFORMATION

DRILLING CO.: Haztech Drilling, Inc.
METHOD OF DRILLING: 6" Hollow Stem Auger
SAMPLING METHODS: Split Spoon
DATES DRILLED: October 27, 2022
LATITUDE/LONGITUDE: 42.940713, -112.826485

▼ Water level during drilling | Standard Split Spoon | Auger Sample | California Sampler

DEPTH	SOIL TYPE	DESCRIPTION	MOISTURE (%)	LL/PI	% < #4	% < #200	SAMPLE	BLOWS	BLOWS PER FOOT (N)
0		SILTY SAND FILL (SM-FILL): Light brown to brown, dry to slighty moist, medium dense, with fine to coarse-grained sand and trace fine gravel.						4,6,11	
		LEAN CLAY (CL): Brown, slightly moist to saturated, soft to stiff, with trace fine-grained sand.						3,5,5	
5								1,2,2	
								1,1,1	
10								1,3,3	
▼		BASALT GRAVEL/FRACTURED BASALT: --Dark gray, highly weathered, closely fractured, weak to moderately strong. --Refusal at 15.5 feet bgs.							
15								50 for 6"	



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Appendix VI GEOTECHNICAL GENERAL NOTES

Unified Soil Classification System			
Major Divisions		**Symbol**	**Soil Descriptions**
Coarse-Grained Soils < 50% passes No.200 sieve	Gravel & Gravelly Soils < 50% coarse	GW	Well-graded gravels; gravel/sand mixtures with little or no fines
		GP	Poorly-graded gravels; gravel/sand mixtures with little or no fines
		GM	Silty gravels; poorly-graded gravel/sand/silt mixtures
		GC	Clayey gravels; poorly-graded gravel/sand/clay mixtures
	Sand & Sandy Soils > 50% coarse fraction	SW	Well-graded sands; gravelly sands with little or no fines
		SP	Poorly-graded sands; gravelly sands with little or no fines
		SM	Silty sands; poorly-graded sand/gravel/silt mixtures
		SC	Clayey sands; poorly-graded sand/gravel/clay mixtures
Fine-Grained Soils > 50% passes No.200 sieve	Silts & Clays LL < 50	ML	Inorganic silts; sandy, gravelly or clayey silts
		CL	Lean clays; inorganic, gravelly, sandy, or silty, low to medium-plasticity clays
		OL	Organic, low-plasticity clays and silts
	Silts & Clays LL > 50	MH	Inorganic, elastic silts; sandy, gravelly or clayey elastic silts
		CH	Fat clays; high-plasticity, inorganic clays
		OH	Organic, medium to high-plasticity clays and silts
Highly Organic Soils		PT	Peat, humus, hydric soils with high organic content

Relative Density and Consistency Classification	
Coarse-Grained Soils	**SPT Blow Counts (N)**
Very Loose:	< 4
Loose:	4-10
Medium Dense:	10-30
Dense:	30-50
Very Dense:	> 50
Fine-Grained Soils	**SPT Blow Counts (N)**
Very Soft:	< 2
Soft:	2-4
Medium Stiff:	4-8
Stiff:	8-15
Very Stiff:	15-30
Hard:	> 30

Moisture Content and Cementation Classification	
Description	**Field Test**
Dry	Absence of moisture, dry to touch
Slightly Moist	Damp, but no visible moisture
Moist	Visible moisture
Wet	Visible free water
Saturated	Soil is usually below water table
Description	**Field Test**
Weak	Crumbles or breaks with handling or slight finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

Particle Size	
Boulders:	> 12 in.
Cobbles:	12 to 3 in.
Gravel:	3 in. to 5 mm
Coarse-Grained Sand:	5 to 0.6 mm
Medium-Grained Sand:	0.6 to 0.2 mm
Fine-Grained Sand:	0.2 to 0.075 mm
Silts:	0.075 to 0.005 mm
Clays:	< 0.005 mm

Acronym List	
GS	grab sample
LL	Liquid Limit
M	moisture content
NP	non-plastic
PI	Plasticity Index
Q_p	penetrometer value, unconfined compressive strength, tsf
V	vane value, ultimate shearing strength, tsf

Appendix VII ROCK CLASSIFICATION SYSTEM

Weathering	
Weathering	**Field Test**
Fresh	No sign of decomposition or discoloration. Rings under hammer impact.
Slightly Weathered	Slight discoloration inwards from open fractures, otherwise similar to Fresh.
Moderately Weathered	Discoloration throughout. Weaker minerals such as feldspar decomposed. Strength somewhat less than fresh rock but cores cannot be broken by hand or scraped with a knife. Texture preserved.
Highly Weathered	Most minerals somewhat decomposed. Specimens can be broken by hand with effort or shaved with knife. Core stones present in rock mass. Texture becoming indistinct but fabric preserved.
Completely Weathered	Minerals decomposed to soil but fabric and structure preserved. Specimens easily crumbled or penetrated.

Fracturing	
Spacing	**Description**
6 ft.	Very widely
2 to 6 ft.	Widely
8 to 24 in.	Moderately
2 ½ to 8 in.	Closely
¾ to 2 ½ in.	Very Closely

Rock Quality Designation (RQD)	
RQD (%)	**Rock Quality**
90 – 100	Excellent
75 to 90	Good
50 to 75	Fair
25 to 50	Poor
0 to 25	Very Poor

Competency			
Strength	**Class**	**Field Test**	**Approximate Range of Unconfined Compressive Strength (tsf)**
Extremely Strong	I	Many blows with geologic hammer required to break intact specimen.	> 2000
Very Strong	II	Hand-held specimen breaks with pick end of hammer under more than one blow.	2000 - 1000
Strong	III	Cannot be scraped or peeled with knife, hand-held specimen can be broken with single moderate blow with pick end of hammer.	1000 - 500
Moderately Strong	IV	Can just be scraped or peeled with knife. Indentations 1 mm to 3 mm show in specimen with moderate blow with pick end of hammer.	500 - 250
Weak	V	Material crumbles under moderate blow with pick end of hammer and can be peeled with a knife, but is hard to hand-trim for tri-axial test specimen.	250 - 10
Friable	VI	Material crumbles in hand.	N/A

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are <u>not</u> final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are <u>Not</u> Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will <u>not</u> of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are <u>not</u> building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

APPENDIX A.2

Geotechnical Report 2011

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Xcell Engineering, LLC
260 Laurel Lane
Chubbuck, ID 83202
Phone (208) 237-5900
Fax (208) 237-5925
E-mail: xcelleng@qwestoffice.net

August 22, 2011
P11015

Mr. Jim Mullen
Keller Associates
305 North 3rd
Suite A
Pocatello, ID 83201

RE: **Geotechnical Report**
Aberdeen WWTP
Aberdeen, Idaho

Dear Jim:

Xcell Engineering has performed the authorized geotechnical engineering evaluation for the proposed improvements to the waste water treatment plant in Aberdeen, Idaho. The purpose of our geotechnical engineering evaluation was to explore the subsurface soil and geologic conditions on the site and to provide geotechnical engineering recommendations to assist project planning, design and construction.

This report summarizes the results of our field evaluation, laboratory testing, engineering opinions, and geotechnical recommendations. The soil and groundwater conditions at the site are presented in the following report. Specific geotechnical opinions and recommendations for foundation design are included. The geotechnical recommendations presented must be read and implemented in their entirety. Portions or individual portions of the report cannot be relied upon without the supporting text of relevant sections.

The success of the proposed construction will depend in part, on following the report recommendations and good construction practice. We recommend that Xcell be retained to provide geotechnical testing and consultation services during construction to verify our report recommendations are followed. It has been our experience that maintaining continuity with a single geotechnical consultant reduces errors and contributes to overall project success and economy. We appreciate the opportunity to work with you on this project. Please call if you have questions or comments.

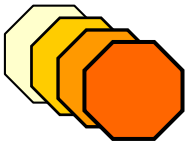
Sincerely,
Xcell Engineering, LLC

J. Paul Bastian, PE
Project Engineer

REPORT
Geotechnical Evaluation
Aberdeen WWTP
Aberdeen, Idaho

PREPARED FOR:
Keller Associates
Pocatello Idaho

PREPARED BY:
Xcell Engineering, LLC
260 Laurel Lane
Chubbuck, Idaho 83202



"Building on Excellence"

August 22, 2011

TABLE OF CONTENTS

REPORT
Geotechnical Evaluation
Aberdeen WWTP
Aberdeen, Idaho

INTRODUCTION

Xcell Engineering has performed the authorized geotechnical evaluation for the proposed improvements to the Aberdeen Waste Water Treatment Plant in Aberdeen, Idaho. The purpose of our geotechnical evaluation was to assess the soil and geologic conditions within the proposed development area and to provide geotechnical and soil related construction recommendations with respect to the proposed improvements. Our recommendations are based on our field observations and laboratory test results. To provide this evaluation of the site we conducted the following scope of work:

1. Reviewed site map and topography maps

2. Reviewed published soil and groundwater information

3. Observed the advancement of 3 borings to the depth of rock contact at 10 to 24.5 feet below the existing ground surface The soil encountered in the borings was described and classified referencing ASTM D 2487 and D 2488 Unified Soil Classification System (USCS) and the soil profiles were logged. The borings were backfilled at the time of exploration. Backfill was not compacted or landscaped.

4. Performed Standard Penetrometer testing to verify the condition of the soil types encountered in the test pits.

5. Performed laboratory testing to verify soil engineering and index properties.

6. The field and laboratory data were analyzed to provide geotechnical opinions and recommendations as outlined in our proposal.

7. Prepared and provided three copies of our final summary report of findings, opinions, and geotechnical recommendations to assist design planning and construction.

PROPOSED CONSTRUCTION

The project site is located on Cemetery Road west of Aberdeen, Idaho. We understand proposed construction will consist of a new headworks building, two new lift stations, a paired set IFAS Basins, a new clarifier, a splitter box and an electrical building. The preliminary project plans will include cuts of up to 24 feet in the location of lift station #1 and cuts of 9 to 15 feet in the IFAS and Headworks building locations. Pavement sections will be provided and are based on observed soil conditions and anticipated traffic types and volumes.

SUBSURFACE EVALUATION PROCEDURES

Three borings were advanced within the proposed project area as identified on the Site Map presented on Plate 1, which accompanies this report. Borings were advanced using auger equipment to depths of 10 to 24.5 feet. SPT was used to determine the in-place condition of soils observed in the borings. Samples were recovered for additional testing in our lab. The soil encountered in the borings was visually classified and described referencing ASTM D 2487 and D 2488, Unified Soil Classification System (USCS). The USCS is provided on Plate 2 and should be referenced to interpret the terms used throughout this report. The subsurface profiles were logged and are presented as plates 3 through 6 of this report. The exploratory boring logs including field and laboratory test data are presented in the Appendix to this report. Select soil samples were obtained for laboratory testing. Laboratory test results and engineering analyses are also included in the appendix. The borings were loosely backfilled at the conclusion of the field evaluation.

SUBSURFACE CONDITIONS

The site is located on the edge of the slough created by the water that issues from Little Hole Draw southeast of Aberdeen. Standing water adjacent to the site is approximately 5-7 feet lower than ground surface on the site and the 50 year and 100 year floodplain elevations are shown on the hydraulic profile, plate 4. Soil stratums underlying the site are consistent with a series of depositional alluvial events and ground water was observed at 5 to 8 feet below the existing ground surface.

Subsurface soil conditions typically consisted of 10 to 24.5 feet of very soft to stiff silt/ clay underlain by hard, massive basalt. The silt/clay is saturated, highly frost sensitive and prone to time rate consolidation. The basalt is part of the Snake River basalt complex and is hard and massive having compressive strengths typically in the range of 6,000 to 12,000 psi.

LABORATORY TESTING

Samples of the silt were tested to assess the Atterberg Limits, moisture content, and percent passing the No. 200 sieve. Friction angle (Ø) of the saturated silt/clay will be very low (on the order of 5-12 and resulting bearing capacities will be lower. Conventional excavation and pneumatic or blasting equipment will be required for rock excavation to the depths indicated.

GENERAL OPINIONS AND RECOMMENDATIONS

Our geotechnical opinions and recommendations are presented in the following sections to assist project planning, design, and construction. Our recommendations are based on the results of our field evaluation, laboratory testing, experience with similar projects in the area, and our understanding of the proposed construction. These opinions and recommendations reflect our conversations with the project team and are based, in part on information provided on the site plan. If design plans change, Xcell Engineering should be notified to review our report recommendations and make necessary modifications.

Soil and rock conditions were observed to be relatively uniform across the site. Depth to basalt appears to increase to the north and northwest. If subsurface conditions are found during construction that vary from those described in the test locations Xcell Engineering should be notified.

Site Preparation

Dewatering will be required to excavate to the planned depths. Dewatering may be achieved by trench and sump systems or by installation of well points and pumps. We anticipate that pumped water volumes for individual buildings may be as high a 100

gpm initially and drop to relatively low pumping rates on the order of 10 to 12 gpm within the first 2-5 days. The preceding pumping rates are estimated only and actual rates will depend on the size and depth of areas being dewatered as well as depth to groundwater at the time dewatering is performed. Dewatering plans should be reviewed by our office prior to approval and implementation. Vegetation on the site is minimal and stripping requirements will be minimal. A depth of 2-4 inches for stripping and grubbing will typically be adequate. An engineer from our office should review all site generated fill material prior to its acceptance and placement. All stumps and roots over 3 inches in diameter shall be removed as part of the site preparation.

After stripping and grubbing, the exposed soil may be loose and disturbed. We recommend any loose native soil disturbed by the stripping and grubbing process be compacted in-place to at least 95% of its maximum dry density per ASTM D-698. If pumping or unstable soil is observed during compaction, the unstable soil should be removed and replaced with compacted structural fill.

Subgrade preparation for all improvements including roads, sidewalks and building areas should include compaction of loose or disturbed sub-grade soil to at least 95 percent of its maximum dry density as determined by ASTM D-698 (Standard Proctor). Subgrade soil should be properly moisture conditioned prior to attempting compaction efforts. Optimum moisture content for compaction will vary with soil types. Therefore, the contractor should anticipate a moisture conditioning effort to achieve acceptable moisture levels. Xcell should review the compaction process prior to placement of structural fill.

Excavation Characteristics

Native silt is a class B soil per OSHA definitions and may be excavated using conventional soil excavation techniques. Excavations in the silt can be vertical up to 4 feet in depth. Trench excavations deeper than 4 feet should allow provisions for excavations to be sloped back at 1:1 (horizontal to vertical). Underlying rock and indurated sand may be excavated to a slope of ¼ :1 if reviewed and approved by an engineer from our office. These materials at this slope will create a falling materials

hazard. Care should be taken to protect individuals working under these slopes. Deeper trenches and excavations should be reviewed by a professional engineer licensed in the State of Idaho.

Structural Fill

Structural fill should be of high quality and should not be saturated or contain vegetation, organic matter, frozen clods, debris or other deleterious materials and should meet the soil classification requirements for GW, GP, GM, SW or SP soil types. Structural fill should not contain rocks or aggregate larger than 6 inches in any dimension because the compaction equipment will tend to ride on the larger aggregate which hinders uniform compaction of the lift and can lead to poorly or non-uniformly compacted fill. All fill should be placed in loose lifts not more than 8-inches thick and each lift should be compacted to at least 95% of its maximum dry density per ASTM D-698 prior to placement of additional fill.

Seismicity

The 2006 International Building Code (IBC) will be utilized for project structural design. Section 1615.1 of the 2006 IBC outlines the procedure for evaluating site ground motions and design-spectral response accelerations. Site soil and USGS seismic data and the project location were used to establish earthquake-loading criteria at the site referencing Section 1615.1 of the 2006 IBC. Based on the results from exploration, and our review of conditions in the area, we recommend a Site Class B be used for structural seismic design. A printout, entitled *"Seismic Design Response Spectrum",* based on the site location and historical seismic activity in the area is presented in the appendix. The printout shows the S_{D1} and S_{DS} values as defined by the IBC and site characteristics.

Foundations

The site preparation procedures discussed above must be implemented prior to initiating fill or foundation preparations. In-place compaction of the native soil will be necessary to improve uniform foundation support. All foundations should be placed so

bottom of footing is at least 36 inches below adjacent outside grade. Outside adjacent grade should slope away from the improvements. If water is permitted to pond adjacent to foundations or improvements, frost heaving is probable. Soft, saturated or unsuitable soil and construction debris should be removed and replaced with compacted structural fill. All structural fill in the bottom of excavations for footings and foundations should be placed in lifts, 6-inches or less in thickness, and compacted to at least 95% of its maximum dry density per ASTM test D-698. Footing trench widths should be 1 foot wider than the footing for each foot of over excavated soil. Provided the footing locations have been adequately prepared, the maximum Allowable Bearing Value (ABV) for the compacted fine silty clay is 1500 psf. The ABV for foundation placed on basalt or compacted sand and gravel over basalt is 4000 psf. Uniformity of foundation soils is critical to foundation performance. Foundations for any given building should not be supported by variable soil or rock conditions. Specifically one side of a building supported by the silty clay and the other supported by rock or compacted sand and gravel over rock greatly increases the risk of long term differential settlement of the building and associated stress cracking of the structure. Uniform support is critical to good performance. If variable soil and/or rock conditions are encountered in building locations soil improvement will be required. We recommend final plans and soil/rock conditions be reviewed by our office prior to placement of concrete for foundations. Bearing Capacity and has been calculated using the Meyerhof method and is presented in the appendix to this report.

Pavement

Site preparation should be performed as outlined in all pavement areas. The silty clay is frost susceptible, and will lose much of it shear strength when wetted. The design pavement section is based on the lower strength of the subgrade in a wet condition. Soft or unstable soil in pavement locations should be removed and replaced with compacted structural fill as previously outlined. Xcell should review pavement subgrade prior to placement of subbase to verify a stable subgrade has been achieved.

Providing site preparation and preceding recommendations have been followed, we recommend the following minimum pavement sections on the silt subgrade:

Clayey Silt	**Inches**
Class III asphalt pavement	2.5
¾-inch minus crushed sand and gravel base course	4.0
Sand and gravel Subbase	10.0
Rigid Pavement	
4000 psi 28 day compressive strength concrete, type II	6.0
¾-inch minus crushed sand and gravel base course	12.0

The flexible pavement sections shown above are based on a 20-year design life, and an estimated 1000 cars, and 1, 3-axel trucks per day and a minimum subgrade R-Value of 18. It should be noted that frost depth controls the design section of the pavement. If additional frost protection is desired the subbase thickness can be increased.

Subbase should consist of free draining, 2-inch nominal maximum size sand and gravel that comply with table 1 in section 801 of the Idaho Standards for Public Works Construction (ISPWC). The subbase should be moisture conditioned to near optimum moisture content and compacted to 95% of its maximum dry density per ASTM D-698.

Base course should consist of ¾ inch type I crushed aggregate conforming to section 802 and specifically table 1 in section 802 of the ISPWC. Base course should be moisture conditioned and compacted as outlined above.

Asphalt pavement should have material properties as specified in 810 of the ISPWC with a mix design that specifies a maximum aggregate size of 3/4 to 3/8 inch. Placement and compaction of the asphalt should be performed in accordance with section 810 of the ISPWC.

Construction should be scheduled to avoid cutting the asphalt or placement of utilities in the parking lot after placement of the asphalt pavement. Cut sections in the pavement are difficult to replace with the same quality as the original construction and frequently become areas where additional maintenance and lower levels of service occur throughout the life of the pavement.

Poor maintenance of the pavement typically allows saturated conditions beneath the pavement section. Saturated conditions in the clay subgrade on the site will decrease the shear strength of the soil and promote conditions where freezing and thawing will accelerate damage to the pavement. Therefore we recommend the

pavement be maintained as needed every two to three years to help limit infiltration of water into the subgrade. It is mandatory that proper drainage away from the pavement(s) and foundations be provided. Failure to provide proper drainage away from improvements will greatly increase the risk of frost heave and poor pavement and foundation performance.

Lateral Earth Pressure

Soil retaining walls should be designed to resist the lateral earth pressure associated with backfill placed against the wall plus any surcharge imposed by equipment or materials within a distance of ½ the wall height to the top of the wall. All soil retaining walls should be drained and water should not be permitted to accumulate behind the wall. If the retained soil becomes saturated hydrostatic pressure on the wall will increase which will exceed the design lateral earth pressures stated below.

Active Lateral Earth Pressure	65 pcf, efp
At-Rest Lateral Earth Pressure	85 pcf, efp
Passive Lateral Earth Pressure	200 pcf, efp

PCF, EFP is pounds per cubic foot equivalent fluid pressure. The values shown do not include hydrostatic pressures that will develop if undrained conditions occur.

Static and seismic lateral earth pressure calculations are shown on the Rankine Lateral Earth Pressure spreadsheet in the appendix. Friction factors (μ) of 0.4 and 0.35 may be used for mass concrete placed on compacted structural fill and fine sandy silt/clay respectively.

Wet Weather Construction

We recommend that site construction be undertaken during dry weather conditions. If the site preparation and grading is undertaken during wet or high groundwater conditions, the native or re-compacted silt/clay will be susceptible to pumping or rutting when subjected to heavy loads from rubber-tired equipment or vehicles that exert a point load. Given the proximity of water to the ground surface

these conditions are likely at whatever point construction is initiated. Earthwork should be performed by low pressure, track-mounted equipment that spreads and reduces the vehicle load. Work should not be performed immediately after rainfall. All soft and disturbed areas should be excavated to undisturbed soil and backfilled with structural fill. Alternatively, the area should be moisture conditioned and re-compacted to structural fill requirements. Assuming the soil is wet and soft but not disturbed, the initial layer of fill placed over the native soil should be at least 12 inches, but no greater than 24 inches, in depth. Compaction of the fill should not cause pumping of the native soil.

Subgrades that become disturbed under construction traffic will require overexcavation to remove soft or disturbed soil. In summary, careful construction procedures are critical to the successful grading operation if the onsite soil is above optimum moisture content and loose. Consulting us prior to initiating this type of construction is recommended to help improve earthwork efficiency and achieve a stable subgrade.

Surface and Subsurface Drainage

Site grading, including all sidewalks and landscaped area grading, should slope a minimum of 2 percent away from structures and improvements to help prevent ponding and to direct surface runoff away from buildings and pavements. Poor drainage can result in frost heaving and settlement of pavement sections and foundations respectively. Backfill placed adjacent to basements or structures should be compacted as previously outlined for structural fill and graded to slope away from improvements to avoid settlement and consequential ponding adjacent to structures. All runoff from downspouts, roof areas, sidewalk areas, landscaped areas, and other large volumes of storm water should be directed and maintained away from the structures. Water should not be allowed to infiltrate the soil adjacent to or beneath building areas, sidewalks, pavements or footings. The underlying soil and/or basalt may significantly impede dissipation of storm water causing water to migrate laterally much farther than would normally be anticipated. Placement of storm water infiltration systems should take into account the probability that water may move along the surface of the indurated soil/ basalt and should be located at least 100 feet from any building.

ADDITIONAL SERVICES RECOMMENDED

Review of Plans and Specifications

We recommend that Xcell Engineering be retained to review the civil and structural foundation plans and earthwork specifications prior to bidding of the construction documents. It has been our experience that having the geotechnical consultant from the design team review construction documents reduces the potential for errors and changes to the contract during construction. Xcell Engineering can provide review of the construction documents on a time and expenses basis.

Construction Observation and Testing

We recommend that Xcell Engineering be retained to perform construction observation and material testing for the project including observation of the exposed subgrade in all building footing trenches and sidewalk areas to verify site stripping, and excavation has been performed and that all soft or unsuitable soil has been removed as described above. If we are not retained to perform the recommended services, we cannot be responsible for soil engineering related construction errors or omissions. The recommended services are not included in this evaluation and would be billed on a time and expense basis.

EVALUATION LIMITATIONS

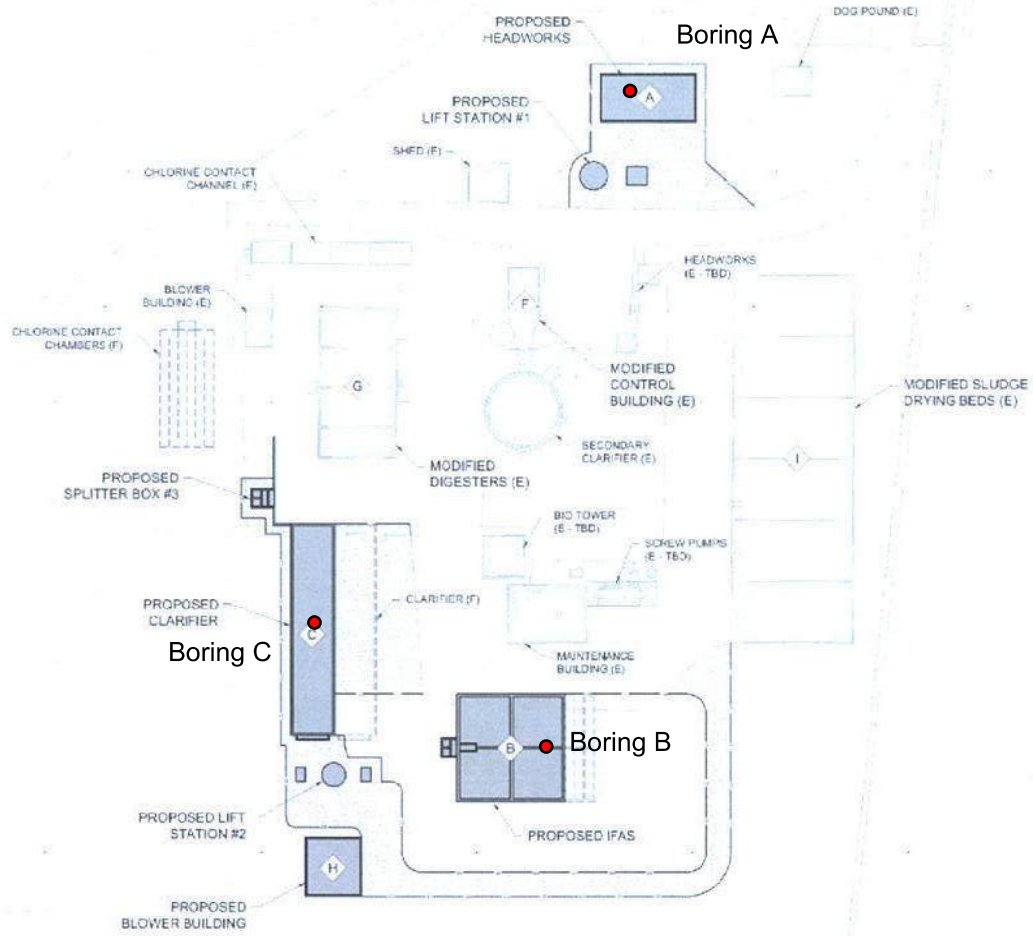
This geotechnical engineering report has been prepared to assist planning, design of the proposed Stake Center in Mountain Home, Idaho. Our services consist of professional opinions and recommendations made in accordance with generally accepted geotechnical engineering principles and practices. This acknowledgment is in lieu of all warranties either expressed or implied.

The following accompany and complete this report:

Plate 1:	Site Map
Plate 2:	Unified Soil Classification System (USCS)
Plate 3:	Cross Section Headworks/IFAS Buildings
Appendix:	Exploratory Logs
	Seismic Design Response Spectrum
	Bearing Capacity – Meyerhof
	Lateral Earth Pressures
	Flexible Pavement Design
	Direct Shear

References:

1. Idaho Standards for Public Works Construction, 2005 Edition Section 200 – Earthwork – Part 2.
2. Idaho Standards for Public Works Construction, 2005 Edition Section 300 – Trenching 3.18.
3. *Highway Engineering 5th Edition* Wright & Paquette pp 482-488.
4. *NAVFAC Design Manual 7.02 Foundations & Earth Structures*, 1986 7.2-63 Table 1.
5. *Journal of Geotechnical & Geoenvironmental Engineering,* Sep 1999 Volume 125 Seismic Earth Pressure on Retaining Structures, Richards, Huang & Fishman pp 771.
6. International Building Code – 2006 Chapters 16, 18 and 19.
7. *Principles of Geotechnical Engineering,* Braja M. Das, PWS Publishers 1985.
8. *Series in Soil Engineering – Soil Mechanics,* Lambe & Whitman, Wiley 1969.
9. *Soil Mechanic in Engineering Practice 3rd Edition,* Terzaghi, Peck & Mesri Wiley 1996.
10. *NAVFAC Design Manual 7.01Soil Mechanics,* 1986.
11. US EPA Siting Tool http://epamap20.epa.gov/tri/emtri.asp
12. USGS Earthquake Hazards Program http://eqdesign.cr.usgs.gov/cgi-bin/design-lookup-96.cgi
13. *National Geographic TOPO!* Mapping Software.



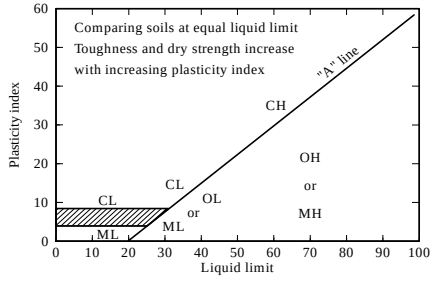
DRAWN: JLT	CHECKED: GRH	50% DESIGN REVIEW SET	KELLER associates	City of Aberdeen, Idaho	WASTEWATER TREATMENT PLANT
DESIGNED: GRH	APPROVED: GRH				OVERALL SITE PLAN (OPTION 2)
CAD NAME:	SCALE: AS NOTED				PROJECT NO: 210080 / SHEET NO: C3-111

PLATE 1 - SITE PLAN

Unified Soil Classification

Field Identification Procedures - (Excluding particles larger than three inches and basing fractions on estimated weights)				Group Symbol (a)	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria		
Coarse Grained Soils: More than half of material is larger than No. 200 Sieve Size (b)	Gravels - More than half coarse fraction is larger than 1/4 "	Clean Gravels - (little or no fines)	Wide Range in grain size and substantial amounts of all intermediate particle sizes	GW	Well graded gravels, gravel sand mixtures, little or no fines	Give typical name;indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition and hardness of the coarse grains; local geologic name and other pertinent descriptive information; symbols in ( ). For undisturbed soils add information on stratification, condition, cementation and moisture. EXAMPLE: Silty SAND - (SM) - Light brown, medium dense to dense, damp to moist. Moderately cemented from 2-3 feet, roots to 1 foot.	Use grain size distribution curve to verify fractions as identified in the field	Determine percentages of gravel and sand from grain size distribution curve. Depending on percentage passing the No. 200 sieve soils are classified as follows: Less than 5% = GW, GP, SW, SP More than 12% = GM, GC, SM, SC 5% to 12% are borderline cases requiring use of dual symbols	(Cu=D60/D10)>4 Cc=(D30)^2/(D10*D60) between 1&3	
			Predominantly one size or a range of sizes with intermediate sizes missing	GP	Poorly graded gravels, gravel sand mixtures, little or no fines			Not meeting all the requirements for GW	
		Gravels with fines- (appreciable amount of fines)	Non plastic fines (for identification procedure see ML below)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures			Atterberg limits below "A" line or PI<4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
			Plastic fines (for identification procedure see CL below)	GC	Clayey gravels, poorly graded gravel-sand-clay mixtures			Atterberg limits above "A" line with PI>7	
	Sands - More than half coarse fraction is smaller than 1/4 "	Clean Sands (little or no fines)	Wide Range in grain size and substantial amounts of all intermediate particle sizes	SW	Well graded sands, gravelly sands, little or no fines			(Cu=D60/D10)>6 Cc=(D30)^2/(D10*D60) between 1&3	
			Predominantly one size or a range of sizes with intermediate sizes missing	SP	Poorly graded sands, gravelly sands, little or no fines			Not meeting all the requirements for GW	
		Sands with fines (appreciable amount of fines)	Non plastic fines (for identification procedure see ML below)	SM	Silty sands, poorly graded sand-silt mixtures			Atterberg limits below "A" line or PI<4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
			Plastic fines (for identification procedure see CL below)	SC	Clayey sands, poorly graded sand-clay mixtures			Atterberg limits below "A" line with PI>7	
Fine-grained soils: More than half the material is smaller than the No. 200 sieve	Identification Procedures on Fraction Smaller than No. 40 Seive								
		Dry Strength	Dilatancy	Toughness					
	Silts and clays liquid limit less than 50	None to slight	Quick to slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sand with slight plasticity			
		Medium to high	None to very slow	Medium	CL	Inorganic clays of low to medium plasticity, lean clays, may be gravelly, sandy or silty.			
		Slight to medium	Slow	Slight	OL	Organic silts and organic silt-clays of low plasticity			
	Silts and clays liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	MH	Inorganic silts micaceous or diatomaceous fine sandy or silty soils, elastic silts			
		High to very high	None	High	CH	Inorganic clay of high plasticity, fat clays			
		Medium to high	None to very slow	Slight to medium	OH	Organic clays of medium to high plasticity			
Highly Oganic Soils		Readily identified by color, odor, spongy feel and frequently y fibrous texture			Pt	Peat and other highly organic soils			

Give typical name;indicate degree and character of plasticity, amount and max size of coarse grains; color when wet, odor, local geologic name, any other information. For undisturbed soil add information on structure, stratification, consistency in undisturbed and remolded states and moisture. EXAMPLE: Clayey SILT -(ML)- brown, stiff to very stiff, moist, (loess).



Plasticity chart
for laboratory classification of fine grained soils

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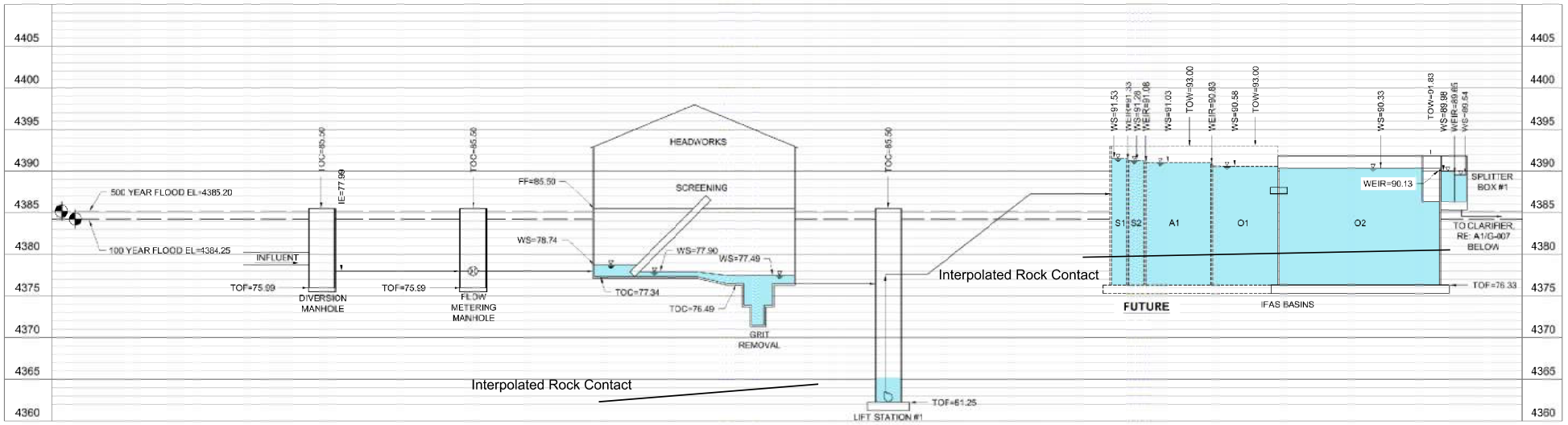
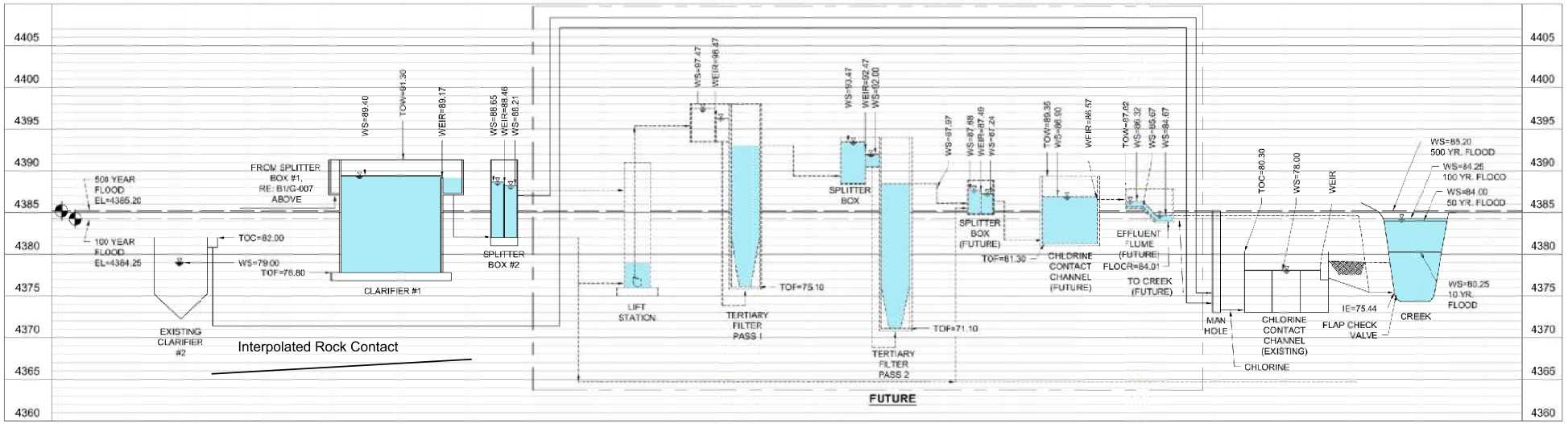
USCS: Plate 2



B1 HYDRAULIC PROFILE
N.T.S.



A1 HYDRAULIC PROFILE
N.T.S.

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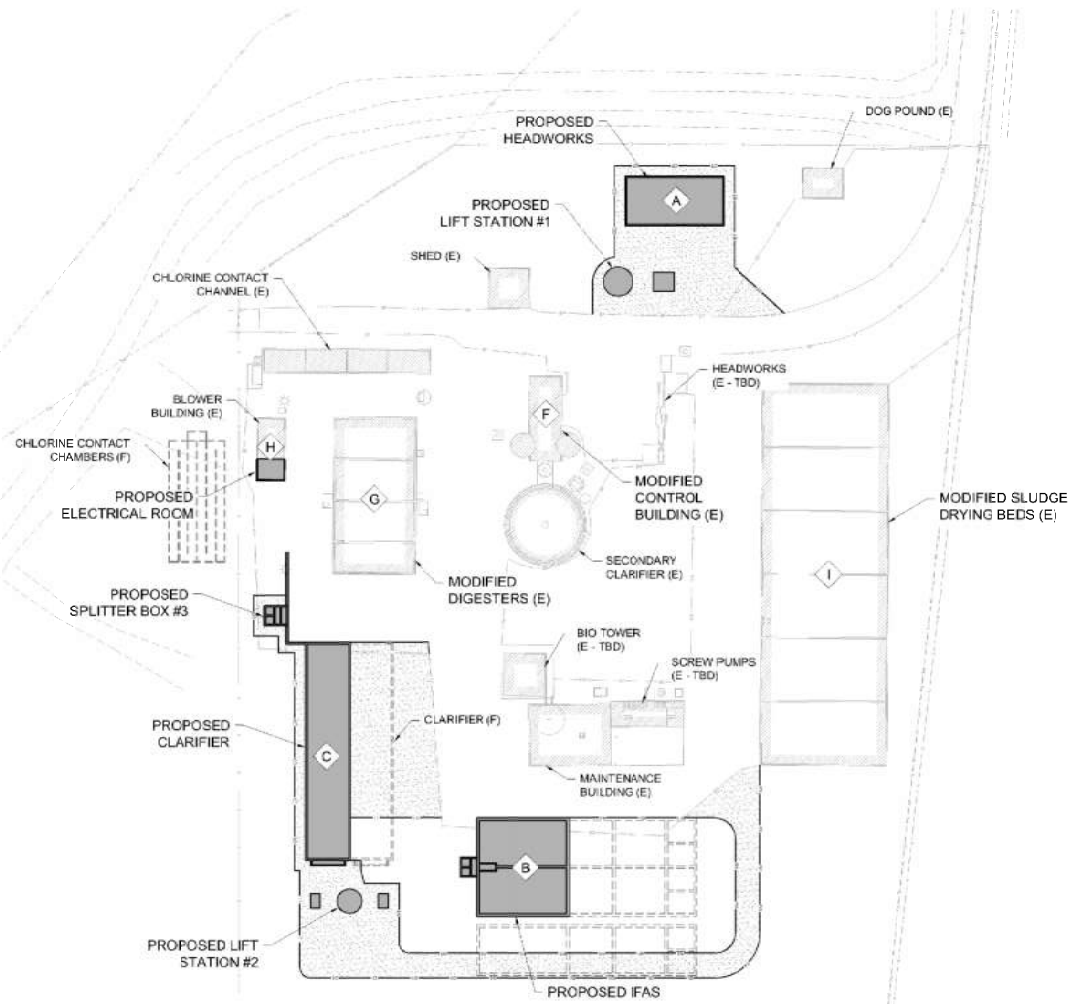
City of Aberdeen, Idaho

WASTEWATER TREATMENT PLANT

Plate 3 - Cross Section

PROJECT NO. 210080

SHEET NO. G-007



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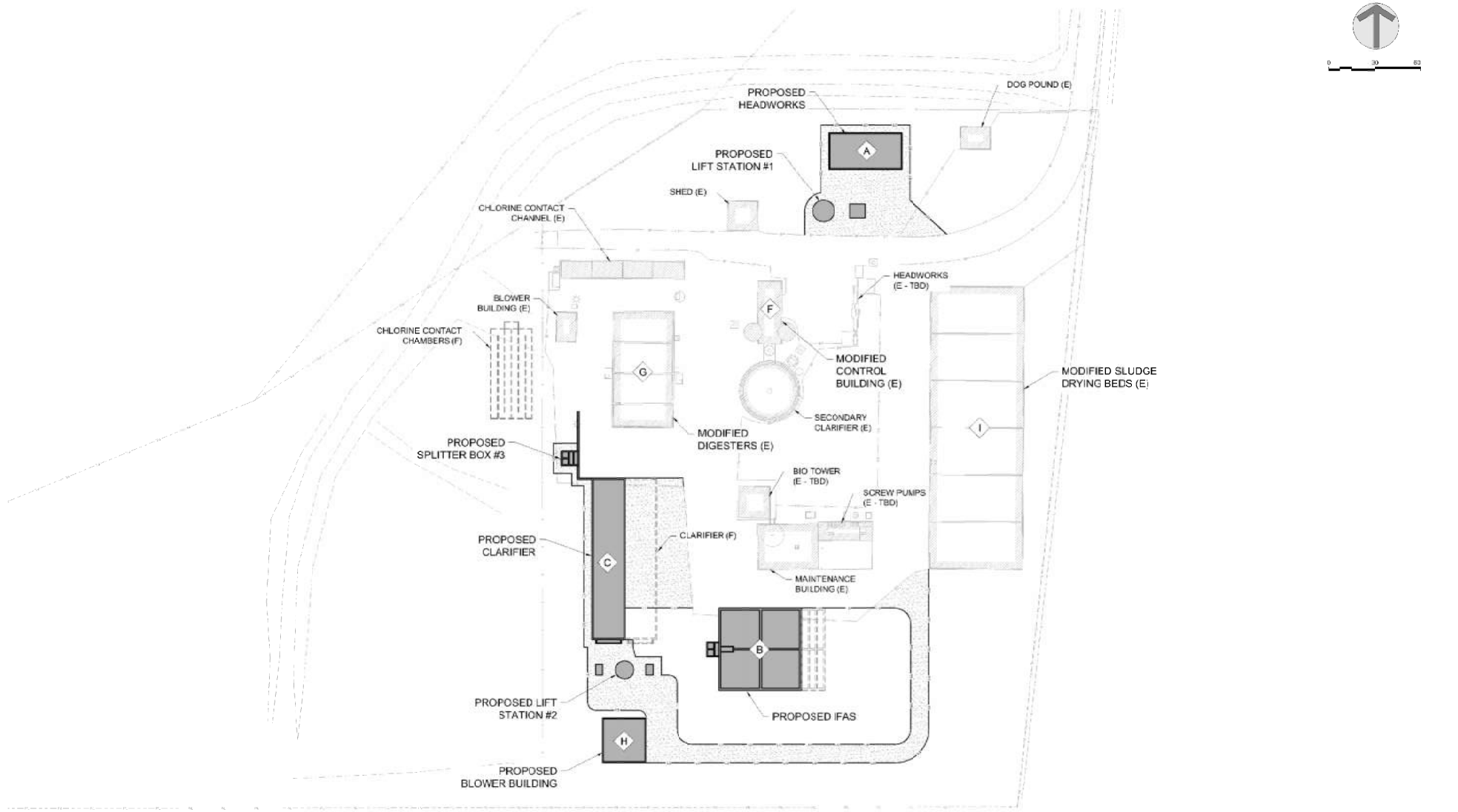
WASTEWATER TREATMENT PLANT

OVERALL SITE PLAN (OPTION 1)

PROJECT NO. 210080

SHEET NO. C3-101



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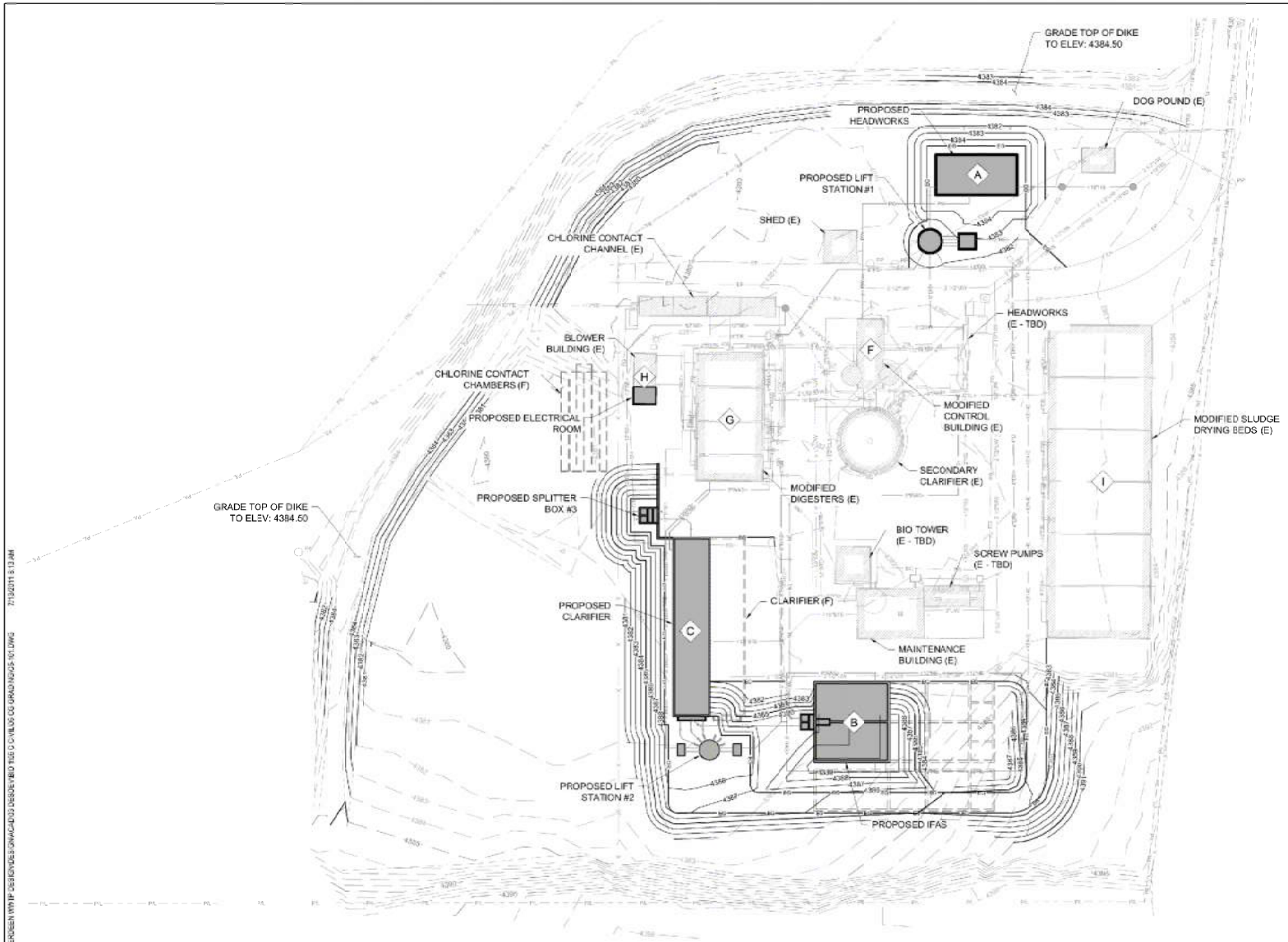
				DESIGNED: GRH	APPROVED: GRH	KELLER associates	City of Aberdeen, Idaho
				CAD NAME:	SCALE: (Based on 22"x34" sheet) AS NOTED		OVERALL SITE PLAN (OPTION 2)

PROJECT NO. 210080

SHEET NO. C3-111



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				CAD NAME:	SCALE: (Based on 22"x34" sheet) AS NOTED		OVERALL GRADING PLAN (OPTION 1)

PROJECT NO: 210080

SHEET NO: C5-101

Appendix

Exploratory Logs
Seismic Design Response Spectrum
Bearing Capacity – Meyerhof
Lateral Earth Pressures
Flexible Pavement Design
Direct Shear

Depth (ft)	Description Per The Unified Soil Classification System (USCS)	USCS Class	Sample Type	Blows per 6”	Blows per Foot	SPT N-Value	Recovery (inches)	Remarks Ground surface
- 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 -	Sandy Silty Clay – Dark Brown, Soft, Dense, Moist to Wet	CL/ ML	SPT	1 1 1	2	2	18	▼ Saturated
- 9 - 10 - 11 - 12 - 13 - 14 -	Fine Sandy Clay – Brown, Soft to Medium Stiff, Saturated	CL	SPT	3 4 4	8	8	19	
- 15 - 16 - 17 - 18 -19 - 20	Soft Clay	CL	SPT	0 2 2	4	4	22	
Soft Clay								

Project: Aberdeen WWTP	**Drill Rig: Simco 2800**
File No.: P10015	**Diameter: 8”**
Date Drilled: 8/9/11	
Logged By: JPB	

BORING NO.: A

XCELL ENGINEERING, LLC
260 Laurel Lane
Chubbuck, Idaho 83202

Depth (ft)	Description Per The Unified Soil Classification System (USCS)	USCS Class	Sample Type	Blows per 6”	Blows per Foot	SPT N-Value	Recovery (inches)	Remarks Ground surface
- 21 - 22 - 23 - 24 -	Clay – Brown, Soft, Saturated	CL	SPT	1 2 2	4	4	22	
- 25 - 26 - 27 - 28 - 29 - 30 - 31 - 32 - 33 - 34 - 35 - 36 - 37 - 38 - 39 - 40	Basalt Bedrock – Gray to Black, Fresh, Massive	RX	SPT	100+ /0”	>>	>>	0	

Project: Aberdeen WWTP	**Drill Rig: Simco 2800**	**BORING NO.: A**
File No.: P11015	**Diameter: 8**	
Date Drilled: 8/9/11		
Logged By: JPB		

XCELL ENGINEERING, LC
5745 Industry Way #4
Chubbuck, Idaho 83202

Depth (ft)	Description Per The Unified Soil Classification System (USCS)	USCS Class	Sample Type	Blows per 6”	Blows per Foot	SPT N-Value	Recovery (inches)	Remarks Ground surface
- 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	Sandy Silty Clay – Dark Brown, Soft, Moist to Wet	SM/ CL	SPT	2 2 2	4	4	18	▼ Saturated
- 11 - 12 - 13 - 14 - 15 - 16 - 17 - 18 -19 - 20	Basalt – Black, Hard, Fresh	CL RX	SPT	50/4	100+	100+	4	

Project: Aberdeen WWTP	**Drill Rig: Simco 2800**
File No.: P10015	**Diameter: 8”**
Date Drilled: 8/9/11	
Logged By: JPB	

BORING NO.: B

XCELL ENGINEERING, LLC
260 Laurel Lane
Chubbuck, Idaho 83202

Depth (ft)	Description Per The Unified Soil Classification System (USCS)	USCS Class	Sample Type	Blows per 6”	Blows per Foot	SPT N-Value	Recovery (inches)	Remarks
								Ground surface
- 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 - 11 - 12 - 13 - 14 - 15 - 16 - 17 - 18 -19 - 20	Sandy Silty Clay – Dark Brown, Soft, Moist to Wet	SM/ CL	SPT	1 1 1	2	42	8	▼ Saturated
	Clay – Brown, Stiff to Very Stiff	CL	SPT	5 8 10	18	18	18	
	Clay – Brown to Orange, Soft, Saturated	CL	SPT	1 2 2	4	4	18	
	Basalt – Black, Hard, Fresh at 21 feet	RX						

Project: Aberdeen WWTP	**Drill Rig: Simco 2800**
File No.: P10015	**Diameter: 8”**
Date Drilled: 8/9/11	
Logged By: JPB	

BORING NO.: C

XCELL ENGINEERING, LLC
260 Laurel Lane
Chubbuck, Idaho 83202

Seismic Design Response Spectrum

Per USGS 2011

Project: Aberdeen WWTP
Date: August 18, 2011
Engineer: JPB

USE →	2% Pobability of Exceedance in 50 Years
	10% Probability of Exceedance in 50 Years

Site Class: B

Ss =	0.32
S_1 =	0.12
Fa =	1.00
Fv =	1.00
S_{MS} =	0.32
S_{M1} =	0.12
S_{DS} =	0.21
S_{D1} =	0.08

Design spectral response accelerations for short and 1 second periods

Values of Fa as a Function of Site Class and Mapped Spectral Response Acceleration at Short Periods (Ss)[a]

Site Class	Ss < 0.25	Ss = 0.5	Ss = 0.75	Ss = 1.00	Ss > 1.25
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	Note b	Note b	Note b	Note b	Note b

Values of Fv as a Function of Site Class and Mapped Spectral Response Acceleration at 1 Second (S_1)[a]

Site Class	S_1 < 0.1	S_1 = 0.2	S_1 = 0.3	S_1 = 0.4	S_1 > 0.5
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	Note b	Note b	Note b	Note b	Note b

a - Use straight line interpolation for intermediate values of mapped spectral response acceleration.
b - Site Specific geotechnical investigation & dynamic site response analyses shall be performed to determine appropriate values, except that for structures with periods of vibration equal to or less than 1/2 second, values of Fa for liquifiable soils are permitted to be taken equal to the values for the site class determined without regard to liquifaction in section 1615.1.5.1

C - S_1 and S_S can be determined from http://eqdesign.cr.usgs.gov/html/design-lookup.html

Site Class	Soil Profile Name	Shear Wave Velocity Vs in feet per second	Standard Penetration	Undrained Shear Strength Su in psf
A	Hard Rock	Vs>5000	N/A	N/A
B	Rock	2500<Vs<5000	N/A	N/A
C	Dense Soil and Soft rock	1200,Vs,2500	N>50	Su>2000
D	Stiff Soil	600<Vs,1200	15<N,50	1000<Su<2000
E	Soft Soil	Vs,600	N<15	Su<1000
E	-	Any profile with more than 100 feet of soil having the following characteristics: 1. Plasticity Index, PI > 20 2. Moisture Content w equal to or greater than 40, and 3. Undrained shear strength Su < 500 psf		
F	-	Any profile containing soils having one or more of the following characteristics: 1. Soils vulnerable to potential failure or collapse under seismic loading such as liquifiable soils, quick and highly sensitive clays or collapsable or weakly cemented soils. 2. Peats and/or highly organic clays(Thickness >10 feet) 3. Very high plasticity clays (Thickness > 25 feet of PI>75) 4. Very thick soft or medium stiff clays (thickness >120 feet)		

Bearing Capacity - Meyerhof

Qult = cNcScDc+qNqSqDq+0.5ɣBNɣSɣDɣ — Vertical Footings

Qult = cNcIcDc+qNqIqDq+0.5ɣBNɣIɣDɣ — Inclined Footings

Project: Aberdeen WWTP

Date: August 19, 2011

Engineer: JPB

Inclination=	0	Degrees
C =	750	psf
Ø =	0	degrees
Unit Wt - ɣ=	115	pcf
FTG Depth=	3	feet
FTG Width=	3	feet
FTG Length=	30	feet
Kp=	1.000	
Nq=	1	
Nc=	5.14	
Nɣ (m)=	0	
Sc=	1.02	
Dc=	1.2	
Sq=	1.01	
Dq=	1.1	
Sɣ =	1.01	
Dɣ =	1.1	

Ø	Nq	Nc	Nɣ (m)
0	1.0	5.14	0.0
5	1.6	6.49	0.1
10	2.5	8.34	0.4
15	3.9	10.97	1.1
20	6.4	14.83	2.9
25	10.7	20.71	6.8
26	11.8	22.25	8.0
28	14.7	25.79	11.2
30	18.4	30.13	15.7
32	23.2	35.47	22.0
34	29.4	42.14	31.1
36	37.7	50.55	44.4
38	48.9	61.31	64.0
40	64.1	75.25	93.6
45	134.7	133.73	262.3
50	318.5	266.50	871.7

For Silt/Sand/Gr Soils	**Qult =**	5102	psf
Ø>10 Inclination=0	**Q Allow =**	**1701**	psf
For Clay Soils	**Qult =**	5064	psf
Ø=0 Inclination=0	**Q Allow =**	**1688**	psf
For Silt/Sand/Gr Soils	**Qult =**	#DIV/0!	psf
Ø>10 Inclination>0	**Q Allow =**	**#DIV/0!**	psf
For Clay Soils	**Qult =**	4971	psf
Ø=0 Inclination>0	**Q Allow =**	**1657**	psf

Inclination Factors	
Ic=Iq=	1.00
Iɣ for Ø>0	#DIV/0!
Iɣ for Ø=0	0.00

NOTE:

1) C = Unconfined Compressive Strength

2) q = Over burden Pressure - ɣ*Depth of Footing

3) B = width of Footing

4) Unit weight = effective unit weight

Rankine Lateral Earth Pressures Including Coulomb's Analysis for Active Force During Seismic Acceleration

Project: Aberdeen WWTP
Date: August 22, 2011
Soil Type: Silty Clay

	Friction Angle (Deg)	Friction Angle (Rad)	Ko	Ka	Kp
Ø	15	0.26180	0.741	0.589	1.698
Cohesion	750				
Wall Height	15	1.00			
Horiz Acceleration - Kh	0.21				
Vert Acceleration - Kv	0.14	0.94			
Unit Wt. (pcf)	115	0.97			
Wall Inclination-Theta	0				
Slope of retained fill - a	0.17	0.26			
Wall Friction Angle - Delta	0.17	0.02			
Beta=Tan^-1(Kh/1-Kv)	13.72	0.24			
Alpha'=a+Beta	13.89				
Theta'=Theta+Beta	13.72	0.24			
K'a	0.93	1.00			
1/cos (B19)	1.03				
Pae	10686				
Static Equivalent Fluid Pressure in Pounds per Cubic Foot =			**85.2**	**67.7**	**195.3**

Active Seismic Forces Using the *Mononobe-Okabe Equations elaborated by Seed and Whitman (1970)
Indicate an additional thrust of 10686 Pounds per Linear Foot of Wall
During the Seismic Event Specified. The force acts at1/3 the wall height at an angle of 15 degrees
below perpendicular to wall face as shown below.

Maximum depth to which tensile cracks in the soil may be anticipated is 17.0 Inches

*Ref: Das Section 9.10 pp337

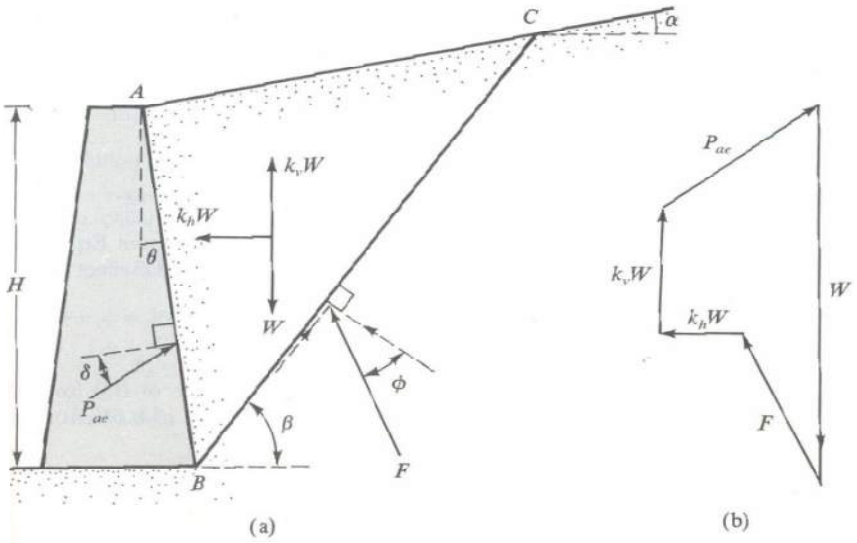

Figure 9.30 Active force on retaining wall with earthquake forces

Flexible Pavement Design

Project:	Aberdeen Waste Wayer Treatment Plant
Date:	August 22, 2011
Engineer:	JPB

Vehicle Type	Enter ADT	EAL 20 Yr Const		Total 20 yr Constant
Automobile	100	1.38		138
2-Axle Truck	0	1380		0
3-Axle Truck	1	3680		3680
4-Axle Truck	0	5880		0
5+-Axle Truck	0	13780		0
All Trucks=18 kip axle			**TOTAL EAL =**	3680

Traffic Index (TI) = 9.0(EAL/1,000,000)^0.119 =	4.6

Enter R-Values:	
Aggregate Base:	80
Aggregate Subbase:	60
Basement Soil:	18

Select a Recommended Safety Factor:		**Enter Selected FS Value**
Class A Cement Treated Base:	0.24	
Class B Cement Treated Base:	0.18	
Asphalt Treated Base:	0.18	0.16
Lime Treated Base:	0.18	
Soil Cement:	0.18	
Aggregate Base:	0.16	

GE = .0032(TI)(100-R) + FS	**Calc GE Thickness (feet)**	**Equivalent Thickness Ratio (Value:1)**	**Actual Required Thickness (feet)**	**Design Section (Inches)**
GE for AC = .0032(TI base)(100-R) +FS =	0.46	2.5	0.18	2.19
GE for Base = .0032(TIsubbase)(100-R) +FS-Pavement =	0.30	1	0.30	3.55
GE Subbase = .0032(TI soil)(100-R)+FS-Pavement -Base =	0.62	0.75	0.83	9.93

Notes:

1) If frost depth is greater than the design pavement section it may be required to increase the section thickness

2) The California Method is based on experience and fatigue analysis may be required

3) If basement soil is expected to become saturated it may be required to increase the section thickness

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APPENDIX B

Prepurchase Bid Documents

- B.1 Prepurchase Bid Documents February 2023
- B.2 Prepurchase Bid Documents April 2023

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APPENDIX B.1

Prepurchase Documents February 2023

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Prepurchase Contract Documents & Specifications

CITY OF ABERDEEN
WWTP IMPROVEMENTS

Volume 1 of 2
Division 00 – Division 46

FEBRUARY 2023

PROJECT NO. 222032-000

PREPARED BY:

KELLER ASSOCIATES

305 North 3rd Ave., Ste. A
Pocatello, ID 83201
(208) 238-2146

PREPARED FOR:

City of Aberdeen

33 N. Main St.
Aberdeen, ID 83210
(208) 397-4161

NOTICE INVITING BIDS

Electronic sealed Bids for the construction of the **City of Aberdeen's Wastewater Treatment Plant Equipment Pre-Purchase** will be received, by the **City of Aberdeen and Keller Associates, Inc.** using QuestCDN Online Electronic Bid platform until 2:00 PM MST on March 23, 2023. Bids will be opened, evaluated, and an announcement will be made as defined in Section P-200 – Instructions to Bidders.

The Project consists of furnishing equipment for the Aberdeen Wastewater Treatment Plant, consisting of an integrated fixed film activated sludge (IFAS) system, sand filter system and mechanical dewatering system. Other associated work as described herein shall be included with each equipment system. The City will sign a purchase agreement with the selected vendor for each equipment package, which agreement will subsequently be assigned to the Installation Contractor. It is anticipated that the City will pay for submittals prior to the selection of the Installation Contractor and that the Contractor will then be responsible for the remainder of the purchase agreement. The Installation Contractor is expected to be selected in the first quarter of 2024. The vendor shall be responsible to coordinate all installation and startup activities with the selected Contractor.

Copies of the Contract Documents and Bid Document may be downloaded electronically at www.kellerassociates.com via QuestCDN for a non-refundable charge of $30.00. Click on 'Current Projects Bidding' which shows, in the left-hand column, all of the projects which we have bidding at this time. The '**City of Aberdeen – WWTP Equipment Pre-Purchase**' hyperlink will display information specific to the project. For assistance in viewing or downloading the digital project information, contact QuestCDN at (952) 233-1632 or info@questcdn.com.

Prospective Bidders will be required to register with the designated website as a plan holder. Bids will be submitted electronically at www.kellerassociates.com via QuestCDN. To submit your electronic Bid, your company will need to have an online signature with QuestCDN. Bids will only be accepted from registered official plan holders. The designated website will be updated periodically with addenda, lists of registered plan holders, reports, and other information relevant to submitting a Bid for the Project. All official notifications, addenda, and other Bidding Documents will be offered through the designated website. Neither Owner nor Engineer will be responsible for Bidding Documents, including addenda, if any, obtained from sources other than the designated website. Instructions for submitting an electronic Bid will be provided with the Bid Documents. Bidders who are unable to access or register with QuestCDN should contact Keller Associates at (208) 238-2146 to make separate arrangements.

A pre-bid conference will not be held. Questions shall be referred to the Project Manager: Dallin Stephens - Keller Associates, Inc. at (208) 238-2146 or via email at dstephens@kellerassociates.com.

The bidder shall be aware that this project will be funded by USDA-RD and DEQ ARPA grant funds and the bidder will need to comply with any funding agency requirements. This project will not need to meet Build America, Buy America requirements, however the project will need to comply with American Iron and Steel requirements.

Each Bid must be submitted on the prescribed forms and accompanied by Bid Security in the form of a cashier's check, or a bid bond executed on the prescribed form, payable to the City of Aberdeen, in an amount not less than five percent (5%) of the bid amount. The successful Bidder will be required to furnish Performance and Payment Bonds with the Purchase Order Agreement, each in the amount of not less than 100% of the contract price.

The City of Aberdeen, in accordance with Title VI of the Civil Rights Act of 1964, 78 Stat. 252, 42 US.C. 2000d to 2000d-4 and Title 49, Code of Federal Regulations, Department of Transportation, Subtitle A, Office of the Secretary, Part 21, Nondiscrimination in Federally-assisted programs of the Department of Transportation issued pursuant to such Act, hereby notifies all invited bidders that it will affirmatively ensure that in any contract entered into pursuant to this advertisement, disadvantaged business enterprises as defined at 49 CFR Part 23 will be afforded full opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, national origin, or sex in consideration for an award. In addition, the City of Aberdeen prohibits discrimination based on ancestry, religion, creed, age, marital or familial status, physical or mental stability, sexual orientation, and gender identity/expression.

The City of Aberdeen is committed to providing access and reasonable accommodation in its services, programs, and activities and encourages qualified persons with disabilities to participate. If you anticipate needing any type of accommodation or have questions about the bid opening, please contact Keller Associates, (208) 238-2146, at least forty-eight (48) hours in advance of the opening.

The City of Aberdeen reserves the right to reject any or all Bids and to waive any nonmaterial informalities in the Bids received.

Publication Dates: March 8, 2023

March 15, 2023

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BIDDING REQUIREMENTS, CONTRACT FORMS, AND CONDITIONS OF THE CONTRACT

TECHNICAL SPECIFICATIONS

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INSTRUCTIONS TO BIDDERS

ARTICLE 1 - GENERAL INFORMATION

1.01 The following instructions outline the procedure for preparing and submitting bids. Bidders must fulfill all requirements as specified in these Contract Documents.

ARTICLE 2 - DEFINED TERMS

2.01 Terms used in these Instructions to Bidders will have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below.

A. *Bidder* – Equipment vendors submitting a bid. Bidder shall be the manufacturer of the proposed equipment or be an authorized distributor of the manufacturer.

B. *Buyer or Owner* – City of Aberdeen, 33 N. Main St., Aberdeen, ID 83210, Telephone: (208) 595-4902.

C. *Engineer* – Keller Associates, Inc., 305 N. 3rd Street, Ste. A, Pocatello, ID 83201, Telephone: (208) 238-2146.

D. *Installation Contractor* – The individual, partnership, corporation, joint-venture, or other legal entity with whom the Owner shall execute a Contract for construction of the City of Aberdeen WWTP, including installation, start-up and testing of the WWTP equipment to be furnished by the selected Vendor(s).

E. *Issuing Office* – The office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered.

F. *Vendor* – Vendor shall have the same definition as *Seller* in the General Conditions.

ARTICLE 3 - BIDS RECEIVED

3.01 Refer to Notice Inviting Bids for information on receipt of Bids.

ARTICLE 4 - COPIES OF BIDDING DOCUMENTS

4.01 Complete sets of the Bidding Documents in the number and for the deposit sum, if any, may be obtained as described in the advertisement or invitation to bid.

4.02 Complete sets of the Bidding Documents shall be used in preparing Bids; neither Buyer nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

4.03 Buyer and Engineer have made copies of Bidding Documents available on the above terms only for the purpose of obtaining Bids for furnishing Goods and Special Services and do not authorize or confer a license for any other use.

ARTICLE 5 - QUALIFICATIONS OF BIDDERS

5.01 Bidder must comply with all bidding procedures and meet the specifications for the Goods and Special Services.

5.02 If Bidder is selected for award of the Contract, Bidder shall be required to obtain a City Business License if needed.

5.03 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

ARTICLE 6 - EXAMINATION OF BIDDING DOCUMENTS, OTHER RELATED DATA, AND POINT OF DESTINATION

6.01 It is the responsibility of each Bidder before submitting a Bid to:

A. examine and carefully study the Bidding Documents, including any Addenda, and the related data identified in the Bidding Documents;

B. become familiar with and satisfy itself as to all Laws and Regulations that may affect cost, progress, or the furnishing of the Goods and Special Services;

C. carefully study, consider, and correlate the information known to Bidder; information commonly known to sellers of similar goods doing business in the locality of the Point of Destination and the site where the Goods will be installed or where Special Services will be provided; and any reports and drawings identified in the Bidding Documents regarding the Point of Destination and the site where the Goods will be installed or where Special Services will be provided, with respect to the effect of such information, observations, and documents on the cost, progress, and performance of Seller's obligations under the Contract Documents;

D. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution (if any) thereof by Engineer is acceptable to Bidder; and

E. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for furnishing Goods and Special Services.

6.02 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 6, that without exception the Bid is premised upon furnishing Goods and Special Services required by the Bidding Documents, that Bidder has given Engineer written notice of all conflicts, errors, ambiguities and discrepancies that Bidder has discovered in the Bidding Documents and the written resolutions (if any) thereof by Engineer are acceptable to Bidder, and that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for furnishing Goods and Special Services.

ARTICLE 7 - INTERPRETATIONS AND ADDENDA

7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by Buyer as having received the Bidding Documents. Questions received less than seven business days prior to the date for opening of Bids will not be answered. Only answers in the Addenda will be binding. Oral statements, interpretations, and clarifications may not be relied upon and will not be binding or legally effective.

7.02 Addenda may be issued to clarify, correct, or change the Bidding Documents as deemed advisable by Buyer or Engineer.

ARTICLE 8 - BID SECURITY

8.01 A Bid must be accompanied by Bid security made payable to Buyer in an amount of at least 5% of Bidder's maximum Bid price and in the form of cash, a cashier's check, or a Bid Bond (on form attached) issued by a surety meeting the requirements of Paragraph 4.01.B of the General Conditions.

8.02 The Bid security of the Successful Bidder will be retained until such Bidder has executed the Contract Documents, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Buyer may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. The Bid security of other Bidders that Buyer believes to have a reasonable chance of receiving the award may be retained by Buyer until the earlier of 7 days after the Effective Date of the Agreement or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be returned. Bid Security in the form of a bid bond will only be returned upon request.

ARTICLE 9 - CONTRACT TIMES

9.01 The number of days within, or the dates by which the work is to be completed is set forth in Section C-400 – Bid Form, Paragraph 7.

9.02 The City of Aberdeen plans to bid the construction of the wastewater treatment plant improvements in the first quarter of 2024. It is expected that construction will begin in the spring or summer of that same year. Construction of the WWTP improvements is anticipated to be completed by the fourth quarter of 2025.

9.03 If the contract is to be awarded, the Owner will give the Successful Bidder a Notice of Award within 60 days after the day of the Bid opening.

9.04 It is anticipated that the Owner will purchase the submittals after an award is made. These submittals will be used by the Engineer to prepare construction drawings and bid the work of installation of the equipment to Contractors. The City will assign the remainder of the Vendor Purchase Agreement to the Installation Contractor after the bidding is finalized and the Contractor selected.

ARTICLE 10 - LIQUIDATED DAMAGES

10.01 Any provisions for liquidated damages are set forth in the Agreement.

ARTICLE 11 - PREPARATION OF BID

11.01 Bidder will complete the Bid Forms electronically at www.kellerassociates.com via QuestCDN according to Section 00 21 14 – Electronic Bid Instructions. Bid documents may be purchased and downloaded electronically at www.kellerassociates.com via Quest CDN for $30.00. Click on 'Current Projects Bidding' which shows, in the left-hand column, all of the projects which we have bidding at this time. The 'City of Aberdeen – WWTP Equipment Pre-Purchase' hyperlink will display information specific to the project.

11.02 Bidders who are unable to access or register with QuestCDN should contact Keller Associates at (208) 238-2146 to make separate arrangements.

11.03 The Bid Form is included with the Bidding Documents.

11.04 All blanks on the Bid Form shall be completed in ink and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each item listed therein. In the case of optional alternates, the words "No Bid," "No Change," or "Not Applicable" may be entered.

11.05 A Bid by a corporation shall be executed in the corporate name by the president or a vice-president or other corporate officer accompanied by evidence of authority to sign. The corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown.

11.06 A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership shall be shown.

11.07 A Bid by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown.

11.08 A Bid by an individual shall show the Bidder's name and official address.

11.09 A Bid by a joint venture shall be executed by each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown.

11.10 All names must be typed or printed in ink below the signature.

11.11 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.

11.12 Each Bidder shall list the postal address, e-mail address, and telephone number for communications regarding the Bid.

ARTICLE 12 - BASIS OF BID; COMPARISON OF BIDS

12.01 The bids will be evaluated and awarded under the selection process outlined in Article 18 of this Section. Although lump sum prices for equipment will be required, these criteria will be "weighted" as indicated in Article 18.03.

12.02 Lump sum prices for WWTP equipment shall be provided by each bidder for each item on the bid form for which they intend to provide a bid. Lump sum prices will include freight/shipping of all equipment to the project site located in Aberdeen, Idaho. Taxes will be paid by the Installation Contractor.

ARTICLE 13 - SUBMITTAL OF BID

13.01 A Bid shall be submitted no later than the date and time prescribed and at the place indicated in the Notice Inviting Bids. Bids may be submitted electronically according to Section 00 21 14 – Electronic Bid Instructions. See Article 11 – Preparation of Bid. If a Bid contains any "trade secrets", as defined by Idaho Code § 74-107(1), then Bidder must clearly identify such information and mark as "CONFIDENTIAL". Prices are not "trade secrets". The City of Aberdeen reserves the right to make its own independent determination as to whether information included in a Bid constitutes a "trade secret".

13.02 With each copy of the Bidding Documents, a Bidder is furnished one copy of the Bid Form, and, if required, the Bid Bond. The copy of the Bid Form is to be completed and submitted with the Bid security.

13.03 Bids received after the date and time prescribed for the Opening of Bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder.

13.04 Prospective Bidders will be required to register with the designated website as a plan holder. Bids will be submitted electronically at www.kellerassociates.com via Quest CDN. To submit your electronic Bid, your company will need to have an online signature with QuestCDN. Bids will only be accepted from registered official plan holders. Bidders who are unable to access or register with QuestCDN should contact Keller Associates at (208) 238-2146 to make separate arrangements.

13.05 The designated website will be updated periodically with addenda, lists of registered plan holders, reports, and other information relevant to submitting a Bid for the Project. All official notifications, addenda, and other Bidding Documents will be offered only through the designated website. Neither Owner or Engineer will be responsible for Bidding Documents, including addenda, if any, obtained from sources other than the designated website.

13.06 Instructions for submitting an electronic Bid will be provided with the Bid Documents as Section 00 21 14 Electronic Bid Instructions.

ARTICLE 14 - MODIFICATION OR WITHDRAWAL OF BID

14.01 A Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the Opening of Bids.

14.02 Any Bidder may modify its bid by telegraphic, fax, or written communication at any time prior to the scheduled closing time for receipt of bids, provided such communication is received by the Buyer prior to the closing time. Telegraphic, faxed, or written communication should not reveal the bid price; it should however, state the addition or subtraction or other modification so that the final prices or terms will not be known by the Buyer until the sealed bid is opened. It is the sole responsibility of the Bidder to see that any modification to its bis is received at the time and place stated in the Notice Inviting Bids.

14.03 It is the sole responsibility of the Bidder to see that any modification to its bid is received at the time and place stated in the Notice Inviting Bids.

ARTICLE 15 - OPENING OF BIDS

15.01 All bids will be evaluated based on the criteria provided and the Instructions to Bidders and information provided in the bid forms, Vendor Performance Questionnaire and the rest of the Vendor Proposal.

15.02 Bids will not be read aloud publicly.

ARTICLE 16 - BIDS TO REMAIN SUBJECT TO ACCEPTANCE

16.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Buyer may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 17 - SCOPE OF SUPPLY

17.01 The successful bidder shall enter into a Procurement Agreement (PA) with the Buyer to provide one or more of the following goods. There will be a separate PA for each equipment system selected. Each Vendor may provide more than one type of equipment.

A. **Integrated Fixed Film Activated Sludge (IFAS) System:** A biological treatment system designed to reduce BOD. The system shall include all major equipment components, including diffusers, blowers, control valves, instrumentation, motor controls and control panels as required in Section 46 53 36 and related sections.

B. **Sand Filter System:** A sand filter system designed to remove phosphorus following a chemical addition and mixing system. The system shall include all major equipment components, such as internal piping and components, media bed, air compressors, instrumentation, motor controls and control panels as required in Section 46 61 27 – Upflow Moving Bed Filter and related sections.

C. **Mechanical Dewatering System:** Press system for dewatering of waste activated sludge to meet the minimum performance criteria identified in Section 46 76 27. System shall include all major equipment components including screw press, polymer activation and dosing skid, polymer injection and mixing assembly, instrumentation, motor controls,

control panel, and other appurtenances as required in Section 46 76 27 and related sections.

17.02 The Procurement Agreement entered into with the Buyer shall also include the following services. These services are required to be included with each equipment system provided.

A. **Submittals:** The Vendor will provide design of the Goods, submittal of the shop drawings, general arrangement drawings of equipment, and a control strategy description; will participate in meetings and assist Engineer during the design; and will make changes to the equipment system as required to coordinate the design with the Engineer during the submittal review process. Submittals shall meet the requirements of Section 01 30 00 – Vendor Submittals.

B. **Supply and Shipping of Equipment:** The Vendor shall supply all equipment identified in the approved submittals and shall deliver equipment to site. During shipment, Vendor shall assume all responsibility for loss or damage.

C. **Start-Up Services and Training**: The Vendor shall provide the minimum number of days and trips identified in the equipment specifications and Section 01 75 16 – Startup Procedures.

D. **Anchoring Calculations**: Design of all equipment supports, and anchor bolt design shall be provided by the Vendor, certified by a licensed professional engineer in the state where the equipment is to be installed. Anchor bolts are to be provided by the Installation Contractor.

17.03 To better define the intended Scope of Supply for the equipment Vendor, it is anticipated that the Installation Contractor's scope of work under a separate general construction contract will include:

A. **Civil Work:** This includes all site work including earthwork, grading, excavation, landscaping, paving, sidewalks, curb and gutter, drainage, and all utility work including yard piping.

B. **Structural Work:** This work includes all superstructure-related work including building enclosure construction. This includes all cast-in-place concrete work, including foundations and floors, and all miscellaneous metal work including gratings, stairs and handrail (unless specified otherwise).

C. **Mechanical Work:** This work includes installation of equipment provided by the Vendor, as well as the supply and installation of all other mechanical equipment and piping not included in the Vendor's scope.

D. **Electrical, Instrumentation and Controls:** This work includes motor control centers, motor starters, main power entrance and switchgear, interconnecting electrical wiring and conduits, plant instrumentation and controls not included in the Vendor's scope, and main plant PLC and standby power.

E. **Protective Coatings:** This work includes coating of materials, equipment and piping not provided by the Vendor. This work also includes any on-site touch up of Vendor supplied equipment, as to be coordinated and approved by the Vendor.

ARTICLE 18 - EVALUATION OF BIDS AND AWARD OF CONTRACT

18.01 Buyer reserves the right to reject any and all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Buyer may also reject the Bid of any Bidder if Buyer believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not responsive or fails to meet any other pertinent standard or criteria established by Buyer. Buyer also reserves the right to waive all informalities not involving price, time, or changes in the Goods and Special Services. Discrepancies in the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

18.02 Selection of a Vendor, if made, will be based on the evaluation criteria discussed in Section 18.03, and will be made to a responsive, responsible, and qualified Vendor as determined by Owner in its sole discretion. Responsive means a Vendor who has submitted a bid that conforms in all material respects to the intent of the Documents. Responsible means a Vendor who as the capacity and capability in all respects to perform fully the Document requirements and who has the integrity and reliability to assure good faith performance.

18.03 The following evaluation shall be conducted by Engineer based on information provided by the Vendor and used to rank Vendors to assist Owner in selecting a Vendor. These criteria shall be weighted as indicated in evaluating proposals. The information submitted by each Vendor as required under Section 00 40 00 – Vendor Performance Questionnaire will be used by Owner to evaluate each bid proposal.

A. Capital Costs (60 Points): Points will be awarded based upon estimated capital costs: price quote for WWTP Equipment and Services as outlined in Scope of Work listed in Section C-400 – Bid Form and the estimated construction costs for the buildings, and other items associated with Vendor's proposal. The low bidder capital cost will receive full points. Accessory items will also be considered in evaluating total project capital costs. The other Bidders will receive points in proportion to the estimated capital cost associated with their equipment.

B. O&M Cost (20-Year) Present Value (35 Points): Points will be awarded based upon the present value of the O&M costs, including power consumption costs, scheduled maintenance, schedule part replacement, and other costs incurred over a 20-year cycle at a 3.5% discount rate. Bidders shall provide a table showing all operations and maintenance items in rows with columns for units, annual, 5 year, 10 year and 20 year costs. The flow rate for the O&M costs shall be based on the Average Annual Flow identified in Section 01 11 00 – Summary of Work. Bidders shall have units in dollars for parts, hours for labor to install parts or perform other operations and maintenance work. Power costs shall be a row item and must consider ALL equipment within each Vendor's scope of supply and shall be listed in kWh. The kWh cost shall be calculated at $0.10 per kWh. Labor shall be estimated at $75 per hour. Bidders shall provide any copies of any calculations used to develop operations and maintenance costs. The lowest life cycle cost will receive full points. Other bids will receive proportionally lower points.

C. Manufacturer's Experience and References (30 Points): The previous experience of each Vendor will be evaluated relative to facility location, capacity and length of operation as listed in the following table:

NO.	Category	Total Possible Points	Score
Company Experience			
1.	Number of operational North American installations where design (avg. annual) flow rate is at least 0.25 mgd.	One point per installation (up to 10 points max)	
2.	Identify the year of manufacturer's first full-scale installation at a municipal WWTP exceeding avg. design flow of 0.25 mgd, excluding pilot projects.	One point per two years prior to current year (up to 5 points max)	
Individual Experience			
3.	Individual Experience – Number of staff who have over 5 years of more experience in design and configuration of Vendor's WWTP Equipment.	One point per qualifying individual (up to 5 points max)	
References			
4.	Positive Reference – Points will be awarded to the degree the Vendor has demonstrated full and timely support during final design, construction and start-up, training capability for Owner's staff, post commissioning for Owner and plant staff, and continued product support with timely delivery of spare parts.	Two points per positive reference (Up to 10 points max)	

D. Product Support (15 Points): Points will be awarded to Manufacturers who offer product support services such as start-up and operator training services, 24/7 telephone service, on-line facility monitoring, additional operator training beyond facility start-up, quarterly site visits, maintenance contract and operator conferences and/or discussion groups. In addition, the number of service/maintenance agreements, number of available maintenance personnel, and location of service centers will be considered.

E. System Configuration and Operation (30 Points): Points will be awarded based upon operation and maintenance requirements such as: (1) WWTP equipment system configuration and accessibility; (2) overall treatment process flexibility; (3) complexity of process controls; (4) level of operator attention; (5) cleaning requirements; and (6) equipment performance and longevity. Note that this evaluation is a subjective evaluation by the City operators and Engineer based on information provided in the submittal.

F. Extended Warranty (5 Points for one year of additional warranty): Points will be awarded based the additional years of warranty the Vendor offers to provide over the number of years of warranty listed in the individual WWTP equipment technical specifications.

G. Owner Preference (25 Points): Points will be awarded based upon Owner's preference of equipment and responsive submittal package.

ARTICLE 19 - CONTRACT SECURITY AND INSURANCE

19.01 Article 4 of the General Conditions and Article 4 of the Supplementary Conditions set forth Buyer's requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the executed Agreement to Buyer, it must be accompanied by such

bonds. If the Bid Security was in the form of a Bid Bond, payment and performance bonds may be submitted after contract award.

ARTICLE 20 - SIGNING OF AGREEMENT

20.01 When Buyer issues a Notice of Intent to Award to the Successful Bidder, it shall be accompanied by the required number of unsigned counterparts of the Agreement with the other Contract Documents that are to be identified in the Agreement and attached thereto. Within 15 days thereafter, Successful Bidder shall sign and deliver the required number of counterparts of the Agreement and attached documents to Buyer.

ARTICLE 21 - SALES AND USE TAXES

21.01 Any applicable state sales and use taxes on materials and equipment to be incorporated in the Project shall be paid by the Installation Contractor. Said taxes shall not be included in the Bid.

ARTICLE 22 - CONTRACT TO BE ASSIGNED

22.01 Bidder's attention is directed to the provisions of Article 10.07 of the Section P-520 – Procurement Agreement which provide for the assignment of the Contractor for furnishing Goods and Special Services covered by these Bidding Documents to an Installation Contractor designated by the Owner to construct the facilities and install the Goods. The application of the terms and conditions of the Contract Documents after the Contract has been assigned to the Installation Contractor should be considered by Bidder. Timing of the assignment is set forth in the Agreement. Forms documenting the assignment of the Contract and for the agreement of the Vendor's surety to such assignment are included as attachments to the Agreement.

END OF SECTION P-200

BID FORM

PROJECT IDENTIFICATION:

City of Aberdeen - WWTP Equipment Pre-Purchase

ARTICLE 1 - BID RECIPIENT

1.01 This Bid is submitted to: **City of Aberdeen, ID**

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into a Contract with Buyer in the form included in the Bidding Documents to furnish the Goods and Special Services as specified or indicated in the Bidding Documents, for the prices and within the times indicated in this Bid, and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 - BIDDER'S ACKNOWLEDGMENTS

2.01 Bidder accepts all of the terms and conditions of the Notice Inviting Bids and Instructions to Bidders, including without limitation those dealing with the deposition of Bid security. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Buyer. Bidder will sign and submit the Agreement with the Bonds and other documents required within 15 days after the date of Owner's Notice of Award herein is received.

2.02 Bidder acknowledges that this Contract, if awarded, will be assigned by the Owner to the Installation Contractor, and hereby consents to the assignment under the terms and conditions of the Contract Documents. Bidder accepts that, until the assignment of contract is executed by all parties, the Owner is not obligated to any monetary commitment associated with the Contract beyond that which is associated with Special Engineering Services.

ARTICLE 3 - BIDDER'S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

A. Bidder has examined and carefully studied the Bidding Documents, the related data identified in the Bidding Documents, and the following Addenda, receipt of which is hereby acknowledged:

Date	Number	Initials

B. Bidder is familiar with and is satisfied as to all Laws and Regulations in effect as of the date of the Bid that may affect cost, progress, and the furnishing of Goods and Special Services.

C. Bidder has carefully studied, considered, and correlated the information known to Bidder; information commonly known to sellers of similar goods doing business in the locality of the Point of Destination and the site where the Goods will be installed or where Special Services will be provided; information and observations obtained from Bidder's visits, if any, to the Point of Destination and the site where the Goods will be installed or Special Services will be provided; and any reports and drawings identified in the Bidding Documents regarding the Point of Destination and the site where the Goods will be installed or where Special Services will be provided, with respect to the effect of such information, observations, and documents on the cost, progress, and performance of Seller's obligations under the Bidding Documents.

D. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution (if any) thereof by Engineer is acceptable to Bidder.

E. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for furnishing the Goods and Special Services for which this Bid is submitted.

ARTICLE 4 - BIDDER'S CERTIFICATIONS

4.01 Bidder certifies that:

A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;

B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;

C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and

D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Buyer, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Buyer of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Buyer, a purpose of which is to establish bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process.

ARTICLE 5 - BASIS OF BID

5.01 BID SCHEDULE 1 – BASE BID: WWTP EQUIPMENT. Bidder will furnish the Goods (specifically equipment by vendors listed below) and Special Services in accordance with the Contract Documents for the following price(s). Vendors may provide bids for one or more of the following base bid items. State of Idaho taxes shall not be included (Section P-800 – Supplementary Conditions 5.05.A).

Item No.	Description	Unit	Amount
1A	**SUBMITTALS AND SHOP DRAWINGS**: As defined in the Agreement, price **not to exceed 10%** of the Contract price for the work outlined in Item 1B.	LS	$
1B	**INTEGRATED FIXED FILM ACTIVATED SLUDGE SYSTEM** consisting of (1) IFAS system and all necessary appurtenances and services as described in Section 46 21 35 of the specifications.	LS	$
1A + 1B	**TOTAL ITEM PRICE** $_____ (In Words)	LS	$

Item No.	Description	Unit	Amount
2A	**SUBMITTALS AND SHOP DRAWINGS**: As defined in the Agreement, price **not to exceed 10%** of the Contract price for the work outlined in Item 2B.	LS	$
2B	**SAND FILTER SYSTEM** consisting of sand filters with all necessary appurtenances and services as described in Section 46 61 27 of the specifications.	LS	$
2A + 2B	**TOTAL ITEM PRICE** $_____ (In Words)	LS	$

Item No.	Description	Unit	Amount
3A	**SUBMITTALS AND SHOP DRAWINGS**: As defined in the Agreement, price **not to exceed 10%** of the Contract price for the work outlined in Item 3B.	LS	$
3B	**MECHANICAL DEWATERING SYSTEM** consisting of mechanical screw press equipment and all necessary appurtenances and services as described in Section 46 66 16 of the specifications.	LS	$
3A + 3B	**TOTAL ITEM PRICE** $_____ (In Words)	LS	$

ARTICLE 6 - PRICE ESCALATION

6.01 Any selected vendor or vendors will be required to honor their submitted proposal pricing for the Goods and Services for 60 consecutive calendar days from the proposal due date for this RFP.

6.02 Where a signed agreement between the City and the manufacturer is not signed within 60 calendar days from the proposal due date, price escalation shall be allowed as follows: Price adjustment will be based on the net change of the ENR Construction Cost Index occurring in the period from 60 consecutive calendar days from the proposal due date to the date when the agreement is signed with the City.

ARTICLE 7 - TIME OF COMPLETION

7.01 Bidder agrees that the furnishing of Goods and Special Services will conform to the schedule below. Startup services and training shall be coordinated with the Installation Contractor and Owner but shall not occur more than 21 days after the Vendor has certified the installation of the equipment.

Item	Required Time for Completion (Calendar days from Vendor Bid Award)
Signing of Agreement	30
	Required Time for Completion (Calendar days from completion of Signed Agreement)
Accepted Submittals, including drawings, calculations, and anchor bolt design	**75**
	Required Time for Completion (Calendar days from Installation Contractor Bid Award)

Assignment of Agreement to Installation Contractor	30
Delivery	212

ARTICLE 8 - ATTACHMENTS TO THIS BID

8.01 The following documents are attached to and made a condition of this Bid:

A. Information Required of Bidder;

B. Required Bid Security;

~~C. If Bid amount exceeds $10,000, signed Compliance Statement (RD 400-6). Refer to specific equal opportunity requirements set forth in paragraph 18.10 of the Supplemental Conditions to the agreement with the Contractor who will install the WWTP equipment and to who the City will assign the contract with the Vendor (attached);~~

~~D. If Bid amount exceeds $25,000, signed Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – Lower Tier Covered Transactions (AD-1048);~~

~~E. If Bid amount exceeds $100,000, signed RD Instruction 1940-Q, Exhibit A01, Certification for Contracts, Grants and Loans.~~

ARTICLE 9 - BID SUBMITTAL

9.01 This Bid submitted by:

If Bidder is:

An Individual

Name (typed or printed): _____

By: _____
(Individual's signature)

Doing business as: _____

Business address: _____

_____

Phone: _____ Facsimile: _____

E-mail address: _____

Partnership

Partnership Name: _____ (SEAL)

By: _____

(Signature of general partner - attach evidence of authority to sign)

Name (typed or printed): _____

Business address: _____

_____

Phone: _____ Facsimile: _____

E-mail address: _____

A Corporation

Corporation Name: _____

State of Incorporation: _____

Type (General Business, Professional, Service, other): _____

By: _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

(CORPORATE SEAL)

Attest _____
(Signature of Corporate Secretary)

Business address: _____

_____

Phone: _____ Facsimile: _____

E-mail address: _____

A Limited Liability Company (LLC)

LLC Name: _____

State in which organized: _____

By: _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

_____

Phone: _____ Facsimile: _____

E-mail address: _____

A Joint Venture

First Joint Venturer Name: _____(SEAL)

By: _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

_____

Phone: _____Facsimile: _____

E-mail address: _____

Second Joint Venturer Name: _____(SEAL)

By: _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

_____

Phone: _____Facsimile: _____

E-mail address: _____

Phone and Facsimile Number, and Address for receipt of official communications to Joint Venture:

_____

_____

(Each joint venturer must sign. The manner of signing for each individual, partnership, corporation, and limited liability company that is a party to the joint venture should be in the manner indicated above.)

BID BOND

Any singular reference to Bidder, Surety, Owner, or other party shall be considered plural where applicable.

BIDDER *(Name and Address)*:

SURETY *(Name, and Address of Principal Place of Business)*:

OWNER *(Name and Address)*:

BID
Bid Due Date:
Description *(Project Name— Include Location)*:

BOND
Bond Number:
Date:
Penal sum _____ $ _____
(Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER	**SURETY**
_____ (Seal)	_____ (Seal)
Bidder's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	By: _____
Signature	Signature (Attach Power of Attorney)
_____	_____
Print Name	Print Name
_____	_____
Title	Title
Attest: _____	Attest: _____
Signature	Signature
Title	Title

Note: Addresses are to be used for giving any required notice.
Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation shall be null and void if:

3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or

3.2 All Bids are rejected by Owner, or

3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after the Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

SECTION 00 40 00 – VENDOR PERFORMANCE QUESTIONNAIRE

1.1 GENERAL

A. This Section lists the submittal requirements for the Vendor Proposal. The purpose of the submitted information will be to provide Owner and Engineer with the necessary information to judge a Vendor's minimum qualifications and to assist in evaluating Vendors for basis of award as indicated in the Instructions to Bidders.

B. Vendor shall submit information and/or responses that address each item below on separate sheets to be attached to the Proposal. Each answer shall reference the item number to which the information pertains. If a question is not applicable to a Vendor's proposed equipment, then an answer of "Not Applicable" or "N/A" must be provided. Failure to provide the requested information may result in a Bid being judged as nonresponsive.

C. Vendor shall provide a separate complete list of all exceptions, or qualifications taken to the Contract Documents or Specifications in Vendors Qualification and Bid Proposal, including, any limitations on Vendor's liability.

D. The Vendor shall submit a copy of each applicable technical specification section with all addenda and all referenced specification sections. Each paragraph shall be check-marked to indicate specification compliance or marked to indicate deviations from the specification requirements. Check marks shall indicate complete compliance with the paragraph requirements. Deviations from the specification shall be indicated by underlining the deviation and marking the paragraph or line with a number or letter. The remainder of the paragraph not marked as a deviation shall indicate compliance with the requirements of the paragraph. The manufacturer shall prepare a detailed justification for each deviation. Failure to include the required specification sections and justification for deviations will indicate non-compliance and shall be rejected without further consideration.

1.2 SUBMITTAL REQUIREMENTS

A. Vendor to submit bound copies of questionnaire per instruction in Section P-030 – Notice Inviting Bids. Submitted information shall be considered the Qualifications Proposal.

B. Qualifications Proposal shall include the following:

1. Identification of Vendor, name of project, name of Owner, and date of submittal.

2. Responses to all questions listed in Parts below including: Product Support Services, Experience and References, Product Design, and pertinent licensing agreements.

3. Provide a complete description of proposed equipment including layout and installation details. Power requirements shall be provided. Description of motors, if any, shall be provided. For blowers, a blower curve shall be provided. For pumps, a pump curve shall be provided.

4. Provide a complete description of equipment operating and maintenance costs for power, materials, and labor hours. Provide a summary of annual maintenance, 5-year maintenance, 10-year maintenance, and 20-year maintenance activities and include estimated labor hours and materials cost for each item of maintenance to help Owner properly evaluate life cycle costs.

5. Indicate and list any and all advantages that Vendor's equipment might have over a competitor's equipment. Include information on any extended equipment or media warrantees offered beyond the specified warranty period.

6. Any other information deemed appropriate by Vendor to assist Owner and Engineer in determining Vendor qualifications including company brochures, product data sheets, etc.

7. Proposal to be organized with table of contents at the front and tabbed dividers between sections.

1.3 PRODUCT SUPPORT SERVICES

A. Provide examples or document past experience.

B. List of office locations of the WWTP Equipment Manufacturer in North America. Provide location where the equipment is manufactured.

C. List all service/maintenance locations in the United States for the WWTP equipment to be provided. Provide the following for each location:

1. Location

2. Type of support services provided

3. Description of Service Provided by Manufacturer or Subcontractor

4. Response Time for Technician to be in Aberdeen

D. Describe the system start-up and operator training capabilities of the Equipment Manufacturer. In addition, provide resume for installation supervision and start-up personnel.

E. Describe facilities, programs and methods, which the Equipment Manufacturer provides to Owners/operators for ongoing maintenance and troubleshooting.

F. Provide description of available 24/7 telephone support services, additional operator training after start-up including conferences, available support groups and quarterly site visits.

1.4 MANUFACTURER'S EXPERIENCE AND REFERENCES

A. Attach to this bid, a list of all municipal contracts completed (and private contracts if allowed) by the Bidder during the last 5 years involving applications for wastewater treatment and of comparable value in North America, please limit to 5 projects. The list shall include the following information as a minimum.

1. Names, address, and telephone number of Plant operator.

2. Name of project.

3. Location of project.

4. Brief description of the work involved.

B. Identify the year that the Equipment Manufacturer first began manufacturing WWTP Equipment for the treatment of municipal wastewater.

C. Furnish a list of North American Equipment installation for the treatment of municipal wastewater. The following information shall all be provided with each listing:

1. Location

2. Equipment rated capacity in mgd

3. Identify system by model or type

4. First year of operation (or identify as under construction)

D. Identify which of the North American installations utilize the manufacturer's same model/type anticipated for City of Aberdeen.

1.5 VENDOR LICENSING AGREEMENTS

A. Attach to this bid, a copy of the manufacturer's licensing agreement for the WWTP equipment technology, if existing, listing commencement and termination dates and all existing contractual arrangements related to the licensing agreement.

END OF SECTION 00 40 00

CONTRACT FORMS

PROCUREMENT AGREEMENT

THIS AGREEMENT is by and between City of Aberdeen, Idaho ("Buyer")

and _____("Seller").

Buyer and Seller hereby agree as follows:

ARTICLE 1 – GOODS AND SPECIAL SERVICES

1.01 Seller shall furnish the Goods and Special Services as specified or indicated in the Contract Documents.

1.02 Seller (Vendor) shall complete the Goods and Services as specified or indicated in the Buyer's Contract Documents and Specifications titled, "City of Aberdeen WWTP Equipment Pre-Purchase".

1.03 The Project, of which the Goods and Special Services may be the whole or only a part, is described as performing or providing all labor, services, engineering, manufacturing, testing, and documentation necessary for Installation Contractor to install and successfully start-up the WWTP Equipment.

1.04 The Goods are generally described as follows:

A. **Integrated Fixed Film Activated Sludge (IFAS) System:** A biological treatment system designed to reduce BOD. The system shall include all major equipment components, including diffusers, blowers, control valves, instrumentation, motor controls and control panels as required in Section 46 53 36 and related sections.

B. **Sand Filter System:** A sand filter system designed to remove phosphorus following a chemical addition and mixing system. The system shall include all major equipment components, such as internal piping and components, media bed, air compressors, instrumentation, motor controls and control panels as required in Section 46 61 27 – Upflow Moving Bed Filter and related sections.

C. **Mechanical Dewatering System:** Press system for dewatering of waste activated sludge to meet the minimum performance criteria identified in Section 46 76 27. System shall include all major equipment components including screw press, polymer activation and dosing skid, polymer injection and mixing assembly, instrumentation, motor controls, control panel, and other appurtenances as required in Section 46 76 27 and related sections.

1.05 The Services are generally described as follows:

D. **Submittals:** The Vendor will provide design of the Goods, submittal of the shop drawings, general arrangement drawings of equipment, and a control strategy description; will participate in meetings and assist Engineer during the design; and will make changes to the equipment system as required to coordinate the design with the Engineer during the submittal review process. Submittals shall meet the requirements of Section 01 30 00 – Vendor Submittals.

E. **Supply and Shipping of Equipment:** The Vendor shall supply all equipment identified in the approved submittals and shall deliver equipment to site. During shipment, Vendor shall assume all responsibility for loss or damage.

F. **Start-Up Services and Training:** The Vendor shall provide the minimum number of days and trips identified in the equipment specifications and Section 01 75 16 – Startup Procedures.

G. **Anchoring Calculations:** Design of equipment supports, and anchor bolt design shall be provided by the Vendor, certified by a licensed professional engineering in the state where the equipment is to be installed. Anchor bolts are to be provided by the Installation Contractor.

ARTICLE 2 – ENGINEER

2.01 The Contract Documents for the Goods and Special Services have been prepared by Keller Associates, Inc., 305 North 3rd Avenue, Ste. A, Pocatello, ID 83201 ("Engineer"), which is to act as Buyer's representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with Seller's furnishing of Goods and Special Services.

ARTICLE 3 – POINT OF DESTINATION

3.01 The point of destination is:

2683 W 1750 S
Aberdeen, ID 83210

ARTICLE 4 – CONTRACT TIMES

4.01 *Time of the Essence*

A. All time limits for Milestones, if any, including the submittal of Shop Drawings and Samples, the delivery of Goods, and the furnishing of Special Services as stated in the Contract Documents, are of the essence of the Contract.

4.02 *Milestones:*

A. *Days for Submittal of Shop Drawings and Samples:* Seller shall submit all Shop Drawings and Samples required by the Contract Documents to Buyer for Engineer's review and approval as noted in the Bid Forms. If more than one resubmittal is necessary for reasons not the fault and beyond the control of Seller, then Seller shall be entitled to seek appropriate relief under Paragraph 7.02.B of the General Conditions.

B. *Days to Achieve Delivery of Goods:* It is expected that the Seller shall deliver the Goods to the Point of Destination and ready for Buyer's receipt of delivery as noted in the Bid Forms. The delivery of the Goods shall be coordinated with the Installation Contractor and provided at the Installation Contractor's request within their construction contract time. Staged delivery of the equipment shall be acceptable at the Installation Contractor's request.

C. *Days for Furnishing Start-Up and Training Services:* The furnishing of start-up services, detailed installation and operation and maintenance manuals, testing services, and operator training shall be coordinated with the Installation Contractor and provided at the Installation Contractor's request within their construction contract time.

4.03 *Buyer's Final Inspection*

A. Days to Achieve Final Inspection: Buyer shall make its final inspection of the Goods pursuant to Paragraph 8.01.C of the General Conditions within 30 days after Buyer's acknowledgement of receipt of delivery of the Goods and Seller's completion of furnishing Start-Up and Training Services. The final inspection shall be requested by the Installation Contractor.

4.04 *Liquidated Damages*

A. Buyer and Seller recognize that Buyer will suffer financial loss if the Goods are not delivered at the Point of Destination and ready for receipt of delivery by Buyer within the times specified above, plus any extensions thereof allowed in accordance with Article 7 of the General Conditions. The parties also recognize that the timely performance of services by others involved in the Project is materially dependent upon Seller's specific compliance with the requirements of Paragraph 4.02. Further, they recognize the delays, expense, and difficulties involved in proving the actual loss suffered by Buyer if complete acceptable Goods are not delivered on time. Accordingly, instead of requiring such proof, Buyer and Seller agree that as liquidated damages for delay (but not as a penalty) Seller shall pay Buyer $1,000.00 for each day that expires after the time specified in Paragraph 7.01 of Section C-400 - Bid Form for delivery of acceptable Goods. Other services provided by the Seller, such as start-up services and training, shall be performed per requirements specified in Article 4 herein and at the request of the Installation Contractor to comply with contractual dates for construction.

ARTICLE 5 – CONTRACT PRICE

5.01 Buyer shall pay Seller for furnishing the Goods and Special Services in accordance with the Contract Documents.

ARTICLE 6 – PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payment*

A. Seller shall submit Applications for Payment in accordance with Article 10 of the General Conditions and Section 01 29 76 - Schedule of Payments. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 *Progress Payments; Retainage*

A. Buyer shall make progress payments on account of the Contract Price on the basis of Section 01 29 76 – Schedule of Payments on or about the 30th day of each month during performance of the Work provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below, but, in each case, less the aggregate of payments previously made and less such amounts as Buyer may withhold, including but not limited to liquidated damages, in accordance with the Contract.

   a. 95 percent of Work completed (with the balance being retainage); and

   b. 95 percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Seller to 100 percent of the Work completed, less such amounts set off by Buyer pursuant to Paragraph 10.04 of the General Conditions, and less 200 percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.03 *Final Payment*

A. Upon receipt of the final Application for Payment accompanied by Engineer's recommendation of payment, Buyer shall pay Seller the amount recommended by Engineer, less any sum Buyer is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages.

ARTICLE 7 – INTEREST

7.01 [Reserved.]

ARTICLE 8 – SELLER'S REPRESENTATIONS

8.01 In order to induce Buyer to enter into this Agreement, Seller makes the following representations:

A. Seller has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents, as applicable to Seller's obligations identified in Article 1 above.

B. If required by the Bidding Documents to visit the Point of Destination and site where the Goods are to be installed or Special Services will be provided, or if, in Seller's judgment, any local condition may affect cost, progress, or the furnishing of the Goods and Special Services, Seller has visited the Point of Destination and site where the Goods are to be installed or Special Services will be provided and become familiar with and is satisfied as to the observable local conditions that may affect cost, progress, and the furnishing of the Goods and Special Services.

C. Seller is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and the furnishing of the Goods and Special Services.

D. Seller has carefully studied, considered, and correlated the information known to Seller; information commonly known to sellers of similar goods doing business in the locality of the Point of Destination and the site where the Goods will be installed or where Special

Services will be provided; information and observations obtained from Seller's visits, if any, to the Point of Destination and site where the Goods are to be installed or Services will be provided; and any reports and drawings identified in the Bidding Documents regarding the Point of Destination and the site where the Goods will be installed or where Special Services will be provided, with respect to the effect of such information, observations, and documents on the cost, progress, and performance of Seller's obligations under the Contract Documents.

E. Seller has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Seller has discovered in the Contract Documents, and the written resolution (if any) thereof by Engineer and Buyer is acceptable to Seller.

F. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for furnishing Goods and Special Services.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 *Contents*

A. The Contract Documents consist of the following:

1. Notice Inviting Bids;
2. Instruction to Bidders;
3. Bid Forms including the Bid, Information required of Bidder, Bid Bond, and all required certificates and affidavits;
4. This Procurement Agreement (EJCDC P-520);
5. Performance Bond;
6. Payment Bond;
7. General Conditions (EJCDC P-700);
8. Supplementary Conditions (EJCDC P-800);
9. Specifications as listed in the Table of Contents;
10. Addenda (Numbers ____ to ___, inclusive);
11. Exhibits to this Agreement (enumerated as follows):
    a. Seller's Bid, solely as to the prices set forth therein;
12. The following, which may be delivered or issued on or after the Effective Date of the Agreement:
    a. Written Amendments to this Agreement;
    b. Notice to Proceed;

c. Change Order(s);

d. Work Change Directive(s).

B. The documents listed in Paragraph 9.01.A are incorporated into this Agreement by reference (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 9.

D. The Contract Documents may only be amended or supplemented as provided in Paragraph 3.04 of the General Conditions.

ARTICLE 10 – MISCELLANEOUS

10.01 *Terms*

A. Terms used in this Agreement will have the meanings indicated in the General Conditions and the Supplementary Conditions.

10.02 *Successors and Assigns*

A. Buyer and Seller each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.03 *Severability*

A. Any provision or part of the Contract Documents held to be void or unenforceable by a court of competent jurisdiction under any applicable Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Buyer and Seller. The Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

10.04 *Seller's Certifications*

A. Seller certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 11.04:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Buyer, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Buyer of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Buyer, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

10.05 *Limitations*

A. Buyer and Seller waive against each other, and against the other's officers, directors, members, partners, employees, agents, consultants, and subcontractors, any and all claims for or entitlement to incidental, indirect, or consequential damages arising out of, resulting from, or related to the Contract. The terms of this mutual waiver do not apply to or limit any claim by either Buyer or Seller against the other based on any of the following: (a) contribution or indemnification, (b) costs, losses, or damages attributable to personal or bodily injury, sickness, disease, or death, or to injury to or destruction of the tangible property of others, (c) intentional or reckless wrongful conduct, or (d) rights conferred by any bond provided by Seller under this Contract.

10.06 *Insurance*

A. Prior to the Buyer's execution of this Procurement Agreement, Seller shall secure, and shall thereafter maintain until completion of the Contract, such public liability and property damage insurance as shall protect Seller from claims for damages for personal injury, including accidental death, as well as from claims for property damage which may arise from or which may concern operations under the Contract, whether such operations be by or on behalf of Seller, any Subvendor or anyone directly or indirectly employed by, connected with or acting for or on behalf of any of them.

B. All liability insurance shall be issued by an insurance company or companies authorized to transact liability insurance business in the State of Idaho and shall cover comprehensive general and automobile liability for both bodily injury (including death) and property damage, including, but not limited to aggregate products, aggregate operations, aggregate protective and aggregate contractual with the limits as specified in the Supplementary General Conditions.

10.07 *Assignment of Procurement Contract*

A. The Contract may at the Owner's discretion be assigned by Owner to Contractor, and Vendor will accept such assignment, pursuant to the Procurement Documents. In the application of the terms and conditions of the Procurement Documents after said assignment, Vendor will function as a subcontractor to the Contractor, and all obligations of the Vendor to Owner will become obligations of the Vendor to Contractor. Notwithstanding this assignment, the guarantees and warranties specified in the Procurement Documents are intended for the benefit of Owner and the Contractor and may be enforced by either party.

B. Assignment of the Purchase Agreement shall be accomplished on Exhibits A-1 and A-2, copies of which are attached to this Purchase Agreement.

C. Miscellaneous Assignments. No further assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and specifically but without limitation monies that may become due and monies that are due may not be assigned without such

consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

IN WITNESS WHEREOF, Buyer and Seller have executed this Agreement and acknowledge that all portions of the Contract Documents have been signed or identified by Buyer and Seller or on their behalf.

This Agreement will be effective on _____("Effective Date").

Buyer: _____	Seller: _____
By: _____	By: _____
Date: _____	Date: _____
[Corporate Seal]	[Corporate Seal]
Attest: _____	Attest: _____
Address for giving notice:	Address for giving notice:
_____	_____
_____	_____
_____	_____
(If Buyer is a corporation, attach evidence of authority to sign. If Buyer is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of Buyer-Seller Agreement.)	Agent for service of process:
	_____
	_____
	_____
	_____
	(If Seller is a corporation or a partnership, attach evidence of authority to sign.)
Designated Representative:	Designated Representative:
Name: _____	Name: _____
Title: _____	Title: _____
Address: _____	Address: _____
Phone: _____	Phone: _____
Facsimile: _____	Facsimile: _____

SECTION P-520 - EXHIBIT A-1
to Procurement Agreement
ASSIGNMENT OF CONTRACT

The Contract between the City of Aberdeen, Idaho (Owner) and Vendor for furnishing Goods and Special Services under the Contract Documents entitled

"City of Aberdeen - WWTP Equipment Pre-Purchase"

Is hereby assigned, transferred, and set over to _____ (Installation Contractor), who shall be totally responsible for all work performed by the assigned and for the duties, rights and obligations of the Owner, not otherwise retained by the Owner, under the terms of the Contract between the Owner and Vendor.

This assignment will be effective on the effective date of the Contract between the Owner and the Contractor for the General Construction Work.

ASSIGNMENT DIRECTED BY: _____
For: Owner

By: _____ _____
(Signature) (Title)

ASSIGNMENT ACKNOWLEDGED AND CONSENTED TO BY: _____
For: Vendor

By: _____ _____
(Signature) (Title)

ASSIGNMENT ACCEPTED BY: _____
For: Contractor

By: _____ _____
(Signature) (Title)

SECTION 00500 – EXHIBIT A-2
to Procurement Agreement
ASSIGNMENT OF CONTRACT

Surety hereby acknowledges and agrees that the Contract for furnishing Goods and Special Services under the Contract Documents entitled "City of Aberdeen - WWTP Equipment Pre-Purchase" by and between the City of Aberdeen, Idaho (Owner) and Vendor may be assigned, transferred, and set over to _____ (Installation Contractor), in accordance with Article 10.07 of Agreement between Owner and Vendor.

Surety further agrees that, upon assignment of the Contract, the Installation Contractor shall have all the rights of the Owner under the Performance Bond.

(Corporate Seal) Surety

Company: _____

By: _____
Signature and Title
(Attach Power of Attorney)

PERFORMANCE BOND
FOR PROCUREMENT CONTRACTS

Any singular reference to Seller, Surety, Buyer, or other party shall be considered plural where applicable.

SELLER (Name and Address):

SURETY (Name and Address of Principal Place of Business):

BUYER (Name and Address):

CONTRACT
Date:
Amount:
Description (Name and Location):

BOND
Date (Not earlier than Contract Date):
Bond Number:
Amount:
Modifications to this Bond Form:

Surety and Seller, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

Seller as Principal
Company: (Corp. Seal)

Signature:
Name and Title:

Surety
Company: (Corp. Seal)

Signature:
Name and Title:
(Attach Power of Attorney)
Address:

Telephone Number:

(Space is provided below for signatures of additional parties, if required.)

Seller as Principal
Company: (Corp. Seal)

Signature:
Name and Title:

Surety
Company: (Corp. Seal)

Signature:
Name and Title:
Address:
Telephone Number:

1. Seller and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to Buyer for the performance of the Contract, which is incorporated herein by reference. For purposes of this bond, Buyer means Buyer's assigns, if and when Buyer has assigned the Contract.

2. If Seller performs the Contract, Surety and Seller have no obligation under this Bond, except to participate in conferences as provided in Paragraph 3.1.

3. If there is no Buyer Default, Surety's obligation under this Bond shall arise after:

   3.1. Buyer has notified Seller and Surety pursuant to Paragraph 10 that Buyer is considering declaring a Seller Default and has requested and attempted to arrange a conference with Seller and Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. (If Buyer, Seller, and Surety agree, Seller shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive Buyer's right, if any, subsequently to declare a Seller Default); and

   3.2. Buyer has declared a Seller Default and formally terminated Seller's right to complete the Contract. Such Seller Default shall not be declared earlier than 20 days after Seller and Surety have received notice as provided in Paragraph 3.1; and

   3.3. Buyer has agreed to pay the Balance of the Contract Price to:

      a. Surety in accordance with the terms of the Contract;

      b. Another seller selected pursuant to Paragraph 4.3 to perform the Contract.

4. When Buyer has satisfied the conditions of Paragraph 3, Surety shall promptly and at Surety's expense take one of the following actions:

   4.1. Arrange for Seller, with consent of Buyer, to perform and complete the Contract; or

   4.2. Undertake to perform and complete the Contract itself, through its agents or through independent contractors; or

   4.3. Obtain bids or negotiated proposals from qualified sellers acceptable to Buyer for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by Buyer and a seller selected with Buyer's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the Bonds issued on the Contract, and pay to Buyer the amount of damages as described in Paragraph 6 in excess of the Balance of the Contract Price incurred by Buyer resulting from Seller Default; or

   4.4. Waive its right to perform and complete, arrange for completion, or obtain a new seller, and with reasonable promptness under the circumstances, either:

      a. determine the amount for which it may be liable to Buyer and, as soon as practicable after the amount is determined, tender payment therefore to Buyer; or

      b. deny liability in whole or in part and notify Buyer citing reasons therefore.

5. If Surety does not proceed as provided in Paragraph 4 with reasonable promptness, Surety shall be deemed to be in default on this Bond 15 days after receipt of an additional written notice from Buyer to Surety demanding that Surety perform its obligations under this Bond, and Buyer shall be entitled to enforce any remedy available to Buyer. If Surety proceeds as provided in paragraph 4.4, and Buyer refuses the payment tendered or Surety has denied liability, in whole or in part, without further notice Buyer shall be entitled to enforce any remedy available to Buyer.

6. After Buyer has terminated Seller's right to complete the Contract, and if Surety elects to act under Paragraph 4.1, 4.2, or 4.3, then the responsibilities of Surety to Buyer shall not be greater than those of Seller under the Contract, and the responsibilities of Buyer to Surety shall not be greater than those of Buyer under the Contract. To a limit of the amount of this Bond, but subject to commitment by Buyer of the Balance of the Contract Price to mitigation of costs and damages on the Contract, Surety is obligated without duplication for:

   6.1. the responsibilities of Seller for correction or replacement of defective Goods and Special Services and completion of the Contract;

   6.2. additional legal, design professional, and delay costs resulting from Seller's Default, and resulting from the actions of or failure to act of Surety under Paragraph 4; and

   6.3. liquidated damages, or if no liquidated damages are specified in the Contract, actual damages caused by delayed performance or non-performance of Seller.

7. Surety shall not be liable to Buyer or others for obligations of Seller that are unrelated to the Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than Buyer or its heirs, executors, administrators, successors, or assigns.

8. Surety hereby waives notice of any change, including changes of time, to the Contract or to related subcontracts, purchase orders and other obligations.

9. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location of the Point of Destination, and shall be instituted within two years after Seller Default or within two years after Seller ceased working or within two years after Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

10. Notice to Surety, Buyer or Seller shall be mailed or delivered to the address shown on the signature page.

11. When this Bond has been furnished to comply with a statutory or other legal requirement in the location of the Point of Destination, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted here from and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

12. Definitions.

   12.1. *Balance of the Contract Price:* The total amount payable by Buyer to Seller under the Contract after all proper adjustments have been made, including allowance to Seller of any amounts

received or to be received by Buyer in settlement of insurance or other Claims for damages to which Seller is entitled, reduced by all valid and proper payments made to or on behalf of Seller under the Contract.

12.2. *Contract:* The agreement between Buyer and Seller identified on the signature page, including all Contract Documents and changes thereto.

12.3. *Seller Default:* Failure of Seller, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Contract.

12.4. *Buyer Default:* Failure of Buyer, which has neither been remedied nor waived, to pay Seller as required by the Contract or to perform and complete or comply with the other terms thereof.

PAYMENT BOND
FOR PROCUREMENT CONTRACTS

Any singular reference to Seller, Surety, Buyer, or other party shall be considered plural where applicable.

SELLER (Name and Address):

SURETY (Name and Address of Principal Place of Business):

BUYER (Name and Address):

CONTRACT
Date:
Amount:
Description (Name and Location):

BOND
Date (Not earlier than Contract Date):
Bond Number:
Amount:
Modifications to this Bond Form:

Surety and Seller, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

Seller as Principal		**Surety**	
Company:	(Corp. Seal)	Company:	(Corp. Seal)
Signature:		Signature:	
Name and Title:		Name and Title: (Attach Power of Attorney)	
		Address:	
		Telephone Number:	

(Space is provided below for signatures of additional parties, if required.)

Seller as Principal		**Surety**	
Company:	(Corp. Seal)	Company:	(Corp. Seal)
Signature:		Signature:	
Name and Title:		Name and Title:	
		Address:	
		Telephone Number:	

1. Seller and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to Buyer to pay for labor, materials and equipment furnished for use in the performance of the Contract, which is incorporated herein by reference. For purposes of this bond, Buyer means Buyer's assigns, if and when Buyer has assigned the Contract.

2. With respect to Buyer, this obligation shall be null and void if Seller:

   2.1. Promptly makes payment, directly or indirectly, for all sums due Claimants, and

   2.2. Defends, indemnifies and holds harmless Buyer from all claims, demands, liens or suits by any person or entity who furnished labor, materials or equipment for use in the performance of the Contract, provided Buyer has promptly notified Seller and Surety (at the addresses described in Paragraph 12) of any claims, demands, liens or suits and tendered defense of such claims, demands, liens or suits to Seller and Surety, and provided there is no Buyer Default.

3. With respect to Claimants, this obligation shall be null and void if Seller promptly makes payment, directly or indirectly, for all sums due.

4. Surety shall have no obligation to Claimants under this Bond until:

   4.1. Claimants who are employed by or have a direct contract with Seller have given notice to Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to Buyer stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.

   4.2. Claimants who do not have a direct contract with Seller:

      a. have furnished written notice to Seller and sent a copy, or notice thereof, to Buyer, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials were furnished or supplied or for whom the labor was done or performed; and

      b. have either received a rejection in whole or in part from Seller or not received within 30 days of furnishing the above notice any communication from Seller by which Seller had indicated the claim will be paid directly or indirectly; and

      c. not having been paid within the above 30 days, have sent a written notice to Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to Buyer stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to Seller.

5. If a notice required by Paragraph 4 is given by Buyer to Seller or to Surety, that is sufficient compliance.

6. Reserved.

7. Surety's total obligation shall not exceed the amount of this Bond, and the amount of this bond shall be credited for any payments made in good faith by Surety.

8. Amounts owed by Buyer to Seller under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any Performance Bond. By Seller furnishing and Buyer accepting this Bond, they agree that all funds earned by Seller in the performance of the Contract are dedicated to satisfy obligations of Seller and Surety under this Bond, subject to Buyer's priority to use the funds for the completion of the furnishing the Goods and Special Services.

9. Surety shall not be liable to Buyer, Claimants or others for obligations of Seller that are unrelated to the Contract. Buyer shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

10. Surety hereby waives notice of any change, including changes of time, to the Contract or to related subcontracts, purchase orders, and other obligations.

11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the Goods relevant to the claim are located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by Paragraph 4.1 or paragraph 4.2.3, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to Surety, Buyer or Seller shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, Buyer or Seller, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory Bond and not as a common law bond.

14. Upon request of any person or entity appearing to be a potential beneficiary of this Bond, Seller shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15. Definitions

    15.1 *Claimant:* An individual or entity having a direct contract with Seller or with a Subcontractor of Seller to furnish labor, materials or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Contract, architectural and engineering services required for furnishing the Goods and Special Services by Seller and Seller's Subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

    15.2. *Contract:* The agreement between Buyer and Seller identified on the signature page, including all Contract Documents and changes thereto.

    15.3. *Buyer Default:* Failure of Buyer, which has neither been remedied nor waived, to pay Seller as required by the Contract or to perform and complete or comply with the other terms thereof.

CONDITIONS OF THE CONTRACT

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STANDARD GENERAL CONDITIONS FOR PROCUREMENT CONTRACTS

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Whenever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to the singular or plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument signed by both Buyer and Seller covering the Goods and Special Services and which lists the Contract Documents in existence on the Effective Date of the Agreement.

3. *Application for Payment*—The form acceptable to Buyer which is used by Seller in requesting progress and final payments and which is accompanied by such supporting documentation as is required by the Contract Documents.

4. *Bid*— The offer or proposal of a Seller submitted on the prescribed form setting forth the prices for the Goods and Special Services to be provided.

5. *Bidder*—The individual or entity that submits a Bid directly to Buyer.

6. *Bidding Documents*—The Bidding Requirements and the proposed Contract Documents (including all Addenda).

7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and Bid Form with any supplements.

8. *Buyer*—The individual or entity purchasing the Goods and Special Services.

9. *Change Order*—A document which is signed by Seller and Buyer and authorizes an addition, deletion, or revision to the Contract Documents or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement. Change Orders may be the result of mutual agreement by Buyer and Seller, or of resolution of a Claim.

10. *Claim*—A demand or assertion by Buyer or Seller seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract*—The entire and integrated written agreement between Buyer and Seller concerning the Goods and Special Services. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents*—Those items so designated in the Agreement. Shop Drawings and other Seller submittals are not Contract Documents, even if accepted, reviewed, or approved by Engineer or Buyer.

13. *Contract Price*—The moneys payable by Buyer to Seller for furnishing the Goods and Special Services in accordance with the Contract Documents as stated in the Agreement.

14. *Contract Times*—The times stated in the Agreement by which the Goods must be delivered and Special Services must be furnished.

15. *Drawings*—That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Goods and Special Services to be furnished by Seller. Shop Drawings and other Seller submittals are not Drawings as so defined.

16. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

17. *Engineer*—The individual or entity designated as such in the Agreement.

18. *Field Order*—A written order issued by Engineer which requires minor changes in the Goods or Special Services but which does not involve a change in the Contract Price or Contract Times.

19. *General Requirements*—Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.

20. *Goods*—The tangible and movable personal property that is described in the Contract Documents, regardless of whether the property is to be later attached to realty.

21. *Goods and Special Services*—The full scope of materials, equipment, other items, and services to be furnished by Seller, including Goods, as defined herein, and Special Services, if any, as defined herein. This term refers to both the Goods and the Special Services, or to either the Goods or the Special Services, and to any portion of the Goods or the Special Services, as the context requires.

22. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

23. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to the Contract Times.

24. *Notice of Award*—The written notice by Buyer to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Buyer will sign and deliver the Agreement.

25. *Notice to Proceed*—A written notice given by Buyer to Seller fixing the date on which the Contract Times commence to run and on which Seller shall start to perform under the Contract.

26. *Point of Destination*—The specific address of the location where delivery of the Goods shall be made, as stated in the Agreement.

27. *Project*—The total undertaking of which the Goods and Special Services may be the whole, or only a part.

28. *Project Manual*—The documentary information prepared for bidding and furnishing the Goods and Special Services. A listing of the contents of the Project Manual is contained in its table of contents.

29. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Goods and Special Services and which establish the standards by which such portion of the Goods and Special Services will be judged.

30. *Seller*—The individual or entity furnishing the Goods and Special Services.

31. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Seller and submitted by Seller to illustrate some portion of the Goods and Special Services.

32. *Special Services*—Services associated with the Goods to be furnished by Seller as required by the Contract Documents.

33. *Specifications*—That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the furnishing of the Goods and Special Services, and certain administrative requirements and procedural matters applicable thereto.

34. *Successful Bidder*—The Bidder submitting a responsive Bid, to whom Buyer makes an award.

35. *Supplementary Conditions*—That part of the Contract Documents which amends or supplements these General Conditions.

36. *Work Change Directive*—A written statement to Seller issued on or after the Effective Date of the Agreement and signed by Buyer ordering an addition, deletion, or other revision in the Contract Documents with respect to the Goods and Special Services. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 *Terminology*

A. The words and terms discussed in Paragraphs 1.02.B and 1.02.C are not defined, but have the indicated meanings when used in the Bidding Requirements or Contract Documents.

B. *Intent of Certain Terms or Adjectives:*

1. The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Goods and Special Services. It is intended that such exercise of professional judgment, action, or determination will be commercially reasonable and will be solely to evaluate, in general, the Goods and Special Services for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to Engineer any duty or authority to supervise or direct the furnishing of Goods or Special Services or any duty or authority to undertake responsibility contrary to any other provision of the Contract Documents.

2. The word "non-conforming" when modifying the words "Goods and Special Services," "Goods," or "Special Services," refers to Goods and Special Services that fail to conform to the Contract Documents.

3. The word "receipt" when referring to the Goods, shall mean the physical taking and possession by the Buyer under the conditions specified in Paragraph 8.01.B.3.

4. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

5. The word "furnish," when used in connection with the Goods and Special Services shall mean to supply and deliver said Goods to the Point of Destination (or some other specified location) and to perform said Special Services fully, all in accordance with the Contract Documents.

C. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 − PRELIMINARY MATTERS

2.01 *Delivery of Bonds*

A. When Seller delivers the executed counterparts of the Agreement to Buyer, Seller also shall deliver such bonds as Seller may be required to furnish.

2.02 *Evidence of Insurance*

A. When Seller delivers the executed counterparts of the Agreement to Buyer, Seller shall deliver to Buyer, with copies to each additional insured identified by name in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Seller is required to purchase and maintain in accordance with Article 4.

2.03 *Copies of Documents*

A. Buyer shall furnish Seller up to five printed or hard copies of the Contract Documents. Additional copies will be furnished upon request at the cost of reproduction.

2.04 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.05 *Designated Representatives*

A. Buyer and Seller shall each designate its representative at the time the Agreement is signed. Each representative shall have full authority to act on behalf of and make binding decisions in any matter arising out of or relating to the Contract.

2.06 *Progress Schedule*

A. Within 15 days after the Contract Times start to run, Seller shall submit to Buyer and Engineer an acceptable progress schedule of activities, including at a minimum, Shop Drawing and Sample submittals, tests, and deliveries as required by the Contract Documents. No progress payment will be made to Seller until an acceptable schedule is submitted to Buyer and Engineer.

B. The progress schedule will be acceptable to Buyer and Engineer if it provides an orderly progression of the submittals, tests, and deliveries to completion within the specified Milestones and the Contract Times. Such acceptance will not impose on Buyer or Engineer responsibility for the progress schedule, for sequencing, scheduling, or progress of the work nor interfere with or relieve Seller from Seller's full responsibility therefor. Such acceptance shall not be deemed to acknowledge the reasonableness and attainability of the schedule.

2.07 *Preliminary Conference*

A. Within 20 days after the Contract Times start to run, a conference attended by Seller, Buyer, Engineer and others as appropriate will be held to establish a working understanding among the parties as to the Goods and Special Services and to discuss the schedule referred to in Paragraph 2.06.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

2.08 *Safety*

A. Buyer and Seller shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss. When Seller's personnel, or the personnel of any subcontractor to Seller, are present at the Point of Destination or any work area or site controlled by Buyer, the Seller shall be responsible for the

compliance by such personnel with any applicable requirements of Buyer's safety programs that are made known to Seller.

ARTICLE 3 − CONTRACT DOCUMENTS: INTENT AND AMENDING

3.01 *Intent*

A. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

B. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce or furnish the indicated Goods and Special Services will be provided, whether or not specifically called for, at no additional cost to Buyer.

C. Clarifications and interpretations of, or notifications of minor variations and deviations in, the Contract Documents, will be issued by Engineer as provided in Article 9.

3.02 *Standards, Specifications, Codes, Laws and Regulations*

A. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws and Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws and Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

B. No provision of any such standard, specification, manual or code, or any instruction of a supplier shall be effective to change the duties or responsibilities of Buyer or Engineer, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall any such provision or instruction be effective to assign to Buyer or Engineer, or any of their consultants, agents, or employees any duty or authority to supervise or direct the performance of Seller's obligations or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

1. *Seller's Review of Contract Documents Before the Performance of the Contract*: Before performance of the Contract, Seller shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Seller shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Seller discovers or has actual knowledge of and shall obtain a written interpretation or clarification from Engineer before proceeding with the furnishing of any Goods and Special Services affected thereby.

2. *Seller's Review of Contract Documents During the Performance of the Contract:* If, during the performance of the Contract, Seller discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Contract, any standard, specification, manual or code, or of any instruction of any Supplier, Seller shall

promptly report it to Engineer in writing. Seller shall not proceed with the furnishing of the Goods and Special Services affected thereby until an amendment to or clarification of the Contract Documents has been issued.

3. Seller shall not be liable to Buyer or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Seller had actual knowledge thereof.

B. *Resolving Discrepancies:* Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

1. the provisions of any standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

2. the provisions of any Laws or Regulations applicable to the furnishing of the Goods and Special Services (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Clarifying Contract Documents*

A. The Contract Documents may be amended to provide for additions, deletions, and revisions to the Goods and Special Services or to modify contractual terms and conditions by a Change Order.

B. Buyer may issue a Work Change Directive providing for additions, deletions, or revisions to the Goods and Special Services, in which case (1) the Contract Price shall be equitably adjusted to account for any reasonable and necessary credits to Buyer for any such deletion, or for costs (including reasonable overhead and profit) incurred by Seller to accommodate such an addition or revision and (2) the Contract Times shall be equitably adjusted to account for any impact on progress and completion of performance. Such adjustments subsequently shall be duly set forth in a Change Order.

C. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Goods and Special Services may be authorized, by one or more of the following ways:

1. A Field Order;

2. Engineer’s approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 5.06.D.3); or

3. Engineer’s written interpretation or clarification.

ARTICLE 4 − BONDS AND INSURANCE

4.01 *Bonds*

A. Seller shall furnish to Buyer performance and payment bonds, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Seller's obligations under the Contract Documents. These bonds shall remain in effect until 1) one year after the date when final payment becomes due or 2) completion of the correction period specified in Paragraph

8.03, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Seller shall also furnish such other bonds as are required by the Contract Documents.

B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.

C. If the surety on any bond furnished by Seller is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 4.01.B, Seller shall promptly notify Buyer and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 4.01.B and 4.02.

4.02 *Insurance*

A. Seller shall provide insurance of the types and coverages and in the amounts stipulated in the Supplementary Conditions.

B. Failure of Buyer to demand certificates of insurance or other evidence of Seller's full compliance with these insurance requirements or failure of Buyer to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Seller's obligation to maintain such insurance.

C. Upon assignment of this Contract, Seller shall comply with the written request of assignee to provide certificates of insurance to assignee.

D. Buyer does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Seller.

E. The insurance and insurance limits required herein shall not be deemed as a limitation on Seller's liability under the indemnities granted to Buyer in the Contract Documents.

4.03 *Licensed Sureties and Insurers*

A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Buyer or Seller shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

ARTICLE 5 − SELLER'S RESPONSIBILITIES

5.01 *Supervision and Superintendence*

A. Seller shall supervise, inspect, and direct the furnishing of the Goods and Special Services competently and efficiently, devoting such attention thereto and applying such skills and expertise

as may be necessary to perform its obligations in accordance with the Contract Documents. Seller shall be solely responsible for the means, methods, techniques, sequences, and procedures necessary to perform its obligations in accordance with the Contract Documents. Seller shall not be responsible for the negligence of Buyer or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure that is shown or indicated in and expressly required by the Contract Documents.

5.02 *Labor, Materials and Equipment*

A. Seller shall provide competent, qualified and trained personnel in all aspects of its performance of the Contract.

B. All Goods, and all equipment and material incorporated into the Goods, shall be as specified, and unless specified otherwise in the Contract Documents, shall be:

1. new, and of good quality;

2. protected, assembled, connected, cleaned, and conditioned in accordance with the original manufacturer's instructions; and

3. shop assembled to the greatest extent practicable.

5.03 *Laws and Regulations*

A. Seller shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of its obligations in accordance with the Contract Documents. Except where otherwise expressly required by such Laws and Regulations, neither Buyer nor Engineer shall be responsible for monitoring Seller's compliance with any Laws or Regulations.

B. If Seller furnishes Goods and Special Services knowing or having reason to know that such furnishing is contrary to Laws or Regulations, Seller shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such performance. It shall not be Seller's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this provision shall not relieve Seller of Seller's obligations under Paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance shall be the subject of an adjustment in Contract Price or Contract Times. If Buyer and Seller are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 9.06.

5.04 *Or Equals*

A. Whenever the Goods, or an item of material or equipment to be incorporated into the Goods, are specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular supplier or manufacturer, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item is

permitted, other items of material or equipment or material or equipment of other suppliers or manufacturers may be submitted to Buyer for Engineer's review.

1. If in Engineer's sole discretion, such an item of material or equipment proposed by Seller is functionally equal to that named and sufficiently similar so that no change in related work will be required, it may be considered by Engineer as an "or-equal" item.

2. For the purposes of this paragraph, a proposed item of material or equipment may be considered functionally equal to an item so named only if:

    a. in the exercise of reasonable judgment, Engineer determines that: 1) it is at least equal in quality, durability, appearance, strength, and design characteristics; 2) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole; 3) it has an acceptable record of performance and availability of responsive service; and

    b. Seller certifies that if approved: 1) there will be no increase in any cost, including capital, installation or operating costs, to Buyer; and 2) the proposed item will conform substantially to the detailed requirements of the item named in the Contract Documents.

B. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraph 5.04.A. Engineer will be the sole judge of whether to accept or reject such a proposal or submittal. No "or-equal" will be ordered, manufactured or utilized until Engineer's review is complete, which will be evidenced by an approved Shop Drawing. Engineer will advise Buyer and Seller in writing of any negative determination. Notwithstanding Engineer's approval of an "or-equal" item, Seller shall remain obligated to comply with the requirements of the Contract Documents.

C. *Special Guarantee:* Buyer may require Seller to furnish at Seller's expense a special performance guarantee or other surety with respect to any such proposed "or-equal."

D. *Data:* Seller shall provide all data in support of any such proposed "or-equal" at Seller's expense.

5.05 *Taxes*

A. Seller shall be responsible for all taxes and duties arising out of the sale of the Goods and the furnishing of Special Services. All taxes are included in the Contract Price, except as noted in the Supplementary Conditions.

5.06 *Shop Drawings and Samples*

A. Seller shall submit Shop Drawings and Samples to Buyer for Engineer's review and approval in accordance with the schedule required in Paragraph 2.06.A. All submittals will be identified as required and furnished in the number of copies specified in the Contract Documents. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Seller proposes to provide.

B. Where a Shop Drawing or Sample is required by the Contract Documents, any related work performed prior to Engineer's approval of the pertinent submittal will be at the sole expense and responsibility of Seller.

C. *Submittal Procedures:*

1. Before submitting each Shop Drawing or Sample, Seller shall have determined and verified:

a. all field measurements (if required), quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto; and

b. that all materials are suitable with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the furnishing of Goods and Special Services.

2. Seller shall also have reviewed and coordinated each Shop Drawing or Sample with the Contract Documents.

3. Each submittal shall bear a stamp or include a written certification from Seller that Seller has reviewed the subject submittal and confirmed that it is in compliance with the requirements of the Contract Documents. Both Buyer and Engineer shall be entitled to rely on such certification from Seller.

4. With each submittal, Seller shall give Buyer and Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both in a written communication separate from the submittal and by specific notation on each Shop Drawing or Sample.

D. *Engineer's Review:*

1. Engineer will provide timely review of Shop Drawings and Samples.

2. Engineer's review and approval will be only to determine if the Goods and Special Services covered by the submittals will, after installation or incorporation in the Project, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole.

3. Engineer's review and approval shall not relieve Seller from responsibility for any variation from the requirements of the Contract Documents unless Seller has complied with the requirements of Paragraph 5.06.C.4 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Seller from responsibility for complying with the requirements of Paragraph 5.06.C.1.

E. *Resubmittal Procedures:*

1. Seller shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review

and approval. Seller shall direct specific attention in writing to any revisions other than the corrections called for by Engineer on previous submittals.

5.07 *Continuing Performance*

A. Seller shall adhere to the progress schedule established in accordance with Paragraph 2.06.A., and the Goods shall be delivered and the Special Services furnished within the Contract Times specified in the Agreement.

B. Seller shall carry on furnishing of the Goods and Special Services and adhere to the progress schedule during all disputes or disagreements with Buyer. No furnishing of Goods and Special Services shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraphs 11.03 or 11.04, or as Buyer and Seller may otherwise agree in writing.

5.08 *Seller's Warranties and Guarantees*

A. Seller warrants and guarantees to Buyer that the title to the Goods conveyed shall be proper, its transfer rightful, and free from any security interest, lien, or other encumbrance. Seller shall defend, indemnify, and hold Buyer harmless against any liens, claims, or demands contesting or affecting title of the Goods conveyed.

B. Seller warrants and guarantees to Buyer that all Goods and Special Services will conform with the Contract Documents, and with the standards established by any Samples approved by Engineer. Engineer shall be entitled to rely on Seller's warranty and guarantee. If the Contract Documents do not otherwise specify the characteristics or the quality of the Goods, the Goods shall comply with the requirements of Paragraph 5.02.B.

C. Seller's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, improper modification, improper maintenance, or improper operation by persons other than Seller; or

2. corrosion or chemical attack, unless corrosive or chemically-damaging conditions were disclosed by Buyer in the Contract Documents and the Contract Documents required the Goods to withstand such conditions;

3. use in a manner contrary to Seller's written instructions for installation, operation, and maintenance; or

4. normal wear and tear under normal usage.

D. Seller's obligation to furnish the Goods and Special Services in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Goods and Special Services that are non-conforming, or a release of Seller's obligation to furnish the Goods and Special Services in accordance with the Contract Documents:

1. observations by Buyer or Engineer;

2. recommendation by Engineer or payment by Buyer of any progress or final payment;

3. use of the Goods by Buyer;

4. any acceptance by Buyer (subject to the provisions of Paragraph 8.02.D.1) or any failure to do so;

5. the issuance of a notice of acceptance by Buyer pursuant to the provisions of Article 8;

6. any inspection, test or approval by others; or

7. any correction of non-conforming Goods and Special Services by Buyer.

E. Buyer shall promptly notify Seller of any breach of Seller's warranties or guarantees.

F. Seller makes no implied warranties under this Contract.

5.09 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, Seller shall indemnify and hold harmless Buyer and Engineer, and the officers, directors, members, partners, employees, agents, consultants, contractors, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of Seller's obligations under the Contract Documents, provided that any such claim, cost, loss, or damages attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Goods themselves), including the loss of use resulting therefrom, but only to the extent cause by any negligent act or omission of Seller, or any individual or entity directly or indirectly employed by Seller or anyone for whose acts Seller may be liable.

B. In any and all claims against Buyer or Engineer or any of their respective assignees, consultants, agents, officers, directors, members, partners, employees, agents, consultants, contractors, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Seller, any subcontractor, any supplier, or any individual or entity directly or indirectly employed by any of them to furnish any of the Goods and Special Services, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 5.09.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for seller or any such subcontractor, supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Seller under Paragraph 5.09.A shall not extend to the liability of Engineer and Engineer's officers, directors, partners, employees, agents, and consultants arising out of:

1. the preparation or approval of, or the failure to prepare or approve, maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

5.10 *Delegation of Professional Design Services*

A. Seller will not be required to provide professional design services unless such services are specifically required by the Contract Documents or unless such services are required to carry out

Seller's responsibilities for furnishing the Goods and Special Services. Seller shall not be required to provide professional services in violation of applicable law.

B. If professional design services or certifications by a design professional related to the Goods and Special Services are specifically required of Seller by the Contract Documents, Buyer and Engineer will specify all performance and design criteria that such services must satisfy. Seller shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Goods and Special Services designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

C. Buyer and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Buyer and Engineer have specified to Seller all performance and design criteria that such services must satisfy.

D. Pursuant to this Paragraph 5.10, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 5.06.D.2.

E. Seller shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 6 − SHIPPING AND DELIVERY

6.01 *Shipping*

A. Seller shall select the carrier and bear all costs of packaging, transportation, insurance, special handling and any other costs associated with shipment and delivery.

6.02 *Delivery*

A. Seller shall deliver the Goods F.O.B. the Point of Destination in accordance with the Contract Times set forth in the Agreement, or other date agreed to by Buyer and Seller.

B. Seller shall provide written notice to Buyer at least 10 days before shipment of the manner of shipment and the anticipated delivery date. The notice shall also include any instructions concerning special equipment or services required at the Point of Destination to unload and care for the Goods. Seller shall also require the carrier to give Buyer at least 24 hours notice by telephone prior to the anticipated time of delivery.

C. Buyer will be responsible and bear all costs for unloading the Goods from carrier.

D. Buyer will assure that adequate facilities are available to receive delivery of the Goods during the Contract Times for delivery set forth in the Agreement, or another date agreed by Buyer and Seller.

E. No partial deliveries shall be allowed, unless permitted or required by the Contract Documents or agreed to in writing by Buyer.

6.03 *Risk of Loss*

A. Risk of loss and insurable interests transfer from Seller to Buyer upon Buyer's receipt of the Goods.

B. Notwithstanding the provisions of Paragraph 6.03.A, if Buyer rejects the Goods as non-conforming, the risk of loss on such Goods shall remain with Seller until Seller corrects the non-conformity or Buyer accepts the Goods. If rejected Goods remain at the Point of Destination pending modification and acceptance, then Seller shall be responsible for arranging adequate protection and maintenance of the Goods at Seller's expense.

6.04 *Progress Schedule*

A. Seller shall adhere to the progress schedule established in accordance with Paragraph 2.06 as it may be adjusted from time to time as provided below.

1. Seller shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.06) proposed adjustments in the progress schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the progress schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 7. Adjustments in Contract Times may only be made by a Change Order.

ARTICLE 7 − CHANGES: SCHEDULE AND DELAY

7.01 *Changes in the Goods and Special Services*

A. Buyer may at any time, without notice to any surety, make an addition, deletion, or other revision to the Contract Documents with respect to the Goods and Services, within the general scope of the Contract, by a Change Order or Work Change Directive. Upon receipt of any such document, Seller shall promptly proceed with performance pursuant to the revised Contract Documents (except as otherwise specifically provided).

B. If Seller concludes that a Work Change Directive issued by Buyer affects the Contract Price or Contract Times, then Seller shall notify Buyer within 15 days after Seller has received the Work Change Directive, and submit written supporting data to Buyer within 45 days after such receipt. If Seller fails to notify Buyer within 15 days, Seller waives any Claim for such adjustment. If Buyer and Seller are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 9.06.

C. Seller shall not suspend performance while Buyer and Seller are in the process of making such changes and any related adjustments to Contract Price or Contract Times.

7.02 *Changing Contract Price or Contract Times*

A. The Contract Price or Contract Times may only be changed by a Change Order.

B. Any Claim for an adjustment in the Contract Price or Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 9.06.

C. If Seller is prevented from delivering the Goods or performing the Special Services within the Contract Times for any unforeseen reason beyond its control and not attributable to its actions or inactions, then Seller shall be entitled to an adjustment of the Contract Times to the extent attributable to such reason. Such reasons include but are not limited to acts or neglect by Buyer, inspection delays, fires, floods, epidemics, abnormal weather conditions, acts of God, and other like matters. If such an event occurs and delays Seller's performance, Seller shall notify Buyer in writing within 15 days of knowing or having reason to know of the beginning of the event causing the delay, stating the reason therefor.

D. Seller shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Seller. Delays attributable to and within the control of Seller's subcontractors or suppliers shall be deemed to be delays within the control of Seller.

E. If Seller is prevented from delivering the Goods or furnishing the Special Services within the Contract Times due to the actions or inactions of Buyer, Seller shall be entitled to any reasonable and necessary additional costs arising out of such delay to the extent directly attributable to Buyer.

F. Neither Buyer nor Seller shall be entitled to any damages arising from delays which are beyond the control of both Buyer and Seller, including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God, and other like matters.

ARTICLE 8 − BUYER'S RIGHTS

8.01 *Inspections and Testing*

A. *General:*

1. The Contract Documents specify required inspections and tests. Buyer shall have the right to perform, or cause to be performed, reasonable inspections and require reasonable tests of the Goods at Seller's facility, and at the Point of Destination. Seller shall allow Buyer a reasonable time to perform such inspections or tests.

2. Seller shall reimburse Buyer for all expenses, except for travel, lodging, and subsistence expenses of Buyer's and Engineer's representatives, for inspections and tests specified in the Contract Documents. If as the result of any such specified testing the Goods are determined to be non-conforming, then Seller shall also bear the travel, lodging, and subsistence expenses of Buyer's and Engineer's representatives, and all expenses of re-inspection or retesting.

3. Buyer shall bear all expenses of inspections and tests that are not specified in the Contract Documents (other than any re-inspection or retesting resulting from a determination of non-conformity, as set forth in Paragraph 8.01.A.2 immediately above); provided, however, that if as the result of any such non-specified inspections or testing the Goods are determined to be non-conforming, then Seller shall bear all expenses of such inspections and testing, and of any necessary re-inspection and retesting.

4. Seller shall provide Buyer timely written notice of the readiness of the Goods for all inspections, tests, or approvals which the Contract Documents specify are to be observed by Buyer prior to shipment.

5. Buyer will give Seller timely notice of all specified tests, inspections, and approvals of the Goods which are to be conducted at the Point of Destination.

6. If, on the basis of any inspections or testing, the Goods appear to be conforming, Buyer will give Seller prompt notice thereof. If on the basis of said inspections or testing, the Goods appear to be non-conforming, Buyer will give Seller prompt notice thereof and will advise Seller of the remedy Buyer elects under the provisions of Paragraph 8.02.

7. Neither payments made by Buyer to Seller prior to any tests or inspections, nor any tests or inspections shall constitute acceptance of non-conforming Goods, or prejudice Buyer's rights under the Contract.

B. Inspection on Delivery:

1. Buyer or Engineer will visually inspect the Goods upon delivery solely for purposes of identifying the Goods and general verification of quantities and observation of apparent condition in order to provide a basis for a progress payment. Such visual inspection will not be construed as final or as receipt of any Goods and Special Services that, as a result of subsequent inspections and tests, are determined to be non-conforming.

2. Within ten days of such visual inspection, Buyer shall provide Seller with written notice of Buyer's determination regarding conformity of the Goods. In the event Buyer does not provide such notice, it will be presumed that the Goods appear to be conforming and that Buyer has acknowledged their receipt upon delivery.

3. If, on the basis of the visual inspection specified in Paragraph 8.01.B.1, the Goods appear to be conforming, Buyer's notice thereof to Seller will acknowledge receipt of the Goods.

C. Final Inspection:

1. After all of the Goods have been incorporated into the Project, tested in accordance with such testing requirements as are specified, and are functioning as indicated, Buyer or Engineer will make a final inspection.

2. If, on the basis of the final inspection, the Goods are conforming, Buyer's notice thereof will constitute Buyer's acceptance of the Goods.

3. If, on the basis of the final inspection, the Goods are non-conforming, Buyer will identify the non-conformity in writing.

8.02 *Non-Conforming Goods and Special Services*

A. If, on the basis of inspections and testing prior to delivery, the Goods and Special Services are found to be non-conforming, or if at any time after Buyer has acknowledged receipt of delivery and before the expiration of the correction period described in Paragraph 8.03, Buyer determines that the Goods and Special Services are non-conforming, then Seller shall promptly, without cost to Buyer and in response to written instructions from Buyer, either correct such non-conforming

Goods and Special Services, or, if Goods are rejected by Buyer, remove and replace the non-conforming Goods with conforming Goods, including all work required for reinstallation.

B. Buyer's Rejection of Non-Conforming Goods:

1. If Buyer elects to reject the Goods in whole or in part, Buyer's notice to Seller will describe in sufficient detail the non-conforming aspect of the Goods. If Goods have been delivered to Buyer, Seller shall promptly, and within the Contract Times, remove and replace the rejected Goods.

2. Seller shall bear all costs, losses and damages attributable to the removal and replacement of the non-conforming Goods as provided in Paragraph 8.02.E.

3. Upon rejection of the Goods, Buyer retains a security interest in the Goods to the extent of any payments made and expenses incurred in their testing and inspection.

C. Remedying Non-Conforming Goods and Special Services:

1. If Buyer elects to permit the Seller to modify the Goods to correct the non-conformance, then Seller shall promptly provide a schedule for such modifications and shall make the Goods conforming within a reasonable time.

2. If Buyer notifies Seller in writing that any of the Special Services are non-conforming, Seller shall promptly provide conforming services acceptable to Buyer. If Seller fails to do so, Buyer may delete the Special Services and reduce the Contract Price a commensurate amount.

D. Buyer's Acceptance of Non-Conforming Goods:

Instead of requiring correction or removal and replacement of non-conforming Goods discovered either before or after final payment, Buyer may accept the non-conforming Goods. Seller shall bear all reasonable costs, losses, and damages attributable to Buyer's evaluation of and determination to accept such non-conforming Goods as provided in Paragraph 8.02.E.

E. Seller shall pay all claims, costs, losses, and damages, including but not limited to all fees and charges for re-inspection, retesting and for any engineers, architects, attorneys and other professionals, and all court or arbitration or other dispute resolution costs arising out of or relating to the non-conforming Goods and Special Services. Seller's obligations shall include the costs of the correction or removal and replacement of the non-conforming Goods and the replacement of property of Buyer and others destroyed by the correction or removal and replacement of the non-conforming Goods, and obtaining conforming Special Services from others.

F. *Buyer's Rejection of Conforming Goods:*

If Buyer asserts that Goods and Special Services are non-conforming and such Goods and Special Services are determined to be conforming, or if Buyer rejects as non-conforming Goods and Special Services that are later determined to be conforming, then Seller shall be entitled to reimbursement from Buyer of costs incurred by Seller in inspecting, testing, correcting, removing, or replacing the conforming Goods and Special Services, including but not limited to fees and charges of engineers, architects, attorneys and other professionals, and all court or arbitration or other dispute resolution

costs associated with the incorrect assertion of non-conformance or rejection of conforming Goods and Special Services.

8.03 *Correction Period*

A. Seller's responsibility for correcting all non-conformities in the Goods and Special Services will extend for a period of one year after the earlier of the date on which Buyer has placed the Goods in continuous service or the date of final payment, or for such longer period of time as may be prescribed by Laws or Regulations or by the terms of any specific provisions of the Contract Documents.

ARTICLE 9 − ROLE OF ENGINEER

9.01 *Duties and Responsibilities*

A. The duties and responsibilities and the limitations of authority of Engineer are set forth in the Contract Documents.

9.02 *Clarifications and Interpretations*

A. Engineer will issue with reasonable promptness such written clarifications or interpretations of the Contract Documents as Engineer may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents. Such written clarifications and interpretations will be binding on Buyer and Seller. If either Buyer or Seller believes that a written clarification or interpretation justifies an adjustment in the Contract Price or Contract Times, either may make a Claim therefor.

9.03 *Authorized Variations*

A. Engineer may authorize minor deviations or variations in the Contract Documents by: 1) written approval of specific variations set forth in Shop Drawings when Seller has duly noted such variations as required in Paragraph 5.06.C.4, or 2) a Field Order.

9.04 *Rejecting Non-Conforming Goods and Special Services*

A. Engineer will have the authority to disapprove or reject Goods and Special Services that Engineer believes to be non-conforming. Engineer will also have authority to require special inspection or testing of the Goods or Special Services as provided in Paragraph 8.01 whether or not the Goods are fabricated or installed, or the Special Services are completed.

9.05 *Decisions on Requirements of Contract Documents*

A. Engineer will be the initial interpreter of the Contract Documents and judge of the acceptability of the Goods and Special Services. Claims, disputes and other matters relating to the acceptability of the Goods and Special Services or the interpretation of the requirements of the Contract Documents pertaining to Seller's performance will be referred initially to Engineer in writing with a request for a formal decision in accordance with this paragraph.

B. When functioning as interpreter and judge under this Paragraph 9.05, Engineer will not show partiality to Buyer or Seller and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by Engineer pursuant to this

Paragraph 9.05 with respect to any such Claim, dispute, or other matter (except any which have been waived by the making or acceptance of final payment as provided in Paragraph 10.07) will be a condition precedent to any exercise by Buyer or Seller of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such Claim, dispute, or other matter.

9.06 *Claims and Disputes*

A. *Notice*: Written notice of each Claim relating to the acceptability of the Goods and Special Services or the interpretation of the requirements of the Contract Documents pertaining to either party's performance shall be delivered by the claimant to Engineer and the other party to the Agreement within 15 days after the occurrence of the event giving rise thereto, and written supporting data shall be submitted to Engineer and the other party within 45 days after such occurrence unless Engineer allows an additional period of time to ascertain more accurate data.

B. *Engineer's Decision*: Engineer will review each such Claim and render a decision in writing within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any.

C. If Engineer does not render a formal written decision on a Claim within the time stated in Paragraph 9.06.B., Engineer shall be deemed to have issued a decision denying the Claim in its entirety 31 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any.

D. Engineer's written decision on such Claim or a decision denying the Claim in its entirety that is deemed to have been issued pursuant to Paragraph 9.06.C, will be final and binding upon Buyer and Seller 30 days after it is issued unless within 30 days of issuance Buyer or Seller appeals Engineer's decision by initiating the mediation of such Claim in accordance with the dispute resolution procedures set forth in Article 13.

E. If Article 13 has been amended to delete the mediation requirement, then Buyer or Seller may appeal Engineer's decision within 30 days of issuance by following the alternative dispute resolution process set forth in Article 13, as amended; or if no such alternative dispute resolution process has been set forth, Buyer or Seller may appeal Engineer's decision by 1) delivering to the other party within 30 days of the date of such decision a written notice of intent to submit the Claim to a court of competent jurisdiction, and 2) within 60 days after the date of such decision instituting a formal proceeding in a court of competent jurisdiction.

F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 9.06.

G. The parties agree to endeavor to avoid or resolve Claims through direct, good faith discussions and negotiations whenever practicable. Such discussions and negotiations should at the outset address whether the parties mutually agree to suspend the time periods established in this Paragraph 9.06; if so, a written record of such mutual agreement should be made and jointly executed.

ARTICLE 10 − PAYMENT

10.01 *Applications for Progress Payments*

A. Seller shall submit to Buyer for Engineer's review Applications for Payment filled out and signed by Seller and accompanied by such supporting documentation as is required by the Contract Documents and also as Buyer or Engineer may reasonably require. The timing and amounts of progress payments shall be as stipulated in the Agreement.

1. The first application for Payment will be submitted after review and approval by Engineer of all Shop Drawings and of all Samples required by the Contract Documents.

2. The second Application for Payment will be submitted after receipt of the Goods has been acknowledged in accordance with Paragraph 8.01.B and will be accompanied by a bill of sale, invoice, or other documentation reasonably satisfactory to Buyer warranting that Buyer has rightfully received good title to the Goods from Seller and that, upon payment, the Goods will be free and clear of all liens. Such documentation will include releases and waivers from all parties with viable lien rights. In the case of multiple deliveries of Goods, additional Applications for Payment accompanied by the required documentation will be submitted as Buyer acknowledges receipt of additional items of the Goods.

10.02 *Review of Applications for Progress Payments*

A. Engineer will, within ten days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Buyer, or return the Application to Seller indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Seller may make the necessary corrections and resubmit the Application.

1. Engineer's recommendation of payment requested in the first Application for Payment will constitute a representation by Engineer, based on Engineer's review of the Application for Payment and the accompanying data, that the Shop Drawings and Samples have been reviewed and approved as required by the Contract Documents and Seller is entitled to payment of the amount recommended.

2. Engineer's recommendation of payment requested in the Application for Payment submitted upon Buyer's acknowledgment of receipt of the Goods will constitute a representation by Engineer, based on Engineer's review of the Application for Payment and the accompanying data Seller is entitled to payment of the amount recommended. Such recommendation will not constitute a representation that Engineer has made a final inspection of the Goods, that the Goods are free from non-conformities, acceptable or in conformance with the Contract Documents, that Engineer has made any investigation as to Buyer's title to the Goods, that exhaustive or continuous inspections have been made to check the quality or the quantity of the Goods beyond the responsibilities specifically assigned to Engineer in the Contract Documents or that there may not be other matters or issues between the parties that might entitle Seller to additional payments by Buyer or Buyer to withhold payment to Seller.

3. Engineer may refuse to recommend that all or any part of a progress payment be made, or Engineer may nullify all or any part of any payment previously recommended if, in Engineer's opinion, such recommendation would be incorrect or if on the basis of subsequently discovered evidence or subsequent inspections or tests Engineer considers

such refusal or nullification necessary to protect Buyer from loss because the Contract Price has been reduced, Goods are found to be non-conforming, or Seller has failed to furnish acceptable Special Services.

10.03 *Amount and Timing of Progress Payments*

A. Subject to Paragraph 10.02.A., the amounts of the progress payments will be as provided in the Agreement. Buyer shall within 30 days after receipt of each Application for Payment with Engineer's recommendation pay Seller the amount recommended; but, in the case of the Application for Payment upon Buyer's acknowledgment of receipt of the Goods, said 30-day period may be extended for so long as is necessary (but in no event more than 60 days) for Buyer to examine the bill of sale and other documentation submitted therewith. Buyer shall notify Seller promptly of any deficiency in the documentation and shall not unreasonably withhold payment.

10.04 *Suspension of or Reduction in Payment*

A. Buyer may suspend or reduce the amount of progress payments, even though recommended for payment by Engineer, under the following circumstances:

1. Buyer has reasonable grounds to conclude that Seller will not furnish the Goods or the Special Services in accordance with the Contract Documents, and

2. Buyer has requested in writing assurances from Seller that the Goods and Special Services will be delivered or furnished in accordance with the Contract Documents, and Seller has failed to provide adequate assurances within ten days of Buyer’s written request.

B. If Buyer refuses to make payment of the full amount recommended by Engineer, Buyer will provide Seller and Engineer immediate written notice stating the reason for such action and promptly pay Seller any amount remaining after deduction of the amount withheld. Buyer shall promptly pay Seller the amount withheld when Seller corrects the reason for such action to Buyer’s satisfaction.

10.05 *Final Application for Payment*

A. After Seller has corrected all non-conformities to the reasonable satisfaction of Buyer and Engineer, furnished all Special Services, and delivered all documents required by the Contract Documents, Engineer will issue to Buyer and Seller a notice of acceptance. Seller may then make application for final payment following the procedure for progress payments. The final Application for Payment will be accompanied by all documentation called for in the Contract Documents, a list of all unsettled Claims, and such other data and information as Buyer or Engineer may reasonably require.

10.06 *Final Payment*

A. If, on the basis of final inspection and the review of the final Application for Payment and accompanying documentation, Engineer is reasonably satisfied that Seller has furnished the Goods and Special Services in accordance with the Contract Documents, and that Seller's has fulfilled all other obligations under the Contract Documents, then Engineer will, within ten days after receipt of the final Application for Payment, recommend in writing final payment subject to the provisions of Paragraph 10.07 and present the Application to Buyer. Otherwise, Engineer will return the Application to Seller, indicating the reasons for refusing to recommend final payment, in which case Seller shall make the necessary corrections and resubmit the Application for payment. If the

Application and accompanying documentation are appropriate as to form and substance, Buyer shall, within 30 days after receipt thereof, pay Seller the amount recommended by Engineer, less any sum Buyer is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages to which Buyer is entitled.

10.07 *Waiver of Claims*

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Buyer against Seller, except Claims arising from unsettled liens from non-conformities in the Goods or Special Services appearing after final payment, from Seller's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Seller's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by Seller against Buyer (other than those previously made in accordance with the requirements herein and listed by Seller as unsettled as required in Paragraph 10.05.A, and not resolved in writing).

ARTICLE 11 − CANCELLATION, SUSPENSION, AND TERMINATION

11.01 *Cancellation*

A. Buyer has the right to cancel the Contract, without cause, at any time prior to delivery of the Goods by written notice. Cancellation pursuant to the terms of this paragraph shall not constitute a breach of contract by Buyer. Upon cancellation:

1. Buyer shall pay Seller for the direct costs incurred in producing any Goods that Seller has specially manufactured for the Project, plus a fair and reasonable amount for overhead and profit.

2. For Goods that are not specially manufactured for the Project, Seller shall be entitled to a restocking charge of 10 percent of the unpaid Contract Price of such Goods.

11.02 *Suspension of Performance by Buyer*

A. Buyer has the right to suspend performance of the Contract for up to a maximum of ninety days, without cause, by written notice. Upon suspension under this paragraph, Seller shall be entitled to an increase in the Contract Times and Contract Price caused by the suspension, provided that performance would not have been suspended or delayed for causes attributable to Seller.

11.03 *Suspension of Performance by Seller*

A. Subject to the provisions of Paragraph 5.07.B, Seller may suspend the furnishing of the Goods and Special Services only under the following circumstance:

1. Seller has reasonable grounds to conclude that Buyer will not perform its future payment obligations under the Contract; and,

2. Seller has requested in writing assurances from Buyer that future payments will be made in accordance with the Contract, and Buyer has failed to provide such assurances within ten days of Seller's written request.

11.04 *Breach and Termination*

A. Buyer's Breach:

1. Buyer shall be deemed in breach of the Contract if it fails to comply with any material provision of the Contract Documents, including but not limited to:

a. wrongful rejection or revocation of Buyer's acceptance of the Goods,

b. failure to make payments in accordance with the Contract Documents, or

c. wrongful repudiation of the Contract.

2. Seller shall have the right to terminate the Contract for cause by declaring a breach should Buyer fail to comply with any material provisions of the Contract. Upon termination, Seller shall be entitled to all remedies provided by Laws and Regulations.

a. In the event Seller believes Buyer is in breach of its obligations under the Contract, Seller shall provide Buyer with reasonably prompt written notice setting forth in sufficient detail the reasons for declaring that it believes a breach has occurred. Buyer shall have seven days from receipt of the written notice declaring the breach (or such longer period of time as Seller may grant in writing) within which to cure or to proceed diligently to cure such alleged breach.

B. Seller's Breach:

1. Seller shall be deemed in breach of the Contract if it fails to comply with any material provision of the Contract Documents, including, but not limited to:

a. failure to deliver the Goods or perform the Special Services in accordance with the Contract Documents,

b. wrongful repudiation of the Contract, or

c. delivery or furnishing of non-conforming Goods and Special Services.

2. Buyer may terminate Seller's right to perform the Contract for cause by declaring a breach should Seller fail to comply with any material provision of the Contract Documents. Upon termination, Buyer shall be entitled to all remedies provided by Laws and Regulations.

a. In the event Buyer believes Seller is in breach of its obligations under the Contract, and except as provided in Paragraph 11.04.B.2.b, Buyer shall provide Seller with reasonably prompt written notice setting forth in sufficient detail the reasons for declaring that it believes a breach has occurred. Seller shall have seven days from receipt of the written notice declaring the breach (or such longer period of time as Buyer may grant in writing) within which to cure or to proceed diligently to cure such alleged breach.

b. If and to the extent that Seller has provided a performance bond under the provisions of Paragraph 4.01, the notice and cure procedures of that bond, if any, shall supersede the notice and cure procedures of Paragraph 11.04.B.2.a.

ARTICLE 12 − LICENSES AND FEES

12.01 *Intellectual Property and License Fees*

A. Unless specifically stated elsewhere in the Contract Documents, Seller is not transferring any intellectual property rights, patent rights, or licenses for the Goods delivered. However, in the event the Seller is manufacturing to Buyer's design, Buyer retains all intellectual property rights in such design.

B. Seller shall pay all license fees and royalties and assume all costs incident to the use or the furnishing of the Goods, unless specified otherwise by the Contract Documents.

12.02 *Seller's Infringement*

A. Subject to Paragraph 12.01.A, Seller shall indemnify and hold harmless Buyer, Engineer and their officers, directors, members, partners, employees, agents, consultants, contractors, and subcontractors from and against all claims, costs, losses, damages, and judgments (including but not limited to all reasonable fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement or alleged infringement of any United States or foreign patent or copyright by any of the Goods as delivered hereunder.

B. In the event of suit or threat of suit for intellectual property infringement, Buyer will promptly notify Seller of receiving notice thereof.

C. Seller shall promptly defend the claim or suit, including negotiating a settlement. Seller shall have control over such claim or suit, provided that Seller agrees to bear all expenses and to satisfy any adverse judgment thereof.

1. If Seller fails to defend such suit or claim after written notice by Buyer, Seller will be bound in any subsequent suit or claim against Seller by Buyer by any factual determination in the prior suit or claim.

2. If Buyer fails to provide Seller the opportunity to defend such suit or claim after written notice by Seller, Buyer shall be barred from any remedy against Seller for such suit or claim.

D. If a determination is made that Seller has infringed upon intellectual property rights of another, Seller may obtain the necessary licenses for Buyer's benefit, or replace the Goods and provide related design and construction as necessary to avoid the infringement at Seller's own expense.

12.03 *Buyer's Infringement*

A. Buyer shall indemnify and hold harmless Seller, and its officers, directors, partners, employees, agents, consultants, contractors, and subcontractors from and against all claims, costs, losses, damages, and judgments (including but not limited to all reasonable fees and charges of engineers,

architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement or alleged infringement of any United States or foreign patent or copyright caused by Seller's compliance with Buyer's design of the Goods or Buyer's use of the Goods in combination with other materials or equipment in any process (unless intent of such use was known to Seller and Seller had reason to know such infringement would result).

B. In the event of suit or threat of suit for intellectual property infringement, Seller must after receiving notice thereof promptly notify Buyer.

C. Upon written notice from Seller, Buyer shall be given the opportunity to defend the claim or suit, including negotiating a settlement. Buyer shall have control over such claim or suit, provided that Buyer agrees to bear all expenses and to satisfy any adverse judgment thereof.

1. If Buyer fails to defend such suit or claim after written notice by Seller, Buyer will be bound in any subsequent suit or claim against Buyer by Seller by any factual determination in the prior suit or claim.

2. If Seller fails to provide Buyer the opportunity to defend such suit or claim after written notice by Buyer, Seller shall be barred from any remedy against Buyer for such suit or claim.

12.04 *Reuse of Documents*

A. Neither Seller nor any other person furnishing any of the Goods and Special Services under a direct or indirect contract with Seller shall: (1) acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media versions; or (2) reuse any of such Drawings, Specifications, other documents, or copies thereof on any other project without written consent of Buyer and Engineer and specific written verification or adaptation by Engineer. This prohibition will survive termination or completion of the Contract. Nothing herein shall preclude Seller from retaining copies of the Contract Documents for record purposes.

12.05 *Electronic Data*

A. Unless otherwise stated in the Supplementary Conditions, copies of data furnished by Buyer or Engineer to Seller, or by Seller to Buyer or Engineer that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. The transferring party will correct any errors detected within the 60-day acceptance period.

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from

the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

ARTICLE 13 − DISPUTE RESOLUTION

13.01 *Dispute Resolution Method*

A. Either Buyer or Seller may initiate the mediation of any Claim decided in writing by Engineer under Paragraph 9.06.B or 9.06.C before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the Engineer's decision from becoming final and binding.

B. Buyer and Seller shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the mediation process does not result in resolution of the Claim, then Engineer's written decision under Paragraph 9.06.B or a denial pursuant to Paragraph 9.06.C shall become final and binding 30 days after termination of the mediation unless, within that time period, Buyer or Seller:

1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions, or

2. agrees with the other party to submit the Claim to another dispute resolution process, or

3. if no dispute resolution process has been provided for in the Supplementary Conditions, delivers to the other party written notice of the intent to submit the Claim to a court of competent jurisdiction, and within 60 days of the termination of the mediation institutes such formal proceeding.

ARTICLE 14 − MISCELLANEOUS

14.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if: 1) delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or 2) if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

14.02 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Point of Destination is located.

B. In the case of any conflict between the express terms of this Contract and the Uniform Commercial Code, as adopted in the state whose law governs, it is the intent of the parties that the express terms of this Contract shall apply.

14.03 *Computation of Time*

A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day shall be omitted from the computation.

14.04 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents, and the provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

14.05 *Survival of Obligations*

A. All representations, indemnifications, warranties and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Goods and Special Services and termination or completion of the Agreement.

14.06 *Entire Agreement*

A. Buyer and Seller agree that this Agreement is the complete and final agreement between them, and supersedes all prior negotiations, representations, or agreements, either written or oral. This Agreement may not be altered, modified, or amended except in writing signed by an authorized representative of both parties.

SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions for Procurement Contracts, EJCDC P-700 (2010 Edition), and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions will have the meanings indicated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings indicated below, which are applicable to both the singular and plural thereof.

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

SC-1.01 Add the following terms and definitions to Article 1:

37. Engineer – The Engineer is further defined as Keller Associates Inc., 305 North 3rd Steet, Ste. A, Pocatello, ID 83201.
38. Buyer – The Buyer is further defined as the City of Aberdeen.
39. Owner – The terms Owner and Buyer may be used interchangeably in the Contract Documents to refer to the same party.
40. Vendor – The terms Seller and Vendor may be used interchangeably in the Contract Documents to refer to the same party.
41. Installation Contractor – The Installation Contractor is further defined as the contractor responsible for installation of the Goods furnished under this project.
42. Construction Contractor – The terms Construction Contractor and Installation Contractor may be used interchangeably in the Contract Documents to refer to the same party.
43. Notice of Intent to Award — Written notice by Buyer to the Bidder with the highest scoring responsive bid, which notice notifies the Bidder of the Buyer's intent to recommend award of the bid to the Bidder, provided the Bidder returns the signed agreement and bonds, when required, to the Buyer. This is not an award.

ARTICLE 2 – PRELIMINARY MATTERS

SC-2.03 Delete Part A and add the following in its place:

A. Engineer shall furnish Seller up to three hard copies of the Contract Documents as requested. Additional copies will be furnished upon request at the cost of reproduction.

SC-2.05 Delete Part A and add the following in its place:

A. Seller shall designate its representative at the time the Agreement is signed. Seller's representative shall have full authority to act on behalf of and make binding decisions in any matter arising out of or relating to the Contract.

ARTICLE 4 – BONDS AND INSURANCE

SC-4.02 Add the following new paragraphs immediately after Paragraph 4.02.E:

F. Seller shall purchase and maintain such liability and other insurance as is appropriate for the furnishing of Goods and Special Services and as will provide protection from claims set forth below which may arise out of or result from Seller's furnishing of the Goods or Special Services and Seller's other obligations under the Contract Documents, whether the furnishing of Goods and Special Services or other obligations are to be performed by Seller, any subcontractor or supplier, or by anyone directly or indirectly employed by any of them to furnish the Goods and Special Services, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;

2. claims for damages because of bodily injury, occupational sickness or disease, or death of Seller's employees;

3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Seller's employees;

4. claims for damages insured by reasonably available personal injury liability coverage which are sustained: (i) by any person as a result of an offense directly or indirectly related to the employment of such person by Seller, or (ii) by any other person for any other reason;

5. claims for damages, other than to the Goods, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

G. The policies of insurance so required by this Paragraph 4.02 to be purchased and maintained shall:

1. with respect to insurance required by Paragraphs SC-4.02.F.3 through SC-4.02.F.6 inclusive, include as additional insureds (subject to any customary exclusion in respect of professional liability) City of Aberdeen and Keller Associates, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided below or required by Laws or Regulations, whichever is greater;

3. include completed operations insurance;

4. include contractual liability insurance covering Seller's indemnity obligations under Paragraphs 5.09 and 12.02.

5. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least thirty days prior written notice has been given to Buyer and Seller and to each other additional insured identified in these Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Seller pursuant to Paragraph SC-4.02.I);

6. remain in effect at least until final payment and at all times thereafter when Seller may be correcting, removing, or replacing non-conforming Goods in accordance with Paragraph 8.03;

7. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment (and Seller shall furnish Buyer and each other additional insured identified in these Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Buyer and any such additional insured of continuation of such insurance at final payment and one year thereafter); and

8. with respect to any delegation of professional design services to Seller pursuant to Paragraph 5.10 of the General Conditions, include professional liability coverage by endorsement or otherwise.

H. The limits of liability for the insurance required by Paragraph SC-4.02.F shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. Workers' Compensation, and related coverages under Paragraphs SC-4.02.F.1 and F.2 that comply with Idaho Laws and Regulations:

a. State:	Statutory
b. Applicable Federal (e.g., Longshoreman's):	Statutory
c. Employer's Liability:	Statutory

2. Seller's General Liability under Paragraphs SC-4.02.F.3 through F.6 which shall include completed operations and product liability coverages and eliminate the exclusion with respect to property under the care, custody and control of Seller:

a. General Aggregate	$2,000,000
b. Products - Completed 1) Operations Aggregate	$2,000,000
c. Personal and Advertising 1) Injury	$1,000,000
2) Each Occurrence (Bodily Injury and Property Damage)	$1,000,000

d. Property Damage liability insurance will provide Explosion, Collapse, and Underground coverages where applicable.

e. Excess or Umbrella Liability
   1) General Aggregate $2,000,000
   2) Each Occurrence $2,000,000

3. Automobile Liability under Paragraph SC-4.02.F.6:

   a. Bodily Injury:
      1) Each person $1,000,000
      2) Each Accident $1,000,000

   b. Property Damage:
      1) Each Accident $1,000,000

   c. Combined Single Limit of $1,000,000

I. Seller shall deliver to Buyer, with copies to each additional insured identified in these Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Buyer or any other additional insured) which Seller is required to purchase and maintain.

J. If Buyer has any objection to the coverage afforded by or other provisions of the insurance required to be purchased and maintained on the basis of non-conformance with the Contract Documents, Buyer shall notify Seller in writing within 10 days after receipt of the certificates or other evidence required by Paragraph SC-4.02.F. Seller shall provide such additional information in respect to insurance as Buyer shall reasonably request.

ARTICLE 5 – SELLER'S RESPONSIBILITIES

SC-5.04.A.2 Replace subparagraphs a) and b) with the following:

All requirements are satisfied as listed in Section 01 25 13 – Product Substitution Procedures.

SC-5.05.A Replace paragraph 5.05.A with the following:

A. The Installation Contractor installing the Owner-selected equipment specified in these Contract Documents shall be responsible for all taxes and duties (if any) arising out of the sale of the Goods and furnishing of the special services provided by the Seller.

SC-5.06 Add the following new paragraphs immediately after Paragraph 5.06.E:

F. Seller shall furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than two submittals. Engineer will record Engineer's time for reviewing subsequent submittals of Shop Drawings, samples, or other items requiring approval and Seller shall reimburse Buyer for Engineer's charges for such time.

G. In the event the Seller requests a change of a previously approved item, Seller shall reimburse Buyer for Engineer's charges for its review time unless the need for such change is beyond the control of Seller.

SC-5.08.B Delete Paragraph 5.08.B in its entirety and insert the following in its place:

Seller warrants and guarantees to Buyer that all Goods and Special Services will conform with the Contract Documents, including any samples approved by Engineer, and the Goods will meet the Buyer's Technical Specifications. Engineer shall be entitled to rely on representation of Seller's warranty and guarantee.

SC-5.08 Add the following new paragraph immediately after Paragraph 5.08.F:

G. For warranties on Goods supplied by Seller to remain in effect, any replacement or addition of Goods to the system must be made using Goods approved in writing by Seller.

ARTICLE 6 – SHIPPING AND DELIVERY

SC-6.02.E Delete Paragraph 6.02.E in its entirety and insert the following in its place:

Partial deliveries and payment will be allowed. Seller shall be responsible for providing bill of sale or shipping receipt that allows Buyer to inventory each shipment.

SC-6.03.A Delete Paragraph 6.03.A in its entirety and insert the following in its place:

Risk of loss and insurable interests transfer from Seller to Buyer upon delivery of Goods to the Point of Destination.

ARTICLE 8 – BUYER'S RIGHTS

SC-8.03.A Delete Paragraph 8.03.A in its entirety and insert the following in its place:

Seller's responsibility for correcting all non-conformities in Goods and Special Services will extend for a period of one year after the substantial completion date for the construction project. *Substantial completion* is defined as "the time at which the Work has progressed to the point where, in the opinion of Engineer, the Work is sufficiently complete, in accordance with the Contract Documents, so that the Work can be utilized for the purposes for which it is intended."

ARTICLE 10 – PAYMENT

SC-10.01. A Delete last sentence and insert: "Payment will be in accordance with Specification Section 01 29 76 - Schedule of Payments."

SC-10.02.A.1 Delete Paragraph 10.02.A.1 in its entirety and insert the following in its place:

Engineer's recommendation of payment requested for submittal of Shop Drawing and Samples for Payment will constitute a representation by Engineer, based on Engineer's review of the Application for Payment and the accompanying data that the Shop Drawings and Samples have been reviewed and approved as required by the Contract Documents and Seller is entitled to payment of the amount recommended.

ARTICLE 12 – LICENSES AND FEES

SC-12.04 Add the following new paragraph immediately after Paragraph 12.04.A:

B. Nothing herein shall preclude Buyer or Engineer from retaining copies of the Contract Documents for record purposes. This prohibition will survive termination or completion of the Contract.

ARTICLE 14 – Miscellaneous

SC-14 Add the following paragraphs immediately after Paragraph 14.06:

14.07 *Independent Contractor*

A. The Parties agree that Seller is an independent contractor with no employment relationship with Buyer or Engineer.

14.08 *Contracting Authority*

A. Each Party warrants that the person or persons executing this Contract on behalf of such Party has the full right, power, and authority to enter into and execute this Contract on such Party's behalf, and that no consent from any other person or entity is necessary as a condition precedent to the legal effect of this Contract.

14.09 *Performance/Waiver*

A. The failure of a Party hereto to insist upon strict performance or observance of the terms of this Contract shall not be a waiver of any breach of any terms or conditions of this Contract by the other Party.

14.10 *Counterparts*

A. This Contract may be executed in counterparts, each of which shall be deemed to be an original, but all of which, taken together, shall constitute one and the same Contract.

END OF SECTION P-800

TECHNICAL SPECIFICATIONS

SECTION 01 11 00 – SUMMARY OF WORK

PART 1 - GENERAL

1.1 WORK INCLUDED

A. It is required that there be furnished, in accordance with these Contract documents, wastewater treatment equipment as set forth in these Technical Specifications.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The successful bidder shall enter into a Procurement Agreement (PA) with the City to provide one or more of the following goods. There will be a separate PA for each equipment system selected. Each Vendor may provide more than one type of equipment.

B. The Procurement Agreement entered into with the Owner shall also include the following services. These services are required to be included with each equipment system provided.

C. Submittals: The Vendor will provide design of the Goods, submittal of the shop drawings, general arrangement drawings of equipment, and a control strategy description; will participate in meetings and assist Engineer during the design; and will make changes to the equipment system as required to coordinate the design with the Engineer during the submittal review process. Submittals shall meet the requirements of Section 01 30 00 – Vendor Submittals.

1.3 PROJECT INFORMATION

A. Equipment provided as part of this contract will be supplied as part of the Gooding Wastewater Treatment Plant Improvements Project.

B. Treatment Plant Description:

1. The WWTP will be undergoing a major plant upgrade which will include modification to the existing headworks building to accommodate a new screen, construction of a new structure for grit removal, new activated sludge process basins, and a new process building containing process blowers, sand filters and UV disinfection equipment. Treated effluent will be discharged to the Little Wood River. Waste activated sludge will be pumped to existing digesters, and subsequently be pumped to the existing sludge drying beds prior to offsite disposal.

C. Site Characteristics:

1. Site Elevation: 4394 ft

2. Maximum Ambient Temperature: 87.9°F

3. Minimum Ambient Temperature: 11.0°F

4. Average Annual Max Temperature: 59.4°F

5. Average Annual Min Temperature: 30.2°F

6. Average Annual Precipitation: 8.80 in (Precipitation) and 21.0 in (Snowfall)

D. Wastewater Flow Characteristics: The flow entering the treatment plant can be classified as standard domestic municipal waste with approximately 26% from commercial connections. Gooding's wastewater is mostly residential and does not have major commercial, institutional, septage, leachate, or industrial contributions. The hospital is the largest non-residential connection.

1. Design Influent:

a. Design Average Day Flow: 0.36 MGD

b. Max Month Flow: 0.50 MGD

c. Peak Day Flow: 0.67 MGD

d. Peak Hour Flow: 1.73 MGD

e. Average BOD: 347 mg/L

f. Average TSS: 404 mg/L

g. Average TKN: 26 mg/L

h. Average Phosphorus: 6 mg/L

i. Water Temperature: 7-19 degrees Celsius

2. Required Effluent Characteristics:

a. Average Monthly BOD: 30 mg/L

b. Average Monthly TSS: 30 mg/L

c. Average Monthly Phosphorus as P: 1.36 lb/day

d. Monthly Geometric E. Coli: 126 MPN/100 mL

1.4 CONTRACT METHOD

A. The Equipment, hereunder, shall be furnished under a lump sum Contract as shown in the Bid Schedule. The Contract shall be assigned to the Installation Contactor as described in the Purchase Agreement. It is expected that the contract with the Installation Contractor will be established in the First Quarter 2024. Payment shall be made in accordance with schedule of payments listed in Section 01 29 76 – Schedule of Payments.

1.5 DELIVERY

A. Vendor is responsible for equipment being adequately and effectively protected against damage from handling, or other cause, during transport from Vendor's premises to the place of delivery.

B. Delivery of equipment to be furnished under the Contract shall be completed at the Owner's job site, within the number of calendar days, after receipt by the Vendor of the Notice to Proceed, as specified in the Agreement. Delivery of all items shall be witnessed by the Owner and verified on the invoice by the Owner.

1.6 FACTORY REPRESENTATIVE

A. Vendor shall provide the services of a qualified factory representative as specified in Section 01 31 13 – Project Coordination and Section 01 43 33 – Vendor's Field Services. Such services shall include installation coordination, startup, operator training assistance and testing. Any services of the factory representative required because of deficiencies in materials and workmanship shall be borne by the Vendor.

1.7 EQUIPMENT FIELD TESTING

A. After installation, all mechanical systems shall be tested for proper operation, efficiency, and capacity by the Installation Contractor and the Vendor, in the presence of the Owner and Engineer. Vendor's factory representative shall perform any final adjustments and inspection during this test. All parts shall operate satisfactorily in all respects. If any part of a unit shows evidence of unsatisfactory or improper operation during the test period, correction or repairs shall be made by the Vendor and the full test operation shall be repeated.

B. All tests shall be performed during normal working hours.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 11 00

SECTION 01 25 13 – PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This document describes the requirements for submission of product information and procedures for consideration of substitutions by Owner, including products proposed to be used by Vendor under "or equal" or "acceptable alternate" provisions.

B. Where equipment, materials or process have been specifically named, it is the intention of the Engineer to use these items. If a Vendor desires to have an alternate considered, they are to provide the information herein. It will be the responsibility of the Vendor to convince the Engineer that the alternate materials are equal and will perform the intended function at or above that of the specified equipment. The burden of proof is on the Vendor to convince the Engineer that the product is equal for the purpose of a particular function.

C. Substitution or Alternative Product Options: The alternative materials shall be submitted to Engineer no less than 15 business days before the bid opening. Engineer shall evaluate the materials, and if Engineer approves the substitution, an addendum shall be issued allowing the equipment alternatives.

1.2 DEFINITIONS

A. The word “Products,” as used herein, is defined to include purchased items incorporated into the work, regardless of whether specifically purchased for the project or taken from Vendor’s stock of previously manufactured products. The word “Materials,” is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form units of work. The word “Equipment” is defined as products with operating parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items). Definitions in this paragraph are not intended to negate the meaning of other terms used in the Contract Documents, including “specialties”, “system”, “structure”, “finishes”, “accessories”, “furnishings”, “special construction”, and similar items, which are self-explanatory and have recognized meanings in the construction industry.

B. Neither “Products” nor “Materials” nor “Equipment” includes machinery and equipment used for preparation, fabrication, conveying and erection of the Goods.

1.3 VENDOR’S OPTIONS

A. For products specified only by reference standards, select any product meeting standards, by any manufacturer.

B. For products specified by naming several products or manufacturers, select any product and manufacturer named.

C. For products specified by naming one or more products but indicating the option of selecting equivalent products by stating "or equal" or "acceptable alternate" after specified product, Vendor must submit request, as required for substitution, for any product not specifically named.

1. "Or-Equal" Items: if in the Engineer's sole judgment an item of material or equipment proposed by Vendor is functionally equal to that named and sufficiently similar so that no change in related work will be required, it may be considered by the Engineer as an "or-equal" item, in which case review and approval of the proposed item may in the Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purpose of the paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. It is at least equal in quality, durability, appearance, strength, and design characteristics.

b. It will reliably perform at least equally well the function imposed by the design concept of the complete project as a functioning whole.

c. There is no increase in cost to the Owner; and

d. It will conform to the detailed requirements of the item named in the Contract Documents.

D. For products specified by name, brand, model, etc., the Vendor shall provide information as required below for the Engineer to review and determine under their sole discretion that the product is acceptable.

1.4 SUBSTITUTIONS

A. If in the Engineer's sole judgment an item of material or equipment proposed by Vendor does not qualify as an "or-equal" item, it will be considered a proposed substitute item and subject to the review process.

B. If Vendor wishes to furnish or use a substitute item of material or equipment, Vendor shall first make written application to the Engineer for review of a proposed substitute item of material or equipment. The application shall certify that the proposed substitute will perform adequately the function and achieve the results called for by the general design, be similar in substance to the specified, and be suited for the same use that is specified.

C. The procedure for review by the Engineer will include the following:

1. If the Vendor wishes to provide a substitution item, the Vendor shall make written application to the Engineer.

2. Unless otherwise provided by law or authorized in writing by the Engineer, the request shall be submitted 15 days before the bid opening.

3. Wherever a proposed substitution item has not been submitted within said 15-day period, or wherever the submission of a proposed substitution material or equipment has been judged to be unacceptable by the Engineer, the Vendor shall provide the material or equipment indicated in the Contract Documents.

4. The Engineer will evaluate each proposed substitution within a reasonable period of time.

5. As applicable, no shop drawing submittals shall be made for a substitution item nor shall any substitution item be ordered, installed, or utilized without the Engineer's prior written acceptance of the Vendor's request.

D. Vendor shall submit sufficient information as provided below to allow the Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and therefore an acceptable substitute, therefore. Requests for review of proposed substitute items of materials or equipment will not be accepted by the Engineer from anyone other than the Vendor. Include the following minimum information in the application:

1. The Vendor shall certify that the proposed substitution will perform adequately the functions and achieve the results called for by the general design and be similar and of equal substance to that indicated and be suited for the same use as the specified.

2. For products:

a. Product identification, including manufacturer's name and address.

b. Manufacturer's literature:

1) Product description

2) Performance and test data

3) Reference standards

3. Samples.

4. Name and address of similar projects on which product was used and date of installation.

5. All variations of the proposed substitute item for the specified shall be identified in the application and available engineering, sales, maintenance, repair, and replacement service shall be indicated.

6. The application shall state the extent, if any, to which the use of the proposed substitute will prejudice Vendor's achievement of delivery on time, whether or not use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provision of any other direct contract with Owner for work on the project) to adapt the design to the proposed substitute item, and whether or not incorporation or use of the substitute in connection with the work is subject to payment of any license fee or royalty.

7. Relation to separate contracts.

8. The application shall also contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other sellers affected by any resulting change, all of which will be considered by the Engineer in evaluating the proposed substitute item.

E. In making a request for substitution, Vendor shall:

1. Investigate proposed product or method and determine that it is equal or superior in all respects to that specified.

2. Provide the same guarantee for substitution as for product or method specified.

3. Coordinate installation of accepted substitution into work, making such changes as may be required for work to be complete in all respects.

4. Waive all claims for additional costs related to substitution which consequently become apparent.

5. Ensure cost data is complete and includes all related costs under this contract, but excludes:

a. Costs under separate contracts.

b. Engineer's redesign.

F. Substitutions will not be considered if:

1. They are indicated or implied on shop drawings or product data submittals without formal request submitted in accordance with Paragraph 1.4;

2. Acceptance will require substantial revision of work.

G. Vendor shall provide all data in support of any proposed substitute or “or-equal” at Vendor’s expense.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 25 13

SECTION 01 29 76 – SCHEDULE OF PAYMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section defines the partial payment milestones and the corresponding payment amount, specified as a percent of the lump sum total contract price as submitted on Vendor's bid forms.

1.2 SCHEDULE OF PAYMENTS

A. The schedule of payments, less retainage, for the supplying of the Goods and Special Services shall be based on the following schedule:

Task Completion	Amount
Engineer's Approval of Submittals	100% of Item A in the Bid Schedule
Delivery of all Goods	60% of Item B in the Bid Schedule
Manufacturer's Installation Certification	10% of Item B in the Bid Schedule
Successful Completion of Testing	10% of Item B in the Bid Schedule
Engineer's Approval of O&M Manual	5% of Item B in the Bid Schedule
Completion of All Training	5% of Item B in the Bid Schedule
Substantial Completion	10% of Item B in the Bid Schedule

B. No partial payments will be paid for delivery of goods. Once all components are delivered to the site, Vendor will be eligible for payment for that task.

C. No payments shall be made beyond 80 percent until the Owner's Manuals have been approved and received by Owner.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 29 76

SECTION 01 30 00 – VENDOR SUBMITTALS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Wherever submittals are required hereunder, all such submittals by the Vendor shall be submitted to the Engineer per schedule listed in the Agreement.

B. Within 7 days after the date of commencement as stated in the Notice to Proceed, the Vendor shall submit the following items to the Engineer for review:

1. A preliminary progress schedule indicating the starting date of manufacture and assembly, and shipping dates of the Goods.

2. A preliminary schedule of Shop Drawings, Samples, and proposed Substitutes ("Or-Equal") submittals listed in the Bid.

1.2 SHOP DRAWINGS

A. Wherever called for in the Contract Documents, or where required by the Engineer, the Vendor shall furnish to the Engineer for review, three (3) copies, plus one electronic copy, of each shop drawing submittal. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, list, graphs, catalog sheets, data sheets, and similar items.

1. Whenever the Vendor is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the project is to be built, unless otherwise directed.

B. Verify that the material or equipment described in each submittal conforms to all requirements of the Specifications and drawings. All Vendor shop drawings submittals shall be carefully reviewed by an authorized representative of the Vendor, prior to submission to the Engineer. Each submittal shall be dated, signed, and certified by the Vendor, as being correct and in strict conformance with the Contract Documents. In the case of shop drawings, each sheet shall be so dated, signed, and certified. No consideration for review by the Engineer of any Vendor submittals will be made for any items which have not been so certified by the Vendor. All non-certified submittals will be returned to the Vendor without action taken by the Engineer, and any delays caused thereby shall be the total responsibility of the Vendor.

C. Where the detailed Specifications require specific submittal data, submit all data at the same time. A multiple page submittal shall be collated into sets, and each set shall be stapled or bound, as appropriate, prior to transmittal to the Engineer. Submittals are to be accompanied by the transmittal form attached at the end of this Section. The Engineer may return for resubmittal any information not accompanied by the specified transmittal form, properly completed.

1. Sequentially number the transmittal forms. Ensure that resubmittals have original number with an alphabetic suffix.

2. A separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required.

D. Except as may otherwise be indicated herein, the Engineer will return prints of each submittal to the Vendor with its comments. The Vendor shall make a complete and acceptable submittal to the Engineer by the second submission of a submittal item. The Owner reserves the right to withhold monies due to the Vendor to cover additional costs of the Engineer's review beyond the second submittal.

E. If copies of a submittal are returned to the Vendor marked "No Exceptions Taken" or “Furnish as Corrected”, formal revision and resubmission of said submittal will not be required.

F. If a submittal is returned to the Vendor marked "Revise and Resubmit" or “Rejected”, the Vendor shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the Engineer.

G. Fabrication of an item shall be commenced only after the Engineer has reviewed the pertinent submittals and returned copies to the Vendor marked either "No Exceptions Taken" or “Furnish as Corrected." Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis for changes to the contract requirements.

1.3 EFFECT OF ACCEPTANCE OF VENDOR INFORMATION

A. Acceptance by the Engineer of any drawings, method of work, or any information regarding materials or equipment the Vendor proposes to provide shall not relieve the Vendor of his responsibility for any errors therein and shall not be regarded as an assumption of risk or liability by the Engineer or Owner, or by any officer or employees thereof, and the Vendor shall have no claim under the contract on account of the failure or partial failure or inefficiency of any plan or method of work or material or equipment so accepted. Such acceptance shall be considered to mean merely that the Engineer has no objection to the Vendor using, upon his own full responsibility, the plan or method of work proposed, or providing the materials or equipment proposed.

B. Approval of shop drawings by the Engineer is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications. The Vendor is responsible for dimensions which shall be confirmed and correlated at the job site, fabrication process and techniques of construction, coordination of his work with that of all other trades and the satisfactory performance of his work.

1.4 DEVIATIONS FROM CONTRACT

A. If the Vendor proposes to provide material or equipment which does not conform to all of the Specifications and Drawings, the transmittal form accompanying the submittal copies shall indicate any deviations under "comments."

1.5 PRODUCT DATA AND SAMPLES

A. Where required in the Specifications and as determined by the Engineer, test specimens or samples of materials, appliances, and fittings to be used or offered for use in connection with the work shall be submitted to the Engineer at the Vendor's expense, with information as to their sources, with all freight charges prepaid, and in such quantities and sizes as may be required for proper examination and tests to establish the quality or equality thereof, as applicable.

B. All samples and test specimens are to be submitted in ample time to enable the Engineer to make any tests or examinations necessary, without delay to the work. The Vendor will be held responsible for any loss of time due to the neglect or failure to deliver the required samples to the Engineer as specified.

C. Samples may also be taken during the course of the work, as required by the Engineer.

D. Laboratory tests and examinations that the Owner elects to make will be made at no cost to the Vendor, except that, if a sample of any material or equipment proposed for use by the Vendor fails to meet the Specifications, the cost of testing subsequent samples will be borne by the Vendor.

E. All tests required by the Specifications to be performed by an independent laboratory are to be made, and the samples therefore furnished shall be at the sole expense of the Vendor.

F. Material used in the work is to conform to the submitted samples and test certificates as approved by the Engineer.

1.6 VENDOR'S SCHEDULES

A. Within 7 calendar days after the Commencement Date in the Notice to Proceed, the Vendor shall furnish the Owner and the Engineer a schedule showing the dates that manufacturing and assembly is to start, and shipment is to commence. This schedule shall be developed and followed to ensure the timely review and approval of shop drawings, and delivery of the equipment. The schedule shall be subject to the Engineer's review and Vendor resubmittal of the schedule shall be as required by the Engineer.

B. The following table is provided as a guidance for the deliverables required to be submitted as well as the required point at which they are to be submitted. This table is provided to identify the minimum requirements for submittals and is not intended to be all inclusive of all deliverables that may be necessary.

Deliverable	When to Submit
Performance Guarantee	Initial Submittal
Warranty	
Shop Drawings	
AutoCad Drawings	
Hydraulic Headloss Calculations	
Product Data	
List of Major Products Proposed	
Factory Inspection Logs and Testing Logs	
Process Calculations	
Performance Testing Plan	
Operation and Maintenance Manual	90 Days Prior to Shipment
Structural Requirements and Calculations	
Manufacturer's Installation Instructions	Prior to Shipment
List of hardware, fasteners, or materials required to interface with mechanical, structural, electrical, control and monitoring instrumentation	
Bill of Materials	
Delivery and Storage Requirements	
Panel Factory Acceptance Testing	
Field Testing Plan	
Operational Readiness Testing (ORT) forms	
Startup procedures	
Manufacturer's Certification of Proper Installation	Prior to Startup
Performance and ORT Testing Reports, including I/O checklist	Startup
Final PLC and HMI Applications and Passwords to Owner	
Operator Training	

1.7 OWNER'S OPERATIONS AND MAINTENANCE MANUAL

A. Refer to requirements in Section 01 78 23 – Operation and Maintenance Data.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 30 00

STANDARD SUBMITTAL FORM

DATE: _____ SUBMITTAL NO._____

FROM: _____ TO: _____
(To be completed afterward)

_____ _____

_____ _____

Vendor: This is: (Check one)

_____ An Original Submittal_____

_____ A 2nd Submittal_____

_____ A ___ Submittal_____

Previous Submittal Nos. _____

No. of Submittal Copies _____

SPECIFICATION OR SUBJECT OF SUBMITTAL	EQUIPMENT DESIGNATION	DRAWING REFERENCE

We have verified that this submittal contains all applicable material and information required for evaluation against the project Specifications. Furthermore, we submit these items, which comply with the Drawings and Specifications (check one):

____ With no exceptions

____ Except for the following deviations

NO.	DEVIATIONS

_____
Vendor's Authorized Representative

SECTION 01 31 13 – PROJECT COORDINATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Equipment Vendor shall accommodate the overall design and construction schedule by submitting shop drawings of proposed equipment to Engineer within the timeframe specified in Section P-520 - Procurement Agreement. In addition, special services requiring the manufacturer's assistance will require interface with the Engineer and timely submittals to maintain design and construction schedule.

B. During the engineering, manufacturing, installation and startup of the Goods, the interface will be between Vendor, the Engineer, and the Owner as stated in Section P-700 – General Conditions.

C. Before and during the installation and startup of the Goods, the Vendor shall be interfacing with both the Engineer and the Installation Contractor. It is understood that direct interface between the Vendor and Installation Contractor will be required. However, it is the Vendor's responsibility to keep the Engineer and Owner informed of all Information passing between itself and the Installation Contractor. Therefore, the Vendor shall send copies of all letters, drawings, telephone notes, etc. exchanged between itself and the Installation Contractor, to the Engineer for distribution.

D. Notice: Any notice, order, request or other communication shall be given in accordance with the provisions of Section P-700 – General Conditions. Any notice sent by first-class mail shall be deemed to have been given two days after the day of mailing.

E. Work by Owner and Others: The Vendor shall fully cooperate and coordinate its activity with the activities of the Owner, Installation Contractor, and other contractors so that work on the entire scheme of development may be performed with utmost speed consistent with good practice.

1.2 VENDOR SUBMITTALS

A. The Vendor shall submit a startup plan to Engineer in accordance with Section 01 30 00 - Vendor Submittals at least 60 days prior to scheduled startup date indicated by Installation Contractor. The startup plan shall include the following:

1. Equipment testing schedule.
2. Performance testing.
3. Instrumentation calibration and alarm review.
4. Programmable logic controller verification and testing.
5. Develop on-going approach to move equipment from startup to full operational status.

B. The start-up plan shall satisfy requirements listed in Section 01 75 16 – Startup Procedures.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 31 13

SECTION 01 42 13 - ABBREVIATIONS AND ACRONYMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Wherever in these Specifications references are made to the standards, specifications, or other published data of the various international, national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user of these Specifications, the following acronyms or abbreviations which may appear in these Specifications shall have the meanings indicated herein.

1.2 ABBREVIATIONS

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturer's Association
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturer's Association, Inc.
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AHAM	Association of Home Appliance Manufacturers
AI	The Asphalt Institute
AlA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANS	American Nuclear Society
ANSI	American National Standards Institute, Inc.
APA	American Plywood Association (or) American Parquet Association, Inc.
API	American Petroleum Institute

APWA	American Public Works Association
ARI	Air-Conditioning and Refrigeration Institute
ASA	Acoustical Society of America
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society of Nondestructive Testing
ASQC	American Society for Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWCI	American Wire Cloth Institute
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BBC	Basic Building Code, Building Officials and Code Administrators
BHMA	Builders Hardware Manufacturer's Association
CBM	Certified Ballast Manufacturers
CDA	Copper Development Association
CEMA	Conveyors Equipment Manufacturer's Association
CGA	Compressed Gas Association
CLFMI	Chain Link Fence Manufacturer's Institute
CLPCA	California Lathing and Plastering Contractors Association
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
DCDMA	Diamond Core Drill Manufacturer's Association
DEQ	Department of Environmental Quality
DHI	Door and Hardware Institute

DIPRA	Ductile Iron Pipe Research Association
DOE	Department of Ecology
DWR	Department of Water Resources
EIA	Electronic Industries Association
ETL	Electrical Test Laboratories
EPA	Environmental Protection Agency
FCI	Fluid Controls Institute
FM	Factory Mutual System
FPL	Forest Products Laboratory
HI	Hydronics Institute (or) Hydraulics Institute
HPMA	Hardwood Plywood Manufacturers Association
IAPMO	International Association of Plumbing and Mechanical Officials
IBC	International Building Code
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IFC	International Fire Code
IME	Institute of Makers of Explosives
IP	Institute of Petroleum (London)
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
ISDSI	Insulated Steel Door Systems Institute
ISEA	Industrial Safety Equipment Association
ISO	International Organization for Standardization
ISPWC	Idaho Standards for Public Works Construction
ITE	Institute of Traffic Engineers
MBMA	Metal Building Manufacturer's Association
MIL	Military Standards (DoD)
MPTA	Mechanical Power Transmission Association

MSS	Manufacturers Standardization Society
MTI	Marine Testing Institute
NAAMM	National Association of Architectural Metal Manufacturer's
NACE	National Association of Corrosion Engineers
NAGDM	National Association of Garage Door Manufacturers
NB	National Board of Boiler and Pressure Vessel Inspectors (alternate NBBPVI)
NBS	National Bureau of Standards (Now NIST)
NCCLS	National Committee for Clinical Laboratory Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association (or) National Fluid Power Association (or) National Forest Products Association
NISO	National Information Standards Organization
NLGI	National Lubricating Grease Institute
NMA	National Microfilm Association
NSF	National Sanitation Foundation
NWMA	National Woodwork Manufacturers Association
NWWDA	National Wood Window and Door Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PPI	Plastics Pipe Institute
RCRA	Resource Conservation and Recovery Act
RIS	Redwood Inspection Service
RMA	Rubber Manufacturers Association
RVIA	Recreational Vehicle Industry Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SAMA	Scientific Apparatus Makers Association
SDI	Steel Door Institute
SMA	Screen Manufacturers Association

SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SPI	Society of the Plastics Industry, Inc.
SPIB	Southern Pine Inspection Bureau
SPR	Simplified Practice Recommendation
SSA	Swedish Standards Association
SSBC	Southern Standard Building Code, Southern Building Code Congress
SSPC	Steel Structures Painting Council
SSPWC	Standard Specifications for Public Works Construction
TAPPI	Technical Association of the Pulp and Paper Industry
TFI	The Fertilizer Institute
TIA	Telecommunications Industries Association
UBC	Uniform Building Code
UFC	Uniform Fire Code
UL	Underwriters Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WCRSI	Western Concrete Reinforcing Steel Institute
WEF	Water Environment Federation
WIC	Woodwork Institute of California
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 42 13

SECTION 01 43 33 – VENDOR'S FIELD SERVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Vendor shall furnish erection assistance as required for consultation at the job site during installation of all equipment. Vendor shall also furnish qualified personnel for inspection, testing and startup of the finished installation and training of operational personnel.

B. Vendor's representative for the equipment specified herein shall be present at the job site and/or classroom designated by the Owner for a minimum number of workdays noted in equipment specific sections. Where recommended by the Vendor for any of the services, the number of additional days or trips, as well as the cost for these additional services, shall be identified in the proposal.

C. The Bid shall include all associated expenses incurred by the technical representative during the jobsite visits.

D. Excluded from this time requirement shall be travel time, time spent at the table during shipping of equipment, time spent at the jobsite correcting any fabrication or manufacturing errors, and time spent preparing and operating the equipment to meet performance requirements.

E. Work Day: For all specifications, a "workday" and a "calendar day" shall both be defined as an eight (8) hour work period onsite, excluding all travel time to and from the site.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 Vendor's services shall conform to the requirements of Section 01 31 13 - Project Coordination with the following additional requirements:

A. At least 30 working days prior to equipment startup, Vendor shall submit a detailed resume with appropriate qualifications of each individual proposed as a technical representative. Substitution of an accepted individual shall require notification and resume submittal at least 10 working days prior to startup and shall be subject to the Engineer's review and acceptance. Minimum qualifications include previous startup experience at a minimum of two (2) projects with similar equipment.

B. Startup services and training of Owner's personnel shall be at such times as requested by the Owner. Vendor shall submit an overall training plan and a detailed lesson plan for each training activity at least 7 working days prior to the training. The Installation Contractor will notify Vendor of the anticipated startup date, at least 30 working days prior to the startup date.

C. Vendor on-site work hours shall be coordinated with the Installation Contractor.

D. Training sessions shall be performed between 8:00 a.m. and 2:30 p.m., Monday through Thursday. Training sessions may be performed in the same day, however no training session for a single group shall last more than 4 hours.

E. Vendor shall videotape all training sessions and provide a copy to Owner for continuing operator training.

F. Vendor shall not be paid for field startup services which are unauthorized or made necessary due to delays, omissions, errors,or defects for which Vendor is responsible.

G. Vendor's erection supervisor(s) shall not assume executive charge of such work, but shall provide necessary direction so that the Installation Contractor, to the extent it follows the recommendations of Vendor, shall be relieved for any claims by Vendor when failure is due to erection, startup and operation during the employment of Vendor's Service Representative.

3.2 TESTING

A. The equipment shall not be considered ready for the performance and 30-day testing until the following conditions are satisfied:

1. Manufacturer's certification of equipment installation has been submitted to the Engineer.

2. Related Owner's Operation and Maintenance Manual and Final Shop Drawing have been accepted by the Engineer.

3. All required functional, electrical tests, and electrical adjustments have been completed to the satisfaction of the Engineer.

4. All safety devices and equipment are installed, fully functional, adjusted, and tested.

B. All testing shall be witnessed by the Owner or Engineer to be considered valid.

C. Vendor shall provide all materials, labor and equipment to prepare all equipment furnished under the Contract to be brought on line. Vendor's scope for field services is limited to supporting the equipment supplied and installed, under this procurement Contract.

END OF SECTION 01 43 33

SECTION 01 45 00 – QUALITY CONTROL

PART 1 - GENERAL

1.1 DEFINITION

A. The term Quality Control includes inspection, sampling and testing, and associated requirements.

1.2 INSPECTION AT PLACE OF MANUFACTURE

A. Unless otherwise indicated, all products, materials, and equipment shall be subject to inspection by the Engineer at the place of manufacture.

B. The presence of the Engineer at the place of manufacturer, however, shall not relieve the Vendor of the responsibility for furnishing products, materials, and equipment which comply with all requirements of the Contract Documents. Compliance is a duty of the Vendor and said duty shall not be avoided by any act or omission on the part of the Engineer.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION

A. The Owner and Installation Contractor shall inspect materials or equipment upon the arrival on the job site and immediately prior to installation and reject damaged and defective items.

B. The Vendor shall verify measurements and dimensions of the Work, as an integral step of starting each installation.

END OF SECTION 01 45 00

SECTION 01 65 00 – PRODUCT DELIVERY REQUIRMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The required delivery date for the Goods shall be as set forth in these Contract Documents and approved by the Engineer.

1.2 EQUIPMENT DELIVERY

A. The Vendor shall deliver the Goods to the Installation Contractor as necessary to meet the approved schedule. The Vendor shall be prepared to ship the Goods from the storage location or Vendor plant within twenty (20) calendar days of Vendor's receipt of written notice from Installation Contractor to ship.

1. The Vendor shall include the cost of shipment of all equipment associated with the Goods to the Point of Destination for the Installation Contractor in its lump sum bid.

2. The Vendor shall notify the Installation Contractor five (5) working days prior to shipment of the equipment, of the details of the shipping schedule.

3. The Vendor shall prepare all articles and materials for shipment in such a manner as to protect them from damage in transit. The Vendor shall be responsible for and make good any and all damage due to improper preparation and loading for shipment and shall ship to the location(s) designated herein.

4. Buyer shall be responsible for unloading the Goods at the site. The Vendor shall provide detailed instructions for off-loading and storage of equipment. The Vendor is hereby notified that all truck unloading activities may occur immediately upon receipt of shipment, and that the unloading activity will not be delayed accommodate the schedule of the individual(s) designated by the Vendor to supervise unloading. The Vendor shall supply all special tools, slings, and components necessary for unloading Vendor's equipment. Such tools, slings, and components shall be included with the shipment in a separate, clearly marked container. Any articles or materials that might otherwise be lost shall be boxed or wired in bundles and plainly marked for identification.

5. The Vendor shall obtain All Risk Transit Insurance covering the value of the materials and equipment being transported to the Project site. This shall include ocean cargo coverage as applicable.

B. The Vendor will arrange to have the Goods delivered to the project site between 8:00 A.M. and 3:30 P.M., Monday to Thursday, except statutory holidays. The Installation Contractor nor the Owner shall not be responsible for Goods delivered outside the acceptable time for delivery.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 65 00

SECTION 01 75 16 – STARTUP PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Equipment testing and startup are requisite to satisfactory completion of the contract and, therefore, shall be completed within the construction contract time.

B. The Vendor shall coordinate with the Installation Contractor all Work necessary for the successful operation of equipment system.

1.2 SUBMITTALS

A. Testing and Startup Plan: Not less than 60 days prior to startup, the Vendor shall submit for review a detailed Testing and Startup Plan. The Plan shall include schedules for equipment certifications, submittal of final Owner's Manuals, training of the Owner's personnel, electrical testing, and a detailed schedule of operations to achieve successful equipment testing, startup, performance and acceptance testing and activities to implement the 7-day and 30-day tests. The Plan shall include test checklists and data forms for each item of equipment and shall address coordination with the Owner's staff. The Vendor shall revise the Plan as necessary based on review comments.

B. Records and Documentation:

1. Submit documentation that the equipment has been properly installed, is in accurate alignment, is free from undue stresses from connecting piping and anchoring and has operated satisfactorily under full load conditions.

2. Testing and Startup Records as specified in Section 3.8.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Prior to scheduling any operations testing, the Vendor shall have previously furnished the Owner's Manuals required under Section 01 78 23 – Operation and Maintenance Data.

B. The Vendor shall coordinate the scheduling of all operations testing. The Vendor is advised that the Engineer and the Owner's operating personnel will witness operations testing and that the Vendor's representative shall be required to instruct the Owner's operating personnel in correct operation and maintenance procedures.

C. The Vendor shall notify the Engineer at least 7 days in advance for testing installed equipment.

3.2 SUPPLIES

A. The Installation Contractor will furnish all process liquid, washwater, compressed air, electrical power, and all other necessary equipment, facilities, and services required for conducting the tests, except for items listed in the equipment specifications to be provided by Vendor.

3.3 FACTORY ACCEPTANCE TESTING

A. The Vendor shall be responsible for conducting a factory acceptance test and achieving Engineer approval as to the outcome of the test prior to the field installation of the equipment, if required by the specifications for the equipment.

B. The Vendor is advised that the Engineer and the Owner’s operating personnel may witness factory testing.

C. The Vendor shall be responsible for scheduling all factory acceptance testing. The Vendor shall coordinate the factory acceptance testing schedule with the Engineer at least 1 week in advance.

D. Factory acceptance testing shall be conducted per the requirements in the equipment specifications.

3.4 EQUIPMENT INSTALLATION AND TESTING

A. The Installation Contractor shall coordinate directly with the Vendor to provide the services of an experienced and authorized representative of the manufacturer, who shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation.

B. The Installation Contractor shall arrange to have the manufacturer's representative revisit the job site as often as necessary until any and all trouble is corrected, and the equipment installation and operation are satisfactory to the Buyer and Engineer.

C. The Installation Contractor shall require that Vendor furnish to the Engineer a written certification addressed to the Owner certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts and has been operated satisfactorily and tested under full-load conditions.

3.5 FUNCTIONAL SYSTEM TESTING

A. In addition to individual equipment and subsystem testing, the Vendor shall perform testing of all process control, electrical and other systems, as listed in the equipment specifications to demonstrate proper operation with equipment operating over full operating ranges and under actual operating conditions, in all of the automatic and manual modes as specified in the control strategies and descriptions in the equipment specifications.

B. The Vendor shall repeat the system tests as necessary to demonstrate proper operation to the satisfaction of the Engineer. The Vendor shall be back charged the cost of Owner's personnel and Engineer's personnel for all tests beyond the second test.

C. Prior to initiating the system testing, the Vendor shall submit the testing procedures to the Engineer for approval. Systems that are included in a 7-day test shall be tested and accepted prior to commencement of the 30-day startup test. The systems that shall be included in the 7-day and 30-day tests include all equipment included in the Vendor's scope of supply.

D. System testing in general shall involve demonstration that all controls, instrumentation loops, alarm/status indication, and all controls described in the equipment specifications function properly. In addition, the Vendor shall demonstrate sustained equipment operation for a minimum of eight continuous hours when operated in conjunction with other system components. The Vendor shall schedule, provide, and coordinate the services of all manufacturers, suppliers, the Engineer, the Installation Contractor, and the Owner for successful system testing.

E. All system testing activities shall follow detailed test procedures, check lists, etc., previously developed and submitted by the Vendor which have been reviewed by the Engineer. Completion of all system testing activities shall be documented by a certified report. Successful completion of the system testing is required prior to commencement of the 7-day test and 30-day test specified below.

F. The Vendor shall test and fully demonstrate proper operation of the utility, safety equipment, and other support systems before commencing the process system testing.

G. The Vendor shall give the Engineer written notice confirming the date of any system test at least (3) working days before the time the system is scheduled to be tested. The Owner's staff will observe system's testing.

3.6 7-DAY PERFORMANCE TEST

A. The startup of the equipment system will require the combined technical expertise of the Vendor, Installation Contractor, Owner, and the Engineer. The Installation Contractor shall provide the effective coordination of all parties necessary for successful 7-day test.

B. The Installation Contractor and Vendor shall provide operating personnel for the duration of the 7-day test.

C. The 7-day test shall not be commenced until all required equipment tests have been completed to the satisfaction of the Engineer.

D. All defects in materials or workmanship which appear during this test period shall be immediately corrected by the Vendor.

E. During the 7-day test, the Installation Contractor and Vendor shall provide the services of authorized representatives, in addition to those services required under operations testing, as necessary, to correct faulty equipment operation.

F. 7-Day Test: The Vendor, in coordination with the Contractor and Owner, shall be required to assist in conducting the 7-day test, operate facilities being tested, and pass a 7-day test. The vendor must be present on site for the duration of the 7-day test; completion of 7-day test by phone or video conferencing will not be acceptable. All equipment must properly run as specified in the equipment specifications during the 7-day test period at test flow rates. If any item provided by the Vendor malfunctions during the test, the item shall be repaired, and the test restarted at day zero with no credit given for the operating time before the aforementioned malfunction.

1. The Vendor shall lubricate and maintain the equipment in accordance with the manufacturer's recommendations.

2. Prerequisites: The following shall be completed before 7-day testing begins.

   a. All Owner's manuals information required by the Contract Documents has been furnished.

   b. Provide all safety equipment, protective guards and shields required by the Contract Documents. Devices and equipment shall be fully functional, adjusted and tested.

   c. Manufacturer's certification of proper installation has been accepted.

   d. Electrical tests, and equipment adjustments have been completed.

   e. The Engineer has approved the 7-day testing and startup plan. The plan shall include a check list documenting that all the prerequisites have been provided and/or completed.

   f. Functional verification of the individual instrumentation loops (analog, status, alarm, and control).

   g. Adjustment of the pressure switches, timing relays, level switches, temperature switches, HMI monitors, and all other control devices to the settings determined by the Engineer or the equipment manufacturer.

   h. Functional verification of the individual interlocks between the field-mounted control devices and the motor control circuits, control circuits of variable-speed controllers, and packaged system controls.

3.7 30-DAY TEST AND PLANT STARTUP

A. The Installation Contractor shall be required to operate the equipment system and pass a 30-day test prior to acceptance. Each equipment system shall be started up as determined by the Contractor's phasing plan and after each has completed the 7-day test. All Vendor equipment must properly run for the 30-day test period. If any item malfunctions during the test, the item shall be repaired, and the test restarted at day zero with no credit given for the operating time before the aforementioned malfunction.

1. Prerequisites: The following shall be completed before plant testing and startup begins.

   a. 7-day performance testing shall be completed and accepted.

   b. The Engineer has approved the 30-day Startup Plan.

B. The Owner and/or Engineer shall provide the effective coordination of all parties necessary for successful 30-day test.

C. After approval of the 30-day Startup Plan and coordination with the Owner, the Installation Contractor shall start the 30-day test by introducing process flow through the equipment. This test, to the greatest extent possible, will take place at 80% of the design flow for each process or piece of equipment.

D. All defects in material or workmanship which appear during the tests shall be immediately corrected by the Vendor or Installation Contractor as applicable.

E. The Owner and Installation Contractor shall provide operating personnel for the duration of the 30-day test.

F. The Vendor shall lubricate and maintain the equipment in accordance with the manufacturer's recommendations.

G. During the 30-day test, the Vendor shall provide the services of authorized representative, in addition to those services required under operations testing, as necessary, to correct faulty equipment operation.

H. Testing and startup records per Section 3.8.

I. After successful completion and acceptance of the 30-day test, the Vendor shall:

1. Complete closeout of the project per Section 01 77 00 – Closeout Procedures.

3.8 RECORDS OF TESTING AND STARTUP

A. The Vendor shall maintain the following during the 7-day and 30-day testing and startup and submit originals to Engineer prior to acceptance of tests and before substantial completion will be considered:

1. Test results from performance testing as specified in the equipment specifications.
2. Lubrication and service records for each mechanical and electrical equipment item.
3. Hours of daily operation for each mechanical and electrical equipment item.
4. Equipment alignment and vibration measurement records, as specified.
5. Logs of electrical measurements and tests.
6. Instrumentation calibration and testing logs.
7. Testing and validation of status indications and alarms.
8. Factory and field equipment settings.
9. Log of problems encountered and adjustments made.
10. Other records, logs, and checklists as required by the Contract Documents.

3.9 TRAINING

A. The Vendor shall coordinate the training periods with the Owner and manufacturer's representatives and shall submit a training schedule and detailed agenda for each piece of equipment or system for which training is to be provided. Said training schedule and agenda shall be submitted not less than 14 calendar days prior to the time that the associated training is to be provided. The Vendor shall confirm each training period a minimum of two days prior to scheduled time.

B. Additional requirements for training are listed in the equipment specifications.

END OF SECTION 01 75 16

SECTION 01 77 00 – CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 CLOSEOUT TIMETABLE

A. The Installation Contractor shall establish dates for equipment testing, acceptance periods, and on-site instructional periods (as required under the Contract). Such dates shall be established not less than two weeks prior to beginning any of the foregoing items, to allow the Vendor, Installation Contractor, Engineer, and their authorized representatives sufficient time to schedule attendance at such activities.

1.2 FINAL SUBMITTALS

A. The Vendor, prior to requesting final payment, shall obtain and submit the following items to the Installation Contractor for transmittal to the Owner:

1. Written guarantees, where required.

2. Owner's Operation and Maintenance Manuals as specified in Section 01 78 23 – Operation and Maintenance Data.

3. Recommended spare parts, special tools.

4. Certificates indicating that all tests and activities required by Section 01 75 16 – Startup Procedures have been successfully completed to the satisfaction of the Engineer.

5. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

6. Process Guarantee, where required.

1.3 MAINTENANCE AND GUARANTEE

A. The Vendor shall comply with the maintenance and guarantee requirements contained in Article 5.08 of the General Conditions.

B. If the Goods fail to perform as warranted, the Vendor shall make all repairs and replacements promptly upon receipt of written order from the Owner. If the Vendor fails to make such repairs or replacements promptly, the Owner reserves the right to do the work and the Vendor and his surety shall be liable to the Owner for the cost thereof.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 77 00

SECTION 01 78 23 – OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall submit technical operation and maintenance information for each item of mechanical and electrical equipment in an organized manner in the Owner's Manual. It shall be written so that it can be used and understood by the Owner's operation and maintenance staff. The Owner's Manual information shall also be submitted in electronic format on a flash drive.

1.2 OWNER'S MANUAL

A. The Owner's Manual shall include the following for each item of mechanical and electrical equipment (as applicable):

1. Equipment Summary: A summary table shall include the equipment name and equipment number, the manufacturer's model number, serial number, and other nameplate information specific to the equipment provided.

2. Operational Procedures: Manufacturer-recommended procedures on the following shall be included:

    a. Installation

    b. Adjustment

    c. Startup

    d. Location of controls, special tools, equipment required, or related instrumentation needed for operation

    e. Operation procedures

    f. Load changes, Calibration, Shutdown

3. Troubleshooting, Disassembly, Reassembly

    a. Realignment

    b. Testing to determine performance efficiency

    c. Tabulation of proper settings for all pressure relief valves, low and high-pressure switches, and other protection devices

    d. List of all electrical relay settings including alarm and contact settings

4. Preventive Maintenance Procedures:

   a. Procedures: Preventive maintenance procedures shall include all manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by leaving the equipment in place.

   b. Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade, type, and temperature ranges, shall be covered.

5. Parts List and Drawings:

   a. Parts List: A complete parts list shall be furnished, including a generic description and manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included.

   b. Drawings: Cross-sectional or exploded view drawings shall accompany the part list.

6. Wiring Diagrams: Include complete internal and connection wiring diagrams for electrical equipment items.

7. Shop Drawings: Include approved shop or fabrication drawings, complete with dimensions. Include performance curves for pumps furnished.

8. Safety: This part describes the safety precautions to be taken when operating and maintaining the equipment or working near it.

9. Documentation: All equipment warranties, affidavits, and certifications required by the Technical Specifications shall be placed in this part.

10. Spare Parts: This part shall contain spare parts information for all mechanical, electrical, and instrumentation equipment. The spare parts list shall include the current list price of each spare part. The spare parts list shall be limited to those spare parts which each manufacturer recommends be maintained by the Owner in inventory at the plant site. Each manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts to facilitate the Owner in ordering. The Vendor shall cross-reference all spare parts lists to the equipment numbers designated in the Contract Documents.

B. If manufacturer’s standard brochures and manuals are used to describe operating and maintenance procedures, modify such brochures and manuals to reflect only the model or series of equipment used on this project and features provided. Cross out neatly or remove extraneous material, or otherwise annotate or eliminate.

1.3 TRANSMITTAL PROCEDURE

A. Provide three (3) original hard copies and one (1) electronic copy in PDF format of all operating and maintenance information. For ease of identification, label each manufacturer's brochure and manual with the equipment name. Organize the information in 3-ring binders and use an indexing feature within the PDF submission, in numerical order, per specification section number. Include in the manuals a table of contents and tab sheets to permit easy location of desired information.

B. The Vendor shall submit to the Engineer three identical Owner's Manuals a minimum of 90 calendar days prior to the scheduled startup of the equipment. Initial submittal for Engineer's review shall consist of one electronic copy and one hard copy.

C. The Engineer will review the Owner's Manuals within 30 days following their receipt by the Engineer. The Vendor shall then make any corrections and changes noted and compile all the corrected Owner's Manuals for final submittal to the Engineer.

1.4 PAYMENT

A. Acceptable operating and maintenance information for the project must be delivered to the Engineer prior to the project being 75 percent complete or at least two weeks prior to startup of any equipment. Progress payments for work in excess of 80 percent completion or 2 weeks prior to startup will not be made until the specified acceptable operating and maintenance information has been delivered to the Engineer.

1.5 FIELD CHANGES

A. Following the acceptable installation and operation of an equipment item, the item's instructions and procedures are to be modified and supplemented to reflect any field changes or information requiring field data.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 78 23

SECTION 26 05 00 – ELECTRICAL, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Work included under this specification consists of furnishing all labor, materials, services, tools and other equipment necessary for the electrical and control equipment fabrication, delivery, and testing as specified herein.

B. The intent of the electrical specifications is to provide enough information to the Vendor to illustrate the electrical equipment standards for which the power and control system are to be fabricated. All field installation (except the required manufacturer's checking, start-up, and testing) will be done under a separate contract.

C. For all separate non-packaged systems, motor control centers, motor starters and variable frequency drives will be provided under a separate contract.

D. For all skid mounted packaged systems, the Vendor will provide the motor starters, variable frequency drives, and all applicable controls.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. The Work of this and other sections is required for operation of electrical equipment provided under specifications in other Divisions. The Vendor's attention is directed to the requirement for proper coordination of the Work of this Section with the Work required by all sections.

1.3 REFERENCE STANDARDS

A. All equipment, materials, and methods of design and installation are to comply with the National Electrical Code, the basic Electrical Regulations of the State where the work is to be completed, the Occupational Safety and Health Act (OSHA), and the requirements of all other applicable codes. Codes and standards of the following organizations may be referred to in this Section and shall be considered as the minimum acceptable. A reference herein to any portion of the standard or code is not to be considered as negating any other portion of the standard or code.

1.	ANSI	American National Standards Institute, Inc.
2.	IEEE	Institute of Electrical & Electronic Engineers
3.	ASTM	American Society for Testing & Materials
4.	UL	Underwriters Laboratories, Inc.
5.	NEMA	National Electric Manufacturers Association
6.	IPECA	Insulated Power and Cable Engineers Institute
7.	NEC	National Electric Code
8.	IES	Illuminating Engineering Society
9.	ISA	Instrument Society of America

B. All electrical equipment shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL) or an independent testing laboratory acceptable to the local code enforcement agency having jurisdiction.

C. Where the Plans or these specifications require a higher degree of workmanship or quality of material than the above codes and standards imply, then these Plans and specifications will prevail.

1.4 VENDOR SUBMITTALS

A. Make all submittals in accordance with Section 01 30 00 – Vendor Submittals.

B. Within 15 days after the contract award, submit material lists for this Section of the work. Lists will include manufacturer and brand name of each class of material.

C. Submit complete shop drawings for review prior to manufacture of power distribution and control equipment.

1. The Vendor shall provide detailed shop drawings depicting necessary wiring, interlocks, etc. for use by a subsequent Installation Contractor. Shop Drawings will show:

a. Elevations

b. Plan layout and dimensions

c. Construction details

d. Elementary diagrams

e. Connection and interconnection diagrams

f. Internal wiring diagrams

g. Bill of Material

h. Nameplates

i. Temperature limitations

j. Voltage requirement, phase, and current, as applicable

k. Grounding requirements

l. Control diagrams

m. Catalog cut sheets or brochures for mass produced, non-custom manufactured material.

D. Motor control center diagrams, motor controller diagrams, and package drive diagrams are to be of the elementary type and show terminal identifications and associated field connections for each drive. Shop drawing shall show the scope of supply by the Vendor.

E. Schematics for all control circuits are to be laid out as a ladder diagram with each line numbered in a sequential manner and all relays having their contact location summary on the line with the relay coil, (per JIC standards). Clearly show and identify interconnection with other systems.

F. Provide and submit for review complete interconnection diagrams for all equipment showing:

1. Terminal blocks of all distribution and control equipment

2. All power, control, and signal raceways

G. Provide Owner's Manuals in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.5 QUALITY ASSURANCE

A. All equipment furnished under this Section will be guaranteed for a minimum period of one (1) year from date of accepted installation against defective materials, design, and workmanship in accordance with the provisions of the General Conditions.

B. Tests

1. The Vendor shall be responsible for factory and field tests required by specifications and by the Engineer or other authorities having jurisdiction. The Vendor shall furnish necessary testing equipment and pay costs of test, including replacement parts and labor, due to damage resulting from damaged equipment or from testing and correction of faulty installation.

2. Where test reports are indicated, proof of design tests reports for mass-produced equipment shall be submitted with the Shop Drawings, and factory performance test reports for custom-manufactured equipment shall be submitted and be approved prior to shipment. Filed test reports shall be submitted for review prior to Submittal completion.

3. Equipment or material that fails a test shall be removed and replaced. All tests which do not pass shall be repeated after identifying and correcting the problems. Any corrections to equipment or materials that are furnished with time for factory personnel to perform startup and/or testing shall be corrected per the recommendations and under the supervision of the factory representative. Any corrections to equipment or materials that are furnished with a factory warranty shall be corrected per the recommendations of the manufacturer and in a manner, which does not violate the terms of the warranty.

1.6 AREA DESIGNATIONS

A. Electrical Work shall comply with requirements listed in the table below:

Area	NEMA ENCLOSURE CLASSIFICATION							
	1	3R	4	4X	7	8	12	Notes
Below grade vaults, manholes, etc.				X				
Outdoors, non-hazardous, non corrosive locations		X						UL listed for outdoor & wet locations
Outdoors, hazardous, non-corrosive locations						X		UL listed for outdoor & wet locations, or add rain Shields
Outdoors, hazardous & corrosive locations						X		UL listed for outdoor & wet locations, or add rain Shields
Building Interior, non-hazardous, non-corrosive locations							X	
Building Interior, non-hazardous, corrosive locations				X				
Building Interior, hazardous & corrosive locations					X			Class 1, Div 1/2 as required by applicable codes. Only non-corroding materials allowed.

B. Electrical Work not included in the table above shall be NEMA 4X carbon steel unless applicable code requires otherwise.

C. Installation in hazardous locations shall conform strictly to the requirements of the Class, Group and Division indicated or required by applicable codes.

1.7 PERMITS

A. Installation Contractor shall obtain and pay for all permits and inspections pertinent to the electrical installation and obtain such permits from the proper governing body before any progress payment will be certified for electrical work.

1.8 SITE INSPECTION

A. Prior to submitting a bid, visit the project site and ascertain conditions affecting the proposed work and all existing electrical facilities. Additional costs / change orders will not be allowed for required work that should have been readily apparent during a pre-bid site visit.

1.9 UTILITY CONNECTION

A. The Owner shall pay any and all fees to utilities for costs associated with installation, connection, and turn-on charges for permanent service. The Vendor shall be responsible for coordination of work with the Installation Contractor for providing temporary utilities as needed. Cost for temporary utilities to be paid by the Installation Contractor.

1.10 TEMPORARY INSTALLATION

A. Temporary installation is to conform to the requirements of the National Electric Code and the State and local governing bodies.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment and material are to be new, free from defects, of current manufacture, and listed by Underwriters Laboratories, Inc., (UL) where UL requirements apply. All materials are to be products of reputable and experienced manufacturers. Similar items in the project are to be of the same manufacturer. Use only equipment and materials of industrial quality and durability, and capable of long, reliable, trouble free service.

B. The Owner reserves the right to operate defective equipment or that equipment which fails to conform to detailed specifications or does not operate satisfactorily until the defects are corrected or the equipment is repaired or replaced, without cost for depreciation, use or wear. Rejected equipment will be removed from operation only at times approved by the Owner.

2.2 MOUNTING HARDWARE

A. Miscellaneous Hardware

1. All nuts and bolts shall be Type 316 stainless steel.

2. Threaded rods for trapeze supports shall be continuous threaded, galvanized steel, 3/8-inch diameter minimum.

3. Strut for mounting of conduits and equipment shall be galvanized steel. Where contact with concrete or dissimilar metals may cause galvanic corrosion, suitable non-metallic insulators shall be utilized to prevent such corrosion. Strut shall be as manufactured by Unistrut, B-Line, or equal.

4. Anchors for attaching equipment to concrete walls, floors and ceilings shall be stainless steel expansion anchors, such as “Rawl-Bolt,” “Rawl-Stud” or “Lok-Bolt” as manufactured by Rawl; similar by Star, or equal. Wood plugs shall be permitted. The Installation Contractor shall provide the anchors.

2.3 ELECTRICAL IDENTIFICATION

A. Nameplates: Nameplates shall be fabricated from black-letter, white face laminated plastic engraving stock, Formica Type ES-1, or equal. Each shall be fastened securely, using fasteners of brass, cadmium plated steel, or stainless steel, screwed into inserts or tapped holes as required. Adhesive attachment is not allowed. Engraved characters shall be block style with no characters small than 1/8-inch top to bottom.

B. Conductor and Equipment Identification: Conductor and equipment identification devices shall be either imprinted plastic-coated cloth marking devices such as manufactured by Brady, Thomas & Betts, or equal, or shall be heat-shrink plastic tubing, imprinted split-sleeve markers cemented in place, or equal.

2.4 SIGNAGE AND MARKINGS

A. Provide danger, caution, and warning signs and equipment identification markings in accordance with applicable federal and state OSHA and NEC requirements.

B. Local Disconnect Switches: Provide local disconnect switches for all equipment. Each local disconnect switch for motors and equipment shall be legibly marked to indicate its purpose unless the purpose is indicated by the location and arrangement.

C. Isolating Switches: Isolating switches not interlocked with an approved circuit interrupting device shall be provided with a sign warning against opening them under load.

2.5 TERMINAL BLOCKS

A. Terminal Blocks where required shall be screw terminal, heavy duty, rated at 20 amperes minimum, 600 volt AC. Terminals shall be provided with integral marking strips which shall be permanently identified with the connecting wire numbers. Each terminal block shall be uniquely identified.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Documents: The Vendor shall provide detailed installation drawings depicting necessary wiring, interlocks, etc. for use by a subsequent Installation Contractor.

B. Incidental: The Installation Contractor who will be awarded the construction installation contract shall provide all incidentals materials required for a complete and operable system. Typical incidentals are terminal lugs not furnished with vendor supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and control wiring required by vendor furnished equipment to connect with other equipment indicated in the Contract Documents.

C. Mounting Height: All panel boards, LCP’s and other non-freestanding panels shall be mounted such that the top of the panel is between 5’- 6” and 6’- 6” above the finished floor or grade unless specifically indicated otherwise in the Contract Documents.

3.2 PROTECTION OF EQUIPMENT AND MATERIALS

A. Provide protection for materials and equipment against loss or damage throughout the contract. Protect everything from the effect of weather prior to installation, store items to be installed in indoor location.

B. Any item subject to corrosion under damp conditions and items containing insulation such as transformers and motors are to be kept in heated locations.

C. The Installation Contractor shall fully protect materials and equipment against damaged from any cause. Materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. Moving parts shall be kept clean and dry. The Installation Contractor shall replace or refinish damaged materials or equipment, including faceplates of panels and switchboard sections as part of the Work.

3.3 EQUIPMENT IDENTIFICATION

A. Equipment and devices shall be identified as follows:

1. Nameplates shall be provided for panel boards, control and instrumentation panels, starters, switches, and pushbutton stations. In addition to nameplates, control devices shall be equipped with standard collar-type legend plates.

2. Control devices within enclosures shall be identified as indicated. Identification shall be similar to the subparagraph above.

3. Toggle switches which control loads out of site of switch and multi-switch locations of more than 2 switches shall have suitable inscribed finish plates.

4. Equipment names and tag numbers shall be utilized on nameplates.

5. The Vendor shall furnish typewritten circuit directories of panel board; circuit directory shall accurately reflect the outlets connected to each circuit.

6. Terminal point on terminal blocks shall be labeled by identifiers attached to the terminal strip. Identifiers shall be pre-printed by the terminal manufacturer custom printed markers, hand lettered markers shall be acceptable.

END OF SECTION 26 05 00

SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes wires, cables and connectors for power, lighting, signal, control, and related systems rated 600 V and less.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by Underwriters Laboratories (UL) and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers complying with the Quality Assurance requirements are acceptable.

2.2 WIRES AND CABLES

A. General: Provide wire and cable suitable for the temperature, conditions, and location where installed.

B. Conductors: Provide solid conductors for power and lighting circuits No. 10 AWG and smaller. Provide stranded conductors for sizes No. 8 AWG and larger.

C. Conductor Material: Copper for all wires and cables. Aluminum conductors are not acceptable.

D. Insulation: Provide THHN/THWN insulation for all conductors No. 6 AWG and smaller. For No. 4 AWG and larger conductors provide XHHW-2 insulation. Type THHN insulation may be used for branch circuit and feeder sizes 100 amp and smaller in dry locations. Adjust conduit size as need to meet NEC fill requirements.

E. Color coding for phase identification:

1. 208/120-V Conductors:

a. Phase A: Black.

b. Phase B: Red.

c. Phase C: Blue.

d. Neutral: White.

e. Ground: Green.

2. 480/277-V Conductors:

a. Phase A: Brown.

b. Phase B: Orange.

c. Phase C: Yellow.

d. Neutral: Gray.

e. Ground: Green.

2.3 ANALOG SIGNAL CABLE

A. Plan Mark SC1: 18 AWG twisted, shielded pair, 600V insulation- General Cable catalog number 285150.

2.4 ETHERNET COMMUNICATION CABLE

A. Plan Mark EC1: Ethernet communication cable to be Category 6, 4-pair, 23AWG, Ethernet/IP compliant industrial ethernet cable, Belden DataTuff or equal.

2.5 DEVICENET COMMUNICATION CABLE:

A. Plan Mark: DN1: DeviceNet cable with construction and ratings fully compliant with ODVA specifications, manufactured by Belden.

2.6 MODBUS COMMUNICATION CABLE:

A. Plan Mark: MB1: Low capacitance twisted, shielded 24 AWG 2-pair. EIA RS-485, Belden 9842.

2.7 CONNECTORS FOR CONDUCTORS

A. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRES AND CABLES

A. General: Install electrical cables, wires, and connectors in compliance with NEC.

B. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant where necessary to keep pulling tension within manufacturer’s recommendations.

C. Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced. No joints or taps permitted in service or feeder circuits.

D. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.

3.2 FIELD QUALITY CONTROL

A. Prior to energizing, test wires and cables for electrical continuity and for short-circuits.

END OF SECTION 26 05 19

SECTION 26 29 13.13 - ACROSS-THE-LINE-MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes A.C. motor control devices rated 600 V and below that are not supplied as an integral part of a motor control center.

B. Related Sections include the following:

1. Section 26 05 00 – Electrical, General for general materials, installation methods, and labeling.

1.3 SUBMITTALS

A. Product data for products specified in this Section. Include dimensions, ratings, and data on features and components.

B. Maintenance Data: For products to include in the maintenance manuals specified in Division 1.

C. Load Current and Overload Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain similar motor-control devices through one source from a single manufacturer.

B. Comply with NFPA 70, UL, and NEMA.

C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms “Listed and Labeled”: As defined in the National Electrical Code, Article 100.

1.5 COORDINATION

A. Coordinate features of controllers and control devices with pilot devices and control circuits provided under Division 23, Division 40 through Division 46 Sections covering control systems.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Spare Fuses and Incandescent Indicating Lamps: Furnish 1 spare for every 5 installed units, but not less than 1 set of 3 of each kind.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Eaton

2. Allen-Bradley Co.; Industrial Control Group.

3. General Electric Co.; Electrical Distribution & Control Div.

4. Square D Co.

2.2 MANUAL MOTOR CONTROLLERS

A. Description: NEMA ICS 2, general purpose, Class A with toggle action and overload element.

2.3 MAGNETIC MOTOR CONTROLLERS

A. Description: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.

B. Control Circuit: 120 V. Provide control power transformer integral with controller where no other supply of 120 V control power to controller is indicated. Provide control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.

C. Combination Controller: Factory assembled with controller and arranged to disconnect switch with or without overcurrent protection as indicated.

1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by a nationally recognized testing laboratory.

D. Overload Relay: NEMA ICS 2, Class 10 tripping characteristics selected to protect motor against voltage unbalance and single phasing. Revise controller specifications to suit Project. Autotransformer Reduced-Voltage Controller: NEMA ICS 2, closed transition.

2.4 ENCLOSURES

A. Description: Flush or surface mounted cabinets as indicated. NEMA 250, Type 12, unless otherwise indicated to comply with environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.

2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

3. Hazardous Areas: NEMA 250, Type 7C.

2.5 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.

F. Current-Sensing, Phase-Failure Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

PART 3 - EXECUTION

3.1 APPLICATION

A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

C. Use fractional-horsepower manual controllers for single-phase motors, unless otherwise indicated.

D. Use manual controllers for 3-phase motors up to 5 hp not requiring automatic or remote control.

E. Pushbutton Stations: In covers of magnetic controllers for manually started motors where indicated, start contact connected in parallel with sealing auxiliary contact for low-voltage protection.

F. Hand-Off-Automatic Selector Switches: In covers of manual and magnetic controllers of motors started and stopped by automatic controls or interlocks with other equipment.

3.2 INSTALLATION

A. Install independently mounted motor-control devices according to manufacturer's written instructions.

B. Location: Locate controllers within sight of motors controlled, unless otherwise indicated.

C. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks.

D. Install freestanding equipment on concrete housekeeping bases conforming to Section 26 05 00 – Electrical, General.

E. Motor-Controller Fuses: Install indicated fuses in each fusible switch.

3.3 IDENTIFICATION

A. Identify motor control components and control wiring in accordance with Section 26 05 00 – Electrical, General.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between motor control devices in accordance to Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic control devices where available.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5, 7.6, and 7.16. Certify compliance with test parameters.

2. Remove and replace malfunctioning units with new units, and retest.

3.5 CONNECTIONS

A. Tighten connectors, terminals, bus joints, and mountings. Tighten field connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, comply with tightening torques specified in UL 486A and UL 486B.

3.6 FIELD QUALITY CONTROL

A. Testing: After installing motor controllers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NeTA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.

2. Remove and replace malfunctioning units with new units, and retest.

3.7 CLEANING

A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally using methods and materials as recommended by manufacturer.

END OF SECTION 26 29 13.13

SECTION 26 29 23 – VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes solid-state, PWM and VFD, VFCs for speed control of three-phase, induction motors. These VFCs are to be enclosed in freestanding NEMA 250, Type 12, unless otherwise indicated to comply with environmental conditions at installed location.

B. VFC vendor to provide VFC that will operate at installed altitude. Vendor shall verify altitude.

1.2 SUBMITTALS

A. Product Data: For each type of VFC, provide dimensions; mounting arrangements; location for conduit entries; shipping and operating weights; and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.

B. The following shall be included in the bid package:

1. Description of equipment and tests included in bid to meet the indicated power quality requirements.

2. Nearest factory authorized service center meeting all points of 1.03A.

3. Qualification and name of engineering and technical persons responsible for support and warranty of this project.

C. The following shall be included in the submittal package and be approved by the engineer prior to any construction of the VFC system:

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.

b. Nameplate legends.

c. Short-circuit current ratings of integrated unit.

d. UL listing for series rating of overcurrent protective devices in combination controllers.

e. Features, characteristics, ratings, and factory settings of each motor-control center unit.

2. Wiring Diagrams: Power, signal, and control wiring for VFC. Provide schematic wiring diagram for each type of VFC.

3. Detailed description of the filter equipment and sample graphs and data to meet IEEE 519-2014.

4. Carrier frequency information.

D. Qualification Data: For testing agency and manufacturer.

E. Field Test Reports: Written reports specified in Part 3.04D below.

F. Manufacturer's field service report.

G. Operation and Maintenance Data: For VFCs, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 26 05 00 – Electrical, General, include the following:

1. Routine maintenance requirements for VFCs and all installed components.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and 24 hour emergency maintenance and repairs.

B. Source Limitations: Obtain VFCs of a single type through one source from a single manufacturer.

C. The system shall be pre-integrated with the necessary harmonic mitigation equipment.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70, IEEE 519-2014, ANSI C37, and ANSI C57.

1.4 COORDINATION

A. Match features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.

B. Match features, accessories, and functions of each VFC and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load. See Division 40 sections for information on motor control sequence.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: To match existing parts and integration requirements, provide products by the following:

1. Allen Bradley; Rockwell Automation.

B. Contractor job site integration of reactors, harmonic filters, power components, etc. may be required. Start-up, harmonic testing and warranty support services must be supplied by the above or other qualified company approved by engineer. Allowable harmonic limits to be coordinated with Idaho Power Utilities.

2.2 VARIABLE FREQUENCY CONTROLLERS

A. Description: NEMA ICS 2, IGBT, PWM, VFD, VFC; listed and labeled as a complete unit and arranged to provide variable speed of a NEMA MG 1, Design B, 3-phase, induction motor by adjusting output voltage and frequency. Refer to Divisions 40 – 43 and 46 for additional information on motors controlled by VFCs.

B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

C. Output Rating: 3-phase; 6 to 120 Hz, with horsepower constant throughout speed range.

D. Unit Operating Requirements:

1. Input AC voltage tolerance of 480 V, plus or minus 10 percent.

2. Input frequency tolerance of 60 Hz, plus or minus 6 percent.

3. Output Rating: 3-phase; 6 to 66 Hz, with amperage equal or greater to motor nameplate amperage including altitude derating.

4. Minimum Inverter Efficiency: 96 percent at 60 Hz, full load.

5. Minimum Displacement Primary-Side Power Factor: 96 percent lagging.

6. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.

7. Starting Torque: Default to be 50% with adjustment to 120%.

8. Speed Regulation: Plus or minus 1 percent.

9. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.

E. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.

2. Maximum Speed: 80 to 100 percent of maximum rpm.

3. Acceleration: Adjustable from .01 to 3600 seconds.

4. Deceleration: Adjustable from .01 to 3600 seconds.

5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

F. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors.

2. Snubber networks to protect against malfunction due to system voltage transients.

3. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.

4. Filtering to prevent noise interference with other electronic equipment.

5. Motor Overload Relay: Adjustable.

6. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.

7. Instantaneous line-to-line and line-to-ground overcurrent trips.

8. Loss-of-phase protection.

9. Reverse-phase protection.

10. Short-circuit protection.

11. Motor overtemperature fault.

G. Automatic Reset and Restart: To attempt three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bi-directional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

H. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped. VFC to automatically re-start motor after outage.

I. Carrier Frequency Adjustment: Provide ability to manually adjust drive carrier frequency. VFCs 100HP and less shall provide carrier frequency adjustment capability from 1 to 10kHz. VFCs over 100HP shall include carrier frequency adjustment information recommended by the manufacturer.

J. Torque Boost: Automatically vary starting and continuous torque to at least 1.5 times the minimum torque to insure high-starting torque and increased torque at slow speeds.

K. Motor Temperature Compensation at Slow Speeds: Adjustable current fallback based on output frequency for temperature protection of self-cooled fan-ventilated motors at slow speeds.

L. Provide line and load side filtering to minimize total harmonic distortion.

M. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

N. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

O. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, and fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

P. Control Signal Interface: Provide VFC with the following:

1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
2. Pneumatic Input Signal Interface: 3 to 15 psig (20 to 104 kPa).

3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:

    a. 0 to 10-V dc.

    b. 0-20 or 4-20 mA.

    c. Potentiometer using up/down digital inputs.

    d. Fixed frequencies using digital inputs.

    e. RS485.

    f. Ethernet connectivity using Ethernet/IP or MODBUS protocol

    g. Keypad display for local hand operation.

    h. Remote start/stop input

4. Output Signal Interface:

    a. Provide two analog output signals (0/4-20 mA), which can be programmed for the following:

    b. Output frequency (Hz).

    c. Output current (load).

    d. DC-link voltage (VDC).

    e. Motor torque (percent).

    f. Motor speed (rpm).

    g. Set-point frequency (Hz).

5. Remote Indication Interface: Provide dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

    a. Motor running.

    b. Set-point speed reached.

    c. Fault and warning indication (overtemperature or overcurrent).

    d. PID high or low speed limits reached.

    e. Drive system is in remote.

Q. Provide bypass switch and contactor to allow manual bypass of the drive and across-the-line starting. Bypass shall be configured with three-contactors to isolate the VFC.

R. Integral Disconnecting Means: Provide HACR rated breaker.

2.3 ACCESSORIES

A. Devices shall be factory installed in motor control center.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Standard Displays:

1. Output frequency (Hz).

2. Set-point frequency (Hz).

3. Motor current (amperes).

4. DC-link voltage (VDC).

5. Motor torque (percent).

6. Motor speed (rpm).

7. Motor output voltage (V).

F. Historical Logging Information and Displays:

1. Real-time clock with current time and date.

2. Running log of total power versus time.

3. Total run time.

4. Fault log, maintaining last four faults with time and date stamp for each.

G. Current-Sensing, Phase-Failure Relays for Bypass Controller: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

H. Harmonic Mitigation: Complying with IEEE Standard 519-2014 shall be a requirement of this project. Harmonic filters, 18 pulse converter configurations, phase multiplication devices, or any other components required to mitigate harmonic voltage and current to IEEE Std. 519-2014 shall be an integral part of the VFC system. Designs which are not pre-integrated and factory wired as part of the UL label will not be acceptable.

1. Designs which cause voltage rise at the VFC terminals must document coordination with the total system variation to prevent nuisance tripping.

2. Designs which do not provide both true and displacement, measured at the VFC terminals, of at least 95% or better at full load are not acceptable. Designs that allow leading power factor at minimum loads are not acceptable.

I. Relevant data for VFC vendor calculations to meet IEEE Std. 519-2014 requirements are as follows:

1. The point of common coupling (PCC) shall be defined per 3.01.C below.

2. The calculated load current (I_L) shall be the total combined full load current of each ASD system supplied as part of this project or the total combined amperage of loads designated as “non-linear”.

3. The VFC vendor is responsible for determining the short circuit current (I_{SC}) available at the PCC.

2.4 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Select features of each VFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, drive, and load.

B. Select rating of controllers to suit motor controlled. The VFC vender shall certify that the supplied equipment is properly matched to the loads being fed.

C. The drive shall be capable of operating in compliance with IEEE 519-2014, with point of common coupling (PCC) defined as the point at which each individual device is connected to the electrical distribution system. Drive manufacturer shall provide harmonic calculations and on-site post installation harmonic testing with certified reports prior to final acceptance of installation. See 3.04D.

3.2 IDENTIFICATION

A. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

3. All tests necessary to prove compliance with IEEE Standard 519-2014.

B. Testing: Perform the following field quality-control testing:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pretesting and adjusting VFCs.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.

2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 sections.

C. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

A. Set field-adjustable switches.

3.7 CLEANING

A. Clean VFCs internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain VFCs.

END OF SECTION 26 29 23

SECTION 40 05 00 – PIPING, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide the piping systems indicated, complete and operable, in accordance with the Contract Documents.

B. The mechanical drawings define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are not pipe construction or fabrication drawings. Where pipe supports and spacings are indicated on the drawings and referenced to a standard detail, the Contractor shall use that detail. Where pipe supports are not indicated on the drawings, it is the Contractor's responsibility to develop the details necessary to design and construct all mechanical piping systems, to accommodate the specified equipment, and to provide all spacers, adapters, and connectors for a complete and functional system.

C. Piping system drawings are diagrammatic and are intended to show approximate location of equipment and piping. Dimensions given on the plans in figures take precedence over scaled dimensions. Verify dimensions, whether in figures or scaled, in the field. The Contractor shall be responsible for the installation of complete and workable systems whether completely detailed on the plans or not.

D. The Contractor shall ascertain locations of apparatus, fixtures, equipment, and piping in the field, and layout work accordingly. The Owner reserves the right to have minor changes in location of piping and equipment made up to the time of installation without additional cost.

1.2 REFERENCE STANDARDS

A. All mechanical work shall conform to latest edition of the International Mechanical Code.

B. Commercial Standards

1.	ASTM B 88	Hard Copper Tube
2.	ASME B 16.22	Copper Fittings
3.	ANSI/ASME B 1.20.1	Pipe Threads, General Purpose (inch)
4.	ANSI B 16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
5.	ANSI/AWWA C 207	Steel Pipe Flanges for Water Works Service; Sizes 4 in through 144 in.
6.	ANSI/AWWA C 606	Grooved and Shouldered Joints
7.	ANS/AWS D1.1	Structural Welding Code

8.	ASTM A 307	Specification for Carbon Steel Bolts and Studs, 6,000 psi Tensile
9.	ASTM A 325	Specification for High-Strength Bolts for Structural Steel Joints
10.	ASTM D 792	Test Methods for Specific Gravity and Density of Plastics by Displacement
11.	ASTM D 2000	Classification System for Rubber Products in Automotive Applications

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Submittal Procedures.

B. At a minimum, the following information shall be submitted for review and approval prior to ordering piping materials.

1. Manufacturer specifications for each pipe type, including all references to acceptable standards as referenced in each individual pipe section.

2. Indicate fittings and manufacturer recommended connections.

3. Pressure ratings.

4. Lining and coating type, thickness, and application procedures.

5. Fitting types and manufacturer recommended applications and acceptable installation procedures and tolerances.

C. Fabrication Drawings: The Contractor shall submit piping fabrication drawings show in all fittings, pipe material, supports, and all dimensions for proper installation of piping system as illustrated on mechanical drawings.

1.4 QUALITY CONTROL

A. Certifications: Necessary certificates, test reports, and affidavits of compliance shall be obtained by the Contractor. A certification from the pipe fabricator that each pipe will be manufactured subject to the fabricators or a recognized quality control program. An outline of the program shall be submitted to the Engineer for review prior to the manufacture of any pipe.

B. Where the assistance of a manufacturer's service representative is advisable, in order to obtain recommended pipe joints, supports, or special connections, the Contractor shall furnish such assistance at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. Extent of Work: Pipes, fittings, and appurtenances shall be provided in accordance with the requirements of the applicable sections of Divisions 31 and 40 and as indicated. Materials in contact with potable water shall be listed as compliant with NSF Standard 61.

B. Pipe Supports: Pipes shall be adequately supported, restrained, and anchored as indicated by the Installation Contractor.

C. Lining: Application, thickness, and curing of pipe lining shall be in accordance with the applicable sections of Division 40 unless otherwise indicated. Fittings and couplings shall be lined with the same material required for the pipeline in which the fittings and couplings are installed.

D. Coating: Application, thickness, and curing of pipe coating shall be in accordance with the applicable sections of Division unless otherwise indicated. Pipes above ground or in structures shall be field-coated as indicated by the Installation Contractor.

E. Pressure Rating: Piping systems shall be designed for the maximum expected pressure as indicated on the drawings and individual pipe specifications.

F. Grooved Piping Systems: Piping systems with grooved joints and fittings may be provided in lieu of flanged, joint systems for exposed ductile iron piping. To assure uniform and compatible piping components, all grooved fittings, couplings, and valves shall be from the same manufacturer. The Contractor shall make the coupling manufacturer responsible for the selection of the correct style of coupling and gasket for each individual location.

G. Tests: Except where otherwise indicated, materials used in the manufacture of the pipe shall be tested in accordance with the applicable specifications and standards. Welds shall be tested as indicated. The Contractor shall be responsible for performing material tests.

H. Welding Requirements: Qualification of welding procedures used to fabricate pipe shall be in accordance with the provisions of ANSI/AWS D1.1 - Structural Welding Code. Welding procedures shall be submitted for the Engineer's review.

I. Welder Qualifications: Welding shall be done by skilled welders and welding operators who have adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 or the ASME Boiler and Pressure Vessel Code, Section 9, by an independent local, approved testing agency not more than six (6) months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the Work shall be used in qualification tests. Qualification testing of welders and materials used during testing is part of the Work.

J. Joining Dissimilar Materials: Di-electric unions shall be used at the junction of two dissimilar metallic pipes as required by the local adopted plumbing code. It shall be the responsibility of the Contractor to identify any such conditions whether indicated in the Project Drawings or not. Di-electric unions shall be lead free, appropriate for the two dissimilar metals and be stamped with an approved UPC seal.

2.2 PIPE FLANGES

A. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise indicated. Attachment of the flanges to the pipe shall conform to the applicable requirements of AWWA C207. Flange faces shall be perpendicular to the axis of the adjoining pipe. Flanges for miscellaneous small diameter pipes shall be in accordance with the standards indicated for these pipes. Flanges shall have pressure ranges corresponding to the following:

1. 150 PSI or less: Flanges shall conform to either AWWA C207 - Steel Pipe Flanges for Waterworks Service-Sizes 4 In. Through 144 In., Class D, or ASME B16.5 - Pipe Flanges and Flanged Fittings, 150 Ib class.

2. 150 to 275 PSI: Flanges shall conform to either AWWA C207 Class E or Class F, or ASME B16.5 150 Ib class.

3. 275 to 700 PSI: Flanges shall conform to ASME B16.5, 300 Ib class.

4. AWWA flanges shall not be exposed to test pressures greater than 125 percent of rated capacity. For higher test pressures, the next higher rated AWWA flange or an ANSI-rated flange shall be selected.

B. Blind Flanges: Blind flanges shall be in accordance with AWWA C207, or as indicated for miscellaneous small pipes. Blind flanges for pipe sizes 12-inches and greater shall be provided with lifting eyes in the form of welded or screwed eye bolts.

C. Flange Coating: Machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.

D. Flange Bolts: Bolts and nuts shall conform the requirements of the applicable specifications and be provided and installed by the Installation Contractor. All-thread studs shall be used on all valve flange connections, where space restrictions preclude the use of regular bolts.

E. Insulating Flanges: Insulated flanges shall have bolt holes 1/4-inch diameter greater than the bolt diameter.

2.3 INSULATING CONNECTIONS

A. Insulating Flange Sets: Unless otherwise specified, insulating flange sets shall be provided at all locations where dissimilar metals are connected. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers, and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2 inch or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2 inch, insulating sleeves and washers shall be two (2) pieces and shall be made of polyethylene or phenolic material. Steel washers shall be in accordance with ASTM A 325 - Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength. Insulating gaskets shall be full-face.

1. Insulating Flange Manufacturers, or equal

a. JM Red Devil, Type E

b. Maloney Pipeline Products Co., Houston

c. PSI Products, Inc., (Frost Engineering Service Co., Costa Mesa, California).

B. Threaded insulating bushings, unions, or couplings, as appropriate, shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved. Threaded insulating connections shall be of nylon, teflon, polycarbonate, polyethylene, or other non-conductive materials, and shall have ratings and properties to suit the service and loading conditions.

C. Insulating Sleeve Couplings: Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a sleeve of an insulating compound material compatible with the fluid service in order to obtain insulation of all coupling metal parts from the pipe.

2.4 SOLID COPPER PIPE CONNECTIONS

A. Solid Filler Materials: ASTM B 32 lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Brazing Filler Metals: AWS AS.B, BCUP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated, and AWS AS.B, Bag 1, silver alloy for refrigerant piping, unless otherwise indicated.

2.5 MECHANICAL-TYPE COUPLINGS (GROOVED OR BANDED PIPE)

A. Cast mechanical-type couplings shall be provided where indicated. The couplings shall conform to the requirements of AWWA C606 - Grooved and Shouldered Joints. Bolts and nuts shall conform to the requirements of the applicable specifications and provided and installed by the Installation Contractor. Mechanical-type couplings shall be bonded. The Contractor shall have the coupling manufacturer's service representative verify the correct choice and application of couplings and gaskets, and the workmanship, to assure a correct installation. To assure uniform and compatible piping components, grooved fittings, couplings, and valves shall be furnished by the same manufacturer as the coupling. Grooving tools shall be of the same manufacturer as the grooved components.

B. Gaskets for mechanical-type couplings shall be compatible with the piping service and fluid utilized, in accordance with the coupling manufacturer's recommendations.

C. The wall thickness of grooved piping shall conform to the coupling manufacturer’s recommendations to suit the highest expected pressure.

D. To avoid stress on equipment; equipment connections with mechanical-type couplings shall have rigid-grooved couplings or flexible type coupling with harness in sizes where rigid couplings are not available, unless thrust restraint is provided by other means.

E. Manufacturers of couplings for steel pipe, or equal

1. Gustin-Bacon (Aeroquip Corp.) (banded or grooved)

2. Victaulic Style 41 or 44 (banded, flexible)

3. Victaulic Style 77 (grooved, flexible)

4. Victaulic Style 07 or HP-70 (grooved, rigid)

F. Manufacturers of ductile iron pipe couplings, or equal

1. Gustin-Bacon, (Aeroquip Corp.)

2. Victaulic Style 31 (flexible or rigid grooving)

Note: Ductile iron pipe couplings shall be furnished with flush seal gaskets.

2.6 SLEEVE-TYPE COUPLINGS

A. Sleeve-type couplings shall be provided where indicated. The Contractor will not be allowed to substitute a sleeve-split coupling for the sleeve coupling unless approved by the Engineer.

B. Construction: Sleeve couplings shall be in accordance with AWWA C219 - Standard for Bolted Sleeve- Type Couplings for Plain-End Pipe. Couplings shall be steel with steel bolts, without pipe stop. Couplings shall be of sizes to fit the pipe and fittings indicated.

1. The middle ring shall be not less than 1/4-inch thick or at least the same wall thickness as the pipe to which the coupling is connected. If the strength of the middle ring material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe. Buried sleeve-type couplings shall be epoxy-coated at the factory as indicated.

2. The coupling shall be either 5- or 7- inches long for sizes up to and including 30-inches and 10-inches long for sizes greater than 30-inches, for standard steel couplings, and 16-inches long for long-sleeve couplings.

3. The followers shall be single-piece contoured mill sections welded and cold-expanded as required for the middle rings, and of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket.

4. Bolts and nuts shall conform to the requirements of the applicable specifications and be provided and installed by the Installation Contractor.

C. Pipe Preparation: Where indicated, the ends of the pipe shall be prepared for flexible steel couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12-inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof- test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.

2.7 GASKETS

A. Gaskets for wastewater and sewerage applications shall be Buna N, Grade 60, or equivalent suitable elastomer.

B. Gaskets shall be full-faced type, with material and thickness in accordance with AWWA C207. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted, unless otherwise indicated. The rubber in the gasket shall meet the following specifications:

Color	Jet Black
Surface	Non-Blooming
Durometer Hardness	74 plus and minus 5
Tensile Strength	1000 psi Minimum
Elongation	175 percent Minimum
Temperature	700 Deg. F
pH	1 - 11

C. The gaskets shall be immune to attack by impurities normally found in water or wastewater. All gaskets shall meet the requirements of ASTM D 2000 - Classification System for Rubber Products in Automotive Applications, AA709Z, meeting Suffix B13 Grade 3, except as noted above. Where sleeve couplings are used in water containing chloramines or other fluids which attack rubber materials, gasket material shall be compatible with the piping service and fluid utilized.

D. Gaskets for flanged joints used in chemicals, air, solvents, hydrocarbons, steam, chlorine and other fluids shall be made of materials compatible with the service, pressure, and temperature.

2.8 FLANGE COUPLING ADAPTERS

A. Flange coupling adapters shall only be used where shown on the drawings or accepted by the Engineer. Otherwise, the Contractor shall only use dismantling joints if additional flexibility is required for the pipe installation.

B. Flange coupling adapters shall be designed for a water working pressure not less than the design pressure of the pipe on which they are to be installed and shall be equipped with suitable rubber gaskets.

C. Couplings shall be Romac RFCA, or equal. Thrust ties shall be provided for all flexible couplings to sustain the force developed by the test pressure. Anchor studs will not be acceptable.

2.9 FLEXIBLE CONNECTORS

A. Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, pumps and other vibrating equipment, and where indicated. Flexible

connectors for service temperatures up to 180 degrees F shall be flanged reinforced neoprene or butyl single-arched spools, rated for a working pressure of 40 to 150 psi, or reinforced flanged duck and rubber, as best suited for the application. Flexible connectors for service temperatures above 180 degrees F shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for minimum 150 psi working pressure, unless otherwise indicated. The connectors shall be a minimum of 9-inches long, face-to-face flanges, unless otherwise indicated. The final material selection shall be approved by the manufacturer. The Contractor shall submit manufacturer's shop drawings and calculations.

B. Grooved pipe flexible mechanical couplings may be used in lieu of the above paragraph on pumps only. The Contractor shall submit manufacturer's shop drawings and calculations.

2.10 MISCELLANEOUS

A. Expansion Joints: Piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement without exertion of undue forces to equipment or structures. This may be accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints. Expansion joints shall be flanged end, stainless steel, Monel, rubber, or other materials best suited for each individual service. The Contractor shall submit detailed calculations and manufacturer's Shop Drawings of all proposed expansion joints, piping layouts, and anchors and guides, including information on materials, temperature, and pressure ratings.

B. Piping Connection to Equipment: Where piping connects to mechanical equipment such as pumps, compressors, and blowers, the piping shall be brought to the equipment connection aligned and perpendicular to the axis of the flange or fitting for which the piping is to be connected to the equipment. The piping shall not impose excessive stress to the equipment connection so much to cause misalignment of the equipment. The Contractor shall assign the responsibility to the equipment manufacturer to review the piping connection to the equipment and submit any modifications to the Engineer for review.

C. Restrained Joints: Sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means. Harnesses shall be designed by the pipe manufacturer in accordance with Manual M11, or as indicated. Harness sets shall be designed for the maximum test pressure of the pipe in which they are installed. Where harness sets are installed near the suction and discharge of the pump. Harness bolts shall have zero elongation to prevent misalignment of the pump imparted by the thrust within the piping system. Thrust restraints systems shall be manufactured by Victaulic, “Depend-O-Lok”; Dresser, “Style 38”; Ford Meter Box Co., Inc., “Style FC1 or FC3”; and Smith-Blair, “Style 411.”

D. Pipe Threads: Pipe threads shall be in accordance with ANSI/ASME B1.20.1 - Pipe Threads, General Purpose (inch), and be made up with Teflon tape unless otherwise indicated.

E. Air and Gas Traps: Air and gas pipes shall slope to low points and be provided with drip legs, shut-off valves, strainers, and traps. The traps shall be piped to the nearest drain. Air and gas traps shall be not less than 150 lb iron body float type with copper or stainless steel float. Bracket, lever, and pins shall be of stainless steel. Drain traps shall have threaded connections acceptable manufacturers include Armstrong International, Inc. and Spirax Sarco, Inc.

2.11 COUPLINGS

A. Flexible Pipe Couplings – Smith Blair OMNI 441 coupling system or approved equal. Couplings shall be lined and coated with a minimum thickness of 0.012" fusion-bonded epoxy or approved equal. Coating must comply with ASTM C213 and AWWA C550.

2.12 DISMANTLING JOINTS

A. Dismantling joints shall be Romac Style DJ400, Smith Blair Model 975 or approved equal. Dismantling joints shall be coated with fusion bonded epoxy per AWWA C213. Provide high strength stainless steel bolts, nuts and tie rods. Use anti seize lubricant when assembling all stainless steel hardware.

2.13 TAPPING SADDLES

A. Tapping saddles shall have a ductile iron body meeting ASTM A536, Grade 65-45-12. Gasket shall be Nitrile Butadiene Rubber (NBR) for water and sewer service. Saddles shall have two, 2" straps constructed of Type 304 stainless steel with GMAW and GTAW welds. Stainless steel shall be passivated for corrosion resistance. Casting shall be coated with fusion bonded black nylon, 10 – 12 mils thick, with a dielectric strength of 1,000 v/mil. Threads as required for installation of instrumentation.

B. Bolts, nuts and washers shall be Type 304 (18-8) heavy gauge stainless steel.

C. Saddles shall comply with AWWA C800 and shall have a pressure rating of 350 psi for pipe sizes up to 24 inch.

D. Provide Romac 202 service saddles or equivalent.

2.14 THRUST BLOCKS

A. Concrete to have a minimum compressive strength of 2,500 psi at 7 days. Place in accordance with plan details.

2.15 MECHANICAL RESTRAINT

A. Type: Standard mechanical joint restraint gland, restraint devices for MJ fittings and appurtenances to conform to ANSI/AWWA C111 or ANSI/AWWA C153.

B. Product: EBAA Iron Series 2000 PV (for PVC Pipe) or EBAA Iron Series 1100 Megalug (for DIP) or approved equal, and to meet requirements of ASTM F1674.

C. Application: Approved for above ground installation and below ground where specifically specified on the Plans. Also, mechanical restraint shall be installed in locations where the pipeline must be used immediately as a temporary restraint while thrust blocks cure.

D. Pipe joints shall be restrained 30 ft. or a minimum of two pipe joints (whichever is longer) upstream and downstream of a mechanically restrained fitting.

2.16 INTERNALLY RESTRAINED PRESSURE PIPE

A. Internally restrained PVC Pressure Pipe shall conform to ANSI/AWWA C900, FM 1612 for 4" to 12" inside diameter pipe and ANSI/AWWA C905 for 14" to 24" inside diameter pipe. Pipe Compound shall conform to ASTM D1784 Cells Class 12454. Integral bell joints shall conform to ASTM D3139. All internally restrained pipe shall be ANSI/NSFF Standard 61 FM approved and certified and shall be provided in full pipe lengths.

B. Pipe shall be rated for pressures indicated or required within the Contract Documents.

C. Internally reinforced pipe shall consist of a molded metal casing within the bell end of the pipe. The casing will be equipped with uni-directional serrated grip rings. The casing and grip rings will be constructed of ductile iron and coated with a corrosion protection system.

D. Internally reinforced pipe lengths shall be labeled to identify that it is equipped with an internal restraining system.

E. Approved products include PVC pipe manufacturers who integrate the BullDog™ Integral Joint Restraint System, including Diamond Plastics Diamond Lok-21®, JM Eagle Eagle LOC 900™.

F. Application or use of the internally restrained pipe is approved for below ground installation where specifically specified on the Plans or in applications where pipelines must be used immediately or where use of alternative restraining methods or prohibitive.

G. Pipe joints shall be restrained 30 ft. or a minimum of two pipe joints (whichever is longer) upstream and downstream of a mechanically restrained fitting.

2.17 FOAM CONTROL SPRAY NOZZLES

A. Foam control spray nozzles shall be installed at the primary and secondary clarifiers as indicated on the drawings and shall be easily flushed. Provide split eye connector for mounting on spray header.

B. Nozzle discharge shall be between 3.0 and 3.5 gallons per minute with an operating pressure of 10 psig. Spray shall be flat, heavy sheet, fan-shaped with uniform distribution and a spray angle of 105 degrees.

C. Nozzle shall include a replaceable spray deflector insert able to rotate away from the orifice opening; nozzle shall be mechanically locked in place and counterweighted.

D. Pressure rating: 200 psi.

E. Spray nozzles shall be of bronze construction with an orifice diameter not less than ¼ inch and a neoprene spray deflector.

F. Coat dissimilar metals with bituminous coating when installing the foam control nozzles to prevent galvanic corrosion or provide other type of insulating connection.

G. Acceptable Manufacturers: Spraying Systems Co., Model No. 22561 or Approved Equal

2.18 BOLTS AND ANCHORS

A. Bolts and anchors for fittings, pipe couplings, valves, piping and accessories shall comply with the requirements of the applicable specifications.

PART 3 - EXECUTION

3.1 GENERAL

A. Piping, fittings, and appurtenances shall be installed in accordance with the requirements of applicable sections of Division 31 and Division 40. Proprietary manufactured couplings shall be installed in accordance with the coupling manufacturer's recommendation.

B. Care shall be taken to ensure that piping flanges, mechanical-type couplings, sleeve-type couplings, flexible connectors, and expansion joints are property installed as follows:

1. Gasket surfaces shall be carefully cleaned and inspected prior to making up the connection. Each gasket shall be centered properly on the contact surfaces.

2. Connections shall be installed to prevent inducing stress to the piping system or the equipment to which the piping is connected. Contact surfaces for flanges, couplings, and piping ends shall be aligned parallel, concentric, and square to each axis at the piping connections.

3. Bolts shall be initially hand-tightened with the piping connections properly aligned. Bolts shall be tightened with a torque wrench in a staggered sequence to the AISC recommended torque for the bolt material.

4. Groove ends shall be clean and free from indentations, projections, and roll marks in the area from the pipe end to the groove.

5. After installation, joints shall meet the indicated leakage rate. Flanges shall not be deformed nor cracked.

C. Soldered Pipe Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook", using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS ASB.

E. Lined Piping Systems: The lining manufacturer shall take full responsibility for the complete, final product and its application. Pipe ends and joints of lined pipes at screwed flanges shall be epoxy-coated to assure continuous protection.

F. Core Drilling: Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiograph of concrete construction to avoid damage to embedded raceways and reinforcing bars.

G. Cleanup: After completion of the Work, cuttings, joining and wrapping materials, and other scattered debris shall be removed from the Site. The entire piping system shall be handed over in a clean and functional condition.

H. Protective Coating: All pipes shall be coated as required by the Installation Contractor.

3.2 MATERIAL DELIVERY, STORAGE, AND PROTECTION

A. Piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground for protection against oxidation caused by ground contact. Defective or damaged materials shall be replaced with new materials.

END OF SECTION 40 05 00

SECTION 40 05 23 - STAINLESS STEEL PIPE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide stainless steel pipe and appurtenances, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A.	ASTM A 312	Seamless and Welded Austenitic Stainless Steel Pipe
B.	ASTM A 409	Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service
C.	ASTM A 778	Welded, Unannealed Austenitic Stainless Steel Tubular Products
D.	ANSI/ASME B 31.1	Power Piping, and ANSI/AWWA C606.
E.	ASTM A 967	Passivation of Stainless Steel Pipe.

PART 2 - PRODUCTS

2.1 PIPE MATERIAL

A. Unless otherwise indicated, stainless steel pipe shall be in accordance with ASTM A 312, Type 304 or 316, seamless with screwed fittings for sizes up to and including 2-1/2 inches. Stainless steel pipe 3 inches in diameter and larger shall be in accordance with ASTM A 409, Type 304 or 316 with welded or flanged fittings.

B. All fittings shall conform to the following schedule:

Fitting Type	Material	Standard
Threaded	Forged stainless steel per ANSI/ASME B 16.11	Type 304 & 316
Socket Welded	Forged stainless steel, ANSI/ASME B 16.11	Type 304 & 316
Butt-Welded	Wrought stainless steel, ASTM A 403, and ANSI/ASME B 16.9	Type 304 &316
Flanged	Forged Stainless Steel, ANSI/ASME B 16.5	Type 304 & 316

C. Flanged Joints

1. Bolts shall be ASTM A193, B8M Class 1 Stainless Steel.
2. Nuts shall be ASTM A194 Grade 8M Stainless Steel.

3. Washers shall be 316 Stainless Steel.

4. Gaskets shall be Viton.

D. Surface Treatment

1. All Stainless Steel pipe shall be surface treated and tested to meet ASTM A 967 Passivation Standard.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Stainless steel pipe shall be installed in a neat and workmanlike manner, properly aligned and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary all piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points. Installation shall be acceptable to the Engineer.

B. Valves and Unions: Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection.

C. Preparation. Prior to installation, each pipe length shall be carefully inspected, be flushed clean of any debris or dust, and be straightened if not true. Ends of threaded pipes shall be reamed and filed smooth. Pipe fittings shall be equally cleaned before assembly.

3.2 PIPE JOINTS

A. Threaded Joints: Pipe threads shall conform to ANSI/ASME B 1.20.1 - Pipe Threads, General Purpose (inch), and shall be full and cleanly cut with sharp dies. Not more than three threads shall remain exposed after installation.

B. Welded Joints: Welding shall be done by skilled and qualified welders.

1. Field welding shall be minimized to the greatest extent possible by use of couplings and prefabrication of pipe systems at the factory. Pipe butt welds may be performed at the Site, providing the butt welds are performed only with an inert gas shielded process and that other indicated welding requirements are followed rigidly.

2. Residue, oxide, and heat stain shall be removed from any type of field weld and the affected areas adjacent by the use of stainless steel wire brushes, followed by cleaning with an agent such as Eutectic Company's "Euclean" or equal, followed by complete removal of the agent.

3.3 INSPECTION AND FIELD TESTING

A. Inspection: The finished installation shall be carefully inspected for proper supports, anchoring, interferences, and damage to pipe, fittings, and coating. Damage shall be repaired to the satisfaction of the Engineer.

END OF SECTION 40 05 23

SECTION 40 05 51 – VALVES, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall provide valves, actuators, and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all valves and valve actuators pertaining to this work as outlined in the Contract Documents. Valves and actuators in particular locations may require a combination of units, sensors, and controls indicated in other sections of the Specifications.

C. Where a valve is to be supported by means other than the piping to which it is attached, the Vendor shall obtain from the valve manufacturer a design for support and foundation that satisfies the criteria in Section 43 05 01 – Equipment General Provisions. The design, including drawings and calculations sealed by an Engineer, shall be submitted with the Shop Drawings. When the design is approved, the support shall be provided.

D. Unit Responsibility: A single manufacturer shall be made responsible for coordination of design, assembly, testing, and furnishing of each valve; however, the Vendor shall be responsible to the Owner for compliance with the requirements of each valve section. Unless indicated otherwise, the responsible manufacturer shall be the manufacturer of the valve.

E. Single Manufacturer: Where two or more valves of the same type and size are required, the valves shall be furnished by the same manufacturer.

1.2 REFERENCE STANDARDS

A.	ANSI B1.20.1	Pipe Threads, General Purpose
B.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
C.	ANSI B16.5	Pipe Flanges and Flanged Fittings
D.	ANSI B16.18	Cast Copper Alloy Solder Joint Pressure Fittings Class 25, 125, 250 and 800
E.	AWWA C111	Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
F.	AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 through 144 IN
G.	NEMA	Motors and Generators

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 30 00 – Vendor Submittals.

B. Shop Drawings: Shop Drawings shall contain the following information:

1. Valve name, size, Cv factor, pressure rating, identification number (if any), and specification section number.

2. Complete information on valve actuator, including size, manufacturer, number, limit switches, and mounting.

3. Cavitation limits for control valves.

4. Assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, handwheels, position indicators, limit switches, integral control systems, needle valves, and control systems.

5. Data in accordance with Section 40 05 93 - Common Motor Requirements for Process Equipment for electric motor-actuated valves.

6. Complete wiring diagrams and control system schematics.

7. Valve Labeling: A schedule of valves to be furnished with stainless steel tags, indicating in each case the valve location and the proposed wording for the label.

8. Certification that products being used under meet requirements of standards referenced.

C. Operation and Maintenance Data: Provide in accordance with Section 01 78 23 – Operations Maintenance Data.

D. Spare Parts List: A Spare Parts List shall contain the required information for each valve assembly, where indicated.

E. Factory Test Data: Where indicated, signed, dated, and certified factory test data for each valve requiring certification shall be submitted before shipment of the valve. The data shall also include certification of quality and test results for factory-applied coatings.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Valve manufacturers shall have a successful record of not less than five (5) years in the manufacture of the valves indicated.

B. Valve Testing: As a minimum, unless otherwise indicated or recommended by the reference Standards, valves 3-inches in diameter and smaller shall be tested in accordance with manufacturer's standard, larger valves shall be factory tested as follows:

1. Hydrostatic Testing: Valve bodies shall be subjected to internal hydrostatic pressure equivalent to twice the water rated pressure of the valve. Metallic valves rating pressures shall be at 100 degrees F and plastic valves shall be at 73-degrees, higher temperature according to type of material. During the hydrostatic test, there shall be no leakage through the valve body, end joints, or shaft seals, nor shall any part of the valve be permanently deformed. The duration shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes.

2. Seat Testing: Valves shall be tested for leaks in the closed position with the pressure differential across the seat equal to the water rated pressure of the valve. The duration of test shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes. Leakage past the closed valve shall not exceed 1 fluid ounce per hour per inch diameter for metal seated valves and drop-tight for resilient seated valves.

3. Performance Testing: Valves shall be shop operated from fully closed to fully open position and reverse under no-flow conditions in order to demonstrate the valve assembly operates properly.

C. Certification: Prior to shipment, the Vendor shall submit for valves over 12- inches in size, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, or ASTM.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Valves shall be new and of current manufacture. Shut-off valves 6-inches and larger shall have actuators with position indicators. Gate valves 18-inches and larger or where chain wheel is required, shall be furnished with spur gear and hand wheel. Buried valves shall be provided with valve boxes and covers containing position indicators and valve extensions. Manual shut-off valves mounted higher than 7-feet above working level shall be provided with chain actuators.

B. Protective Coating: The exterior surfaces of all valves and the wet interior surfaces of ferrous valves of sizes 4-inches and larger shall be coated in accordance with manufacturer’s written instructions. The valve manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant prior to shipment. Flange faces of valves shall not be epoxy coated.

C. Valve Labeling: Except when such requirement is waived by the Engineer in writing, a label shall be provided on shut-off valves and control valves except for hose bibbs. The label shall be of 1/16-inch plastic or stainless steel, minimum 2-inches by 4-inches in size and shall be permanently attached to the valve or on the wall adjacent to the valve as directed by the Engineer.

2.2 MATERIALS

A. Materials shall be suitable for the intended application. Materials in contact with potable water shall be listed as compliant with NSF Standard 61. Materials not indicated shall be high-grade standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended. Unless otherwise indicated, valve and actuator bodies shall conform to the following requirements:

1. Cast Iron: Close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

2. Ductile Iron: ASTM A 536 - Ductile Iron Castings, or to ASTM A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

3. Steel: ASTM A 216 - Steel Castings, Carbon Suitable for Fusion Welding for High- Temperature Service, or to ASTM A 515 - Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service.

4. Bronze: ASTM B 62 - Composition Bronze or Ounce Metal Castings, and valve stems not subject to dezincification shall conform to ASTM B 584 - Copper Alloy Sand Castings for General Applications.

5. Stainless Steel: Stainless steel valve and operator bodies and trim shall conform to ASTM A 351 - Steel Castings, Austenitic, for High-Temperature Service, Grade CF8M, or shall be Type 316 stainless steel.

6. PVC: Polyvinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 12454.

7. CPVC: Chlorinated Polyvinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 23447.

2.3 VALVE CONSTRUCTION

A. Bodies: Valve bodies shall be cast, molded (in the case of plastic valves), forged, or welded of the materials indicated, with smooth interior passages. Wall thicknesses shall be uniform in agreement with the applicable standards for each type of valve, without casting defects, pinholes, or other defects that could weaken the body. Welds on welded bodies shall be done by certified welders and shall be ground smooth. Valve ends shall be as indicated and be rated for the maximum temperature and pressure to which the valve will be subjected.

B. Valve End Connections: Unless otherwise indicated, valves 2-1/2 inches diameter and smaller may be provided with threaded end connections. Valves 3-inches and larger shall have flanged end connections.

C. Bonnets: Valve bonnets shall be clamped, screwed, or flanged to the body and shall be of the same material, temperature, and pressure rating as the body. The bonnets shall have provision for the stem seal with the necessary glands, packing nuts, or yokes.

D. Stems: Valve stems shall be of the materials indicated, or, if not indicated, of the best commercial material for the specific service, with adjustable stem packing, O-rings, Chevron V-type packing, or other suitable seal. Where subject to dezincification, bronze valve stems shall conform to ASTM B 62, containing not more than 5 percent of zinc or more than 2 percent of aluminum, with a minimum tensile strength of 30,000 psi, a minimum yield strength of 14,000 psi, and an elongation of at least 10 percent in 2 inches.

E. Stem Guides: Stem guides shall be provided per the manufacturer's recommendations. Submerged stem guides shall be 304 stainless steel.

F. Internal Parts: Internal parts and valve trim shall be as indicated for each individual valve. Where not indicated, valve trim shall be of Type 316 stainless steel or other best suited material.

G. Nuts and Bolts: Nuts and bolts on valve flanges and supports shall be 316 stainless steel. Use anti-seize lubricant when assembling stainless steel hardware.

2.4 VALVE ACCESSORIES

A. Valves shall be furnished complete with the accessories required to provide a functional system.

2.5 SPARE PARTS

A. The Vendor shall furnish the required spare parts suitably packaged and labeled with the valve name, location, and identification number. The Vendor shall also furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve. Spare parts are intended for use by the Owner, after expiration of the correction of defects period.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation, inspect interconnecting piping and end connections to assure compatibility.

B. Prior to installation, inspect and verify condition of valve and appurtenances. Installation constitutes installer's acceptance of product condition for satisfactory installation.

C. Assure exposed piping is sufficiently supported to bear weight of valve when it is installed.

3.2 VALVE INSTALLATION

A. Valves, actuating units, stem extensions, and accessories shall be installed in accordance with the manufacturer's written instructions and as indicated. Valves shall be firmly supported to avoid undue stresses on the pipe.

B. Access: Valves shall be installed with easy access for actuation, removal, and maintenance and to avoid interference between valve actuators and structural members, handrails, or other equipment.

C. Valve Accessories: Where combinations of valves, sensors, switches, and controls are indicated, the Installation Contractor shall properly assemble and install such items so that systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on Shop Drawing submittals.

END OF SECTION 40 05 51

SECTION 40 05 57 – ACTUATORS FOR PROCESS VALVES AND GATES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall furnish and place into satisfactory operating condition all valve actuators and appurtenances, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all valves and gates, except where otherwise indicated in the Contract Documents. This Section includes manual operators and motorized valve operators, and mechanical, gear type limit switches.

C. Unit Responsibility: A single manufacturer shall be responsible for furnishing and coordinating design, assembly, testing, and installation of each type of valve and gate.

D. Single Manufacturer: Where two or more valve or gate actuators of the same type or size are required, the actuators shall all be produced by the same Manufacturer.

1.2 REFERENCE STANDARDS

A. Unless otherwise indicated and where applicable, all actuators shall be in accordance with ANSI/AWWA C540 - AWWA Standard for Power-Actuating Devices for Valves and Sluice Gates.

B. National Electrical Manufacturer’s Association (NEMA).

1.3 SUBMITTALS

A. Submittals shall be furnished in accordance with Section 01 30 00 – Vendor Submittals and Section 40 05 51 - Valves, General.

B. Shop Drawings: Shop Drawings of all actuators shall be submitted together with the valve and gate submittals as a complete package.

C. Motorized valve submittals shall include the following:

1. Installation list of similar municipal applications with contacts and phone numbers to verify experience.

2. Shop drawings and product data.

3. Motor, gear type and design information.

4. Design Data shall include:

a. Operating calculations for max break and max dynamic torques and minimum safety factor at which degree of valve opening and at break.

b. Submit data and calculations to substantiate operating time.

c. Submit proposed operator configuration and dimensions for each valve.

5. Wiring Schematics.

6. Manufacturer's published installation instructions.

7. Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 – Operation and Maintenance Data.

8. Warranty.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. The motorized operators offered for this project shall have a minimum of 5 years of commercial use in municipal wastewater installations of a similar scope and use. New and prototype hardware/software will not be accepted.

2. Submit evidence of satisfactory operation of the proposed product in at least five separate facilities in accordance with the following requirements. Include contact names and phone numbers.

B. Warranty:

1. Provide 2-year warranty for all motorized valves. Warranty shall cover site visits, labor, shipping, repair and replacement of valves and operators at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. All valve and gate actuators shall comply with the requirements of Section 40 05 51 – Valves, General.

B. Unless otherwise indicated, all shut-off and throttling valves, and externally actuated valves and gates, shall be provided with manual or power actuators. The Vendor shall furnish all actuators complete and operable with appurtenances, as applicable. All actuators shall be capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering. All wires of motor-driven actuators shall be identified by unique numbers.

C. Materials: All actuators shall be current models of the best commercial quality materials and liberally-sized for the maximum expected torque. All materials shall be suitable for the environment in which the valve or gate is to be installed.

D. Mounting: All actuators shall be securely mounted by means of brackets or hardware specially designed and sized for this purpose and of ample strength. The word "open" shall be cast on each valve or actuator with an arrow indicating the direction to open in the counter-clockwise direction. All gear and power actuators shall be equipped with position indicators. Where possible, manual actuators shall be located between 48 and 60 inches above the floor or the permanent working platform.

E. Functionality: Electric and pneumatic actuators shall be coordinated with power and instrumentation equipment indicated elsewhere in the Contract Documents.

2.2 MANUAL ACTUATORS

A. Unless otherwise indicated, all valves and gates shall be furnished with manual actuators as specified below:

1. Valves up to and including 4 inches in diameter shall have direct acting lever or handwheel actuators of the manufacturer's best standard design.

2. Larger valves and gates shall have gear-assisted manual actuators, with a maximum operating pull of 60 pounds on the rim of the handwheel.

a. Above ground valves 6-inches to 24-inches in diameter may have traveling nut actuators, worm-gear actuators, spur- or bevel-gear actuators, as appropriate for each valve.

b. Above ground valves 30-inches in diameter and greater and valves for pressures higher than 250 psi shall have totally enclosed worm-gear actuators.

c. Buried and submerged valves, gates, and other valves as indicated shall have totally enclosed worm-gear actuators, hermetically-sealed water-tight and grease-packed.

B. Buried Valves: Unless otherwise indicated, buried valves shall have extension stems to grade, with square nuts or floor stands, position indicators, and cast-iron or steel pipe extensions with valve boxes, covers, and operating keys. Where so indicated, buried valves shall be in cast-iron, concrete, or similar valve boxes with covers of ample size to allow operation of the valve actuators. Covers of valve boxes shall be permanently labeled as required by the local Utility Company or the Engineer. Wrench-nuts shall comply with AWWA C500 – Metal-Seated Gate Valves for Water Supply Service.

C. Chain Actuator: Manually-activated valves with the stem located more than 7-feet above the floor or operating level shall be furnished with chain drives consisting of sprocket-rim chain wheels, chain guides, and operating chains, and be provided by the valve Manufacturer. The wheel and guide shall be of ductile-iron, cast-iron, or steel, and furnish heavy-duty, Type 304 stainless steel operating chain looped to extend within 3-feet of the operating floor level. The valve stem of chain-actuated valves shall be extra strong to allow for the extra weight and chain pull. Hooks shall be provided for chain storage where chains interfere with pedestrian traffic.

D. Floor Boxes: Hot-dip galvanized cast-iron or steel floor boxes and covers to fit the slab thickness shall be provided for all operating nuts in or below concrete slabs. For operating nuts in the concrete slab, the cover shall be bronze-bushed.

E. Manual Worm-Gear Actuator: The actuator shall consist of a single or double reduction gear unit contained in a weather-proof cast-iron or steel body with cover and minimum 12-inch diameter handwheel. The actuator shall be capable of 90-degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The actuator shall consist of spur or helical gears and worm-gearing. The spur or helical gears shall be of hardened alloy steel and the worm-gear shall be alloy bronze. The worm-gear shaft and the handwheel shaft shall be of stainless steel. All gearing shall be accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Actuator output gear changes shall be mechanically possible by simply changing the exposed or helical gear set ratio without further disassembly of the actuator. All gearing shall be designed for a 100 percent overload.

2.3 ELECTRIC MOTOR ACTUATORS

A. Where electric motor actuators are indicated, an electric motor-actuated valve control unit shall be attached to the actuating mechanism housing by means of a flanged motor adaptor piece.

B. Design:

1. The actuators shall be suitable for use on a nominal 480 volt, 3 phase, 60Hz power supply and are to incorporate motor, integral reversing starter, local control facilities and terminals for remote control and indication connections housed within a self-contained, sealed enclosure.

2. Meet applicable AWWA requirements and meet the requirements set out in EN15714-2 and ISA SP96.02.

3. The actuator shall be sized to guarantee valve closure. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. For linear operating valves, the operating speed shall be such as to give valve closing and opening at approximately 10-12 inches per minute unless otherwise stated in the data sheet. For quarter turn valve types, the operating time will be a maximum of 60 seconds.

4. Handwheels for Manual Operation:

   a. Metallic with arrows to indicate "open" rotation; incapable of rotation during motor operation; unaffected by fused motor, being mechanically independent of the motor drive; maximum 80 pound pull on rim for manual operation. Actuators shall be fitted with 2-inch AWWA nut for portable operator. When in the manual operating mode, actuator to remain in this mode until motor is energized, at which time the actuator shall automatically return to electric operation.

5. Declutch Lever: Padlockable, capable of mechanically disengaging motor and related gearing positively when motor is de-energized and freeing handwheel for manual operation.

   a. Do not share any gearing between motor operation and handwheel operation.

   b. Design so that simultaneous manual and motor operation is impossible.

6. Motorized operators shall be provided with an integrally mounted communication module within the actuators, to allow non-intrusive set up, double sealed electrical housing and shall not require access after factory fitting. In order to maintain the integrity of the enclosure, setting of the torque levels, position limits and configuration of the indication contacts etc. shall be carried out without the removal of any actuator covers and without mains power over an Infra-red or *Bluetooth*® wireless interface. Sufficient commissioning tools shall be provided with the actuators and must meet the enclosure protection and certification levels of the actuators. Commissioning tools shall not form an integral part of the actuator and must be removable for secure storage. In addition, provision shall be made for the protection of configured actuator settings by a means independent of access to the commissioning tool. Provision shall be made to disable *Bluetooth*® communications or only allow a *Bluetooth*® connection initiated by an Infra-Red command for maximum security.

    a. Each operator shall have independent HAND-OFF-AUTO selector switch and OPEN-CLOSE control devices that are wired to the motor starter circuit and completely isolated and independent of the valve actuator remote control network.

    b. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel irrespective of the connection sequence of the power supply.

7. The complete motorized operator enclosure shall be:

    a. NEMA 4 and NEMA 6 submersible to IP68 (20 feet of head for 72 hours). Actuators shall be suitable for indoor and outdoor use. The actuator shall be capable of functioning in an ambient temperature ranging from -33°C (22°F) to 70°C (140°F), up to 100% relative humidity.

    b. Actuators for hazardous area applications shall meet the area classification, gas group and surface temperature requirements specified in data sheet.

    c. Equipped with a separately sealed (double “O” ring) terminal area, such that with the terminal cover removed the actuator’s internal components are protected from environmental moisture and dust during storage and “no-power” conditions, start-up and working life. Enclosure must allow for temporary site storage without the need for electrical supply connection.

    d. All external fasteners shall be stainless steel.

C. Actuator Gearing:

1. Meet applicable AWWA requirements.

2. Single reduction type with hardened alloy steel worm gear, and aluminum bronze worm gear set; self-locking to maintain gate position.

3. Power Gearing: Accurately cut to assure minimum backlash; anti-friction bearing with caged balls or rollers throughout.

4. Stem Nuts: High tensile aluminum bronze; accurately machined and mounted in heavy ball or roller bearings.

5. Actuator Gear Housing: Aluminum housing with a separate cast iron thrust base.

6. Lubrication: Rotating power train components immersed in oil with provisions for inspection and re-lubrication without disassembly.

   a. Lubricants: Suitable for ambient conditions of -20 degrees F to +150 degrees F.

   b. Provide seals on shafting. All seals, feed throughs, and bearings shall provide sealing such that the actuator can be mounted in any position with no leakage of oil. Secondary gearboxes shall be externally attached to the actuator to accommodate variations in output speeds, torques or operating times and for use with quarter-turn valves. These multi-turn and quarter-turn gearboxes are to use accurately cut gears suitable for motor drive.

D. Motors:

1. The motor shall an integral part of the actuator, designed specifically for valve actuator applications. It shall be a low inertia high torque design, class F insulated with a class B temperature rise giving a time rating of 15 minutes at 40°C (104°F) at an average load of at least 33% of maximum valve torque. Where the total cycle time (two complete strokes) is longer than 15 minutes then NEMA Class H motor for 30 minute duty rating is to be used, with a maximum continuous temperature rating of 125 degrees C rise over ambient Temperature shall be limited by 2 thermostats embedded in the motor end windings and integrated into its control. Type: Specifically designed for gate actuator service with high starting torque, low inertia, totally enclosed, non-ventilated construction.

2. Protection shall be provided for the motor as follows:

   a. Stall - the motor shall be de-energized within 8 seconds in the event of a stall when attempting to unseat a jammed valve.

   b. Over temperature - thermostat will cause tripping of the motor. Auto-reset on cooling.

   c. Single phasing - lost phase protection

   d. Direction – phase rotation correction

3. Motor Windings: Epoxy treated.

4. Size: Sufficient to provide the maximum torque required for valve opening/closing operation, with a safety factor of 1.5. Torque shall be based on the valve manufacture’s calculated torque required for opening/closing at full differential and maximum valve dynamic torque.

5. Voltage Tolerance: Capable of operating at within 10 percent of specified voltage.

6. Motor Starters:

   a. For Open-Close Service: Self-contained electromechanical reversing starter suitable for 60 starts/hr.

   b. For Modulating Service: Self-contained solid-state reversing starter suitable for 1,200 starts per hour. The hammer action will be replaced by a direct drive.

7. Accessories: Internal thermal contacts embedded in the motor windings for detecting motor overload and a ground lug.

8. Power Supply: As scheduled or as indicated.

9. Enclosures for Motors, Switches, and Other Electrical Compartments shall be:

   a. In Class 1, Division 1 or Division 2, classified areas or NEMA 7 and NEMA 6 submersible to IP68.

   b. In other locations: NEMA 4 and NEMA 6 submersible to IP68.

   c. Terminal compartment shall have three threaded cable entries as a minimum. Provide additional threaded entries if required.

E. Controls:

1. Coordinate requirements with P&IDs, electrical schematics, and Specification Section 40 61 96 – Control Strategies.

2. Voltage Transformer:

   a. As required to step down power supply to control voltage.

   b. Size voltage transformer to provide 24VDC or 120 VAC control power, for customer signals, indication and interlock relays as needed with 25 percent spare capacity or 15 VA, whichever is greater, for the multi-turn actuator.

3. Control Station:

   a. Integral with operator. Enclosures shall be:

      a) In Class 1, Division 1 or Division 2 classified areas: NEMA 7 and NEMA 6 submersible to IP68.

      b) In other locations: NEMA 4 and NEMA 6 submersible to IP68.

   b. Provided with Following Devices:

      a) HAND-OFF-AUTO selector switch, lockable in the OFF position.

      b) OPEN and CLOSE pushbuttons.

      c) OPEN and CLOSE indicating lights.

4. Torque Sensing:

   a. Torque and thrust loads in both closing and opening directions shall be limited by a torque sensing device.

   b. Torque setting: 40 percent to 100 percent rated torque, adjustable in 1% increments and indicated locally.

5. Electric Circuit Diagrams:

   a. Identical regardless of whether gates are to open or close on torque or position limit.

   b. Non-intrusive calibration-adjustment and interrogation of the actuator shall be accomplished without the removal of any of the actuator's covers. Non-intrusive calibration, adjustment & interrogation will be by means of a setting tool to provide speedy interrogation capabilities as well as security. The setting tool shall be in a non-intrusive intrinsically safe watertight casing. In addition, it shall be possible to use a PDA or laptop.

6. Valve Position/Actuator Status Indication:

   a. The actuator shall provide a local display of the position of the valve, even when the power supply is not present.

   b. In the event of a (main) power (supply) loss or failure, the position contacts shall continue to be able to supply remote position feedback and maintain interlock capabilities.

   c. Absolute position measurement should be incorporated within the actuator. The technology must be capable of reliably measuring position even in the case of a single fault. The design must be simple with the minimum number of moving parts (no more than 5). Technologies such as LEDs or potentiometers for position measurement are considered unreliable and therefore not preferred. The position of the actuator and valve shall be updated contemporaneously, even when the power supply is not present.

   d. Four contacts shall be provided which can be selected to indicate any position of the valve; Provision shall be made for the selection of a normally closed or open contact form. Contacts shall maintain and update position indication during handwheel operation when all external power to the actuator is isolated. The contacts shall be rated at 5 Amps, 250 VAC, 30 VDC. Provision shall be made in the design for an additional eight contacts having the same functionality. A configurable monitor relay shall be provided as standard, which can be used to indicate either Availability or Fault. The relay should be a spring return type with a Normally Open / Normally Closed contact pre-wired to the terminal bung.

   e. As an alternative to providing valve position, any of the above contacts shall be selectable to signal one of the following:

      a) Valve Opening or Closing.

b) Motor Tripped on Torque in Mid Travel.

c) Motor Stalled.

d) Actuator Being Operated by Handwheel.

f. For actuators in modulating service, provide a controller that will accept a 4-20 mA analog signal. Additionally, a 4-20 mA position transmitter shall be included to provide a valve position feedback. The controller shall compare the input signal with the feedback signal to produce an error signal. The controller shall cause the motor to move the valve or gate in a direction so as to reduce the magnitude of the error signal. The controller positioning accuracy shall be plus or minus 1.0 percent of travel or better. It shall be possible to adjust Dead Band (0 to 9.9 percent of travel) and a Motion Inhibit Timer (2 to 99 seconds), and select action upon loss of signal, open/close/stay put.

7. Integral Starter and Transformer

a. The reversing starter, control transformer and local controls shall be integral with the valve actuator, suitably housed to prevent breathing and condensation. The starter shall be suitable for 60 starts per hour and of rating appropriate to motor size. The controls supply transformer shall be fed from two of the incoming three phases and incorporate overload protection. It shall have the necessary tapping and be adequately rated to provide power for the following functions:

a) Energizing of the contactor Coils

b) 24VDC or 110V AC output for remote controls (maximum 5W/VA)

c) Supply for all internal electrical circuits

8. Local Position Indication:

a. The actuator display shall include a dedicated numeric/symbol digital position indicator displaying valve position from fully open to fully close in 0.1% increments. Valve closed and open positions shall be indicated by symbols showing valve position in relation to the pipework to ensure that valve status is clearly interpreted. With mains power connected, the display shall be backlit to enhance contrast at all ambient light levels and shall be legible from a distance of at least 5m (16ft).

b. Red, green, and yellow LEDs corresponding to open, closed and intermediate valve positions shall be included on the actuator display when power is switched on. The yellow LED should also be fully programmable for on/off, blinker and fault indication. The digital display shall be maintained and updated during handwheel operation when mains power to the actuator is isolated.

c. The actuator display shall include a fully configurable dot-matrix display element with a minimum pixel resolution of 168 x 132 to display operational, alarm, configuration and graphical datalogger information. The text display shall be selectable between English and other languages such as: Spanish, German, French, and Italian. Provision shall be made to upload a different language without removal of any covers or using specialized tools not provided as standard with the actuator Local Display: Large enough to be readable from a distance of six feet when the actuator is powered up. It shall be possible to rotate the display in 90 degree increments to compensate for the actuators installed position.

d. Each actuator shall include a Data Logger to provide diagnostic information for maintenance & preventative maintenance purposes, including torque curves for both open & close strokes. This information is to be accessed by means of a) the setting tool, b) PDA or c) laptop, and in a format that can be saved electronically or on paper and then viewed at a later date. The software to achieve this and any updates to the software are to be supplied at no extra cost to the end user. Datalogger graphical displays should as a minimum be able to display log and trend graphs on the local LCD for the following:

a) Torque versus Position

b) Number of Starts versus Position

c) Number of starts per hour

d) Dwell Time

e) Average temperature.

e. The main display shall be capable of indicating 4 different home-screens of the following configuration:

a) Isolation and status

b) Position and torque (analogue)

c) Position and torque (digital)

d) Position and demand (positioning).

F. Operation:

1. Controller System: Rated as follows:

a. Open-Close Service - 60 starts per hour (minimum).

b. Modulating Service - 1,200 starts per hour (minimum).

G. Manufacturers:

1. Intelligent electric actuators with torque output requirements of 750 ft-lbs. and less for butterfly valves and eccentric plug valves shall be quarter turn type. Acceptable manufactures include:

a. Rotork “IQT Series”

b. Limitorque “QX”

c. EIM “HQ Series”

2. Intelligent electric actuators for open-close service shall be multi-turn type. Acceptable manufacturers include:

a. Rotork “IQ Series”

b. Limitorque “MX”

c. EIM “TEC 2000”

3. Intelligent electric actuators for modulating service shall be as follows:

a. Rotork “IQ Series”

b. Limitorque “MX”

c. EIM “TEC 2000”

4. Intelligent actuators for explosion proof service shall be as follows:

a. Rotork “IQ Series”

b. Limitorque “MX”

c. EIM “TEC 2000”

PART 3 - EXECUTION

3.1 GENERAL

A. Field representatives of manufacturers of valves or gates with electric actuators shall adjust actuator controls and limit switches in the field for the required function.

B. All valve and gate actuators and accessories shall be installed in accordance with Section 40 05 51 - Valves, General. Actuators shall be located to be readily accessible for operation and maintenance, without obstructing walkways. Actuators shall not be mounted where shock or vibrations will impair their operation, nor shall the support systems be attached to handrails, process piping, or mechanical equipment.

3.2 SOURCE QUALITY CONTROL

A. Factory test each motorized operator assembly in accordance with AWWA C540, except as modified herein.

B. Demonstrate that the stroke time is within the specified range.

C. Verify limit switch and torque switch functions in both directions.

D. Provide individual factory test certificates for each motorized actuator at no additional cost. Record the following parameters as a minimum.

1. No load current.

2. Current at maximum torque setting.

3. Stall current.

4. Torque at maximum torque setting.

5. Stall torque.

6. Test voltage and frequency.

7. Flash test voltage.

8. Actuator output speed.

E. Record details of specification, such as gear ratios for both manual and automatic drive, closing direction, wiring diagram, and serial number on the test certificates.

F. Require the motorized actuator manufacturer to submit certified statements that proof-of-design tests were carried out per the “Valve Actuator” section of AWWA C540 and that all requirements were successfully met.

3.3 INSTALLATION

A. Install operators in accordance with manufacturer's instructions.

3.4 MANUFACTURER'S FIELD SERVICES

A. Coordinate field service work with Owner and Engineer prior to initiating such work.

B. Furnish a qualified Manufacturer’s Representative to provide manufacturer’s field services for inspection, testing, equipment startup, and operator training.

C. Manufacturer’s representative shall perform the following services as described below and as specified in Section 01 75 16 – Startup Procedures.

1. Installation Assistance:

a. Advise/observe the Contractor on the installation of motorized operators.

b. Check and verify that installation of the motorized operators is in accordance with manufacturer’s installation instructions.

c. Provide additional assistance as required.

2. Provide a 2-year warranty from date of substantial completion for the project.

3. Training: Provide a minimum of four (4) hours of training for the Owner's staff on the operation and maintenance of electric operated gates and valves.

3.5 COMMISSIONING KIT

A. Each actuator shall be supplied with a start-up kit comprising installation instruction manual, electrical wiring diagram and cover seals to make good any site losses during the commissioning period. In addition, sufficient actuator commissioning tools shall be supplied to enable actuator set up and adjustment during valve/actuator testing and site installation commissioning.

END OF SECTION 40 05 57

SECTION 40 05 62 - PLUG VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall furnish and place into satisfactory operating condition plug valves, where required, in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A. ASTM A 126 Gray Iron Castings for Valves

B. ASTM A 536 Ductile Iron Castings

1.3 SUBMITTALS

A. The Vendor shall furnish submittals in accordance with Section 01 30 00 – Vendor Submittals and Section 40 05 51 – Valves, General.

B. Vendor shall indicate actuator position for each valve in submittal. Valves installed in horizontal piping shall have the plug swing upward when opening, no exceptions.

PART 2 - PRODUCTS

2.1 ECCENTRIC PLUG VALVES (1/2 INCH TO 72-INCH)

A. Construction: Eccentric plug valves shall be of the non-lubricated, eccentric plug design with cast iron bodies conforming to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with ANSI 125 lb. flanged ends for valves 3-inch and larger, and screwed or flanged ends for smaller sizes.

1. The plugs and shafts shall be of cast iron or ductile iron conforming to ASTM A 536 - Ductile Iron Castings, and the plugs shall be lined with a resilient coating, best suited for the specific service.

2. The body shall be lined with a suitable elastomer, where required for a special service, or it shall be epoxy-lined.

3. The seats shall be of nickel or stainless steel welded to the body.

4. All top and bottom shaft bearings shall be of permanently lubricated stainless steel or Teflon coated stainless steel.

5. Grit seals of Teflon, Nylatron, or similar suitable material shall be at the top and bottom plug journals.

6. Valves shall have an unobstructed, full port of 100 percent of full pipe area.

7. All eccentric plug valves shall have a pressure rating of not less than 150 psi WOG, for bubble-tight shut-off in the standard flow direction, and 25 psi WOG in the reverse flow direction.

8. When equipped with worm gear actuator, the pressure rating shall be 150 psi WOG in both directions.

9. The stem seal shall consist of field adjustable packing, replaceable without removal of the actuator, or of self-adjusting U-cup packing.

2.2 ACTUATORS

A. Unless otherwise indicated, eccentric plug valves 3-inch and smaller shall have operating levers; larger valves shall have worm-gear actuators. Valve actuators shall be in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.

B. Vendor shall coordinate actuator position for ease of operation by Owner and to ensure plug shall swing upward when installed in horizontal piping.

2.3 MANUFACTURERS, OR EQUAL

A. DeZurik Corporation

B. Clow Valve Company

C. Pratt Valve

D. Val-Matic

PART 3 - EXECUTION

3.1 INSTALLATION

A. Plug valves shall be installed in strict accordance with the manufacturer's published recommendations and the applicable provisions of Section 40 05 51 – Valves, General.

B. Unless otherwise directed, the following rules shall be observed for the installation of eccentric plug valves on sewage, sludge, or other liquid systems containing solids, silt, or fine sand:

1. The valves shall be positioned with the stem in the horizontal direction.

2. In horizontal pipelines, the plug shall swing upwards when opening, to permit flushing out of solids. Coordinate location of valve actuator so plug swings upward prior to ordering valves.

3. The orientation of the valve shall prevent the valve body from filling up with solids when closed; however, where the pressure differential through the valve exceeds 25 psi, the higher pressure for valves without worm gear, electric, or air operators shall be through the valve to force the plug against the seat.

4. Valves which may be closed for extended periods (stand-by, bypass, or drain lines) and valves with reversed flow (higher pressure on downstream side, forcing the plug away from its seat), shall be equipped with worm gear operators for all sizes.

5. For special applications or when in doubt, consult with the manufacturer prior to installation.

END OF SECTION 40 05 62

SECTION 40 05 63 - BALL VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall furnish and place ball valves into satisfactory operating condition, where required, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. The Vendor shall furnish submittals in accordance with Section 01 30 00 – Vendor Submittals and Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 STAINLESS STEEL BALL VALVES (4-INCH AND SMALLER)

A. Unless otherwise indicated, general purpose metal ball valves in sizes up to 4-inch shall have actuators in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.

B. Body: Ball valves up to 4-inch (incl.) in size shall have stainless steel 2-or 3-piece bodies with screwed ends for a pressure rating of not less than 600 psi WOG.

C. Balls: The balls shall be stainless steel, with standard port (single reduction) or full port openings.

D. Stems: The valve stems shall be of the blow-out proof design, stainless steel with reinforced Teflon seal.

E. Seats: The valve seats shall be of Teflon or Buna-N, for bi-directional service and easy replacement.

F. Manufacturers, or equal

1. Conbraco Industries, Inc. (Apollo)

2. ITT Engineered Valves

3. Neles-Jamesbury, Inc.

4. Watts Regulator

5. Worcester Controls

2.2 PLASTIC BALL VALVES

A. Plastic ball valves for corrosive fluids shall be made of polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), polypropylene (PP), or polyvinylidene fluoride (PVDF), as recommended by the Manufacturer for the specific application. Valves shall have manual actuators in accordance with Section 40 05 57 – Actuators for Process Valves and Gates, unless otherwise indicated.

B. Construction: Plastic ball valves shall have union ends or flanged ends to mate with ANSI B 16.5, class 150 flanges, for easy removal. The balls shall have full size ports and Teflon seats. Body seals, union o-ring seals, and stem seals shall be in accordance with the corrosion resistance requirements of respective valve manufacturer. External (without entering into the wetted area) seat packing adjustment is preferred. Metal reinforced stems to prevent accidental breakage are preferred. The valves shall be suitable for a maximum Working non-shock pressure of 150 psi at 73 degrees F for PVC and CPVC, with decreasing ratings for higher temperatures and other plastics.

C. Manufacturers, or equal

1. ASAHI-America
2. George Fischer, Inc.
3. Plast-O-Matic Valves, Inc.
4. Spears Mfg. Co.

PART 3 - EXECUTION

3.1 GENERAL

A. Valves shall be installed in accordance with Section 40 05 51 – Valves, General. Care shall be taken that valves in plastic lines are well supported at each end of the valve.

END OF SECTION 40 05 63

SECTION 40 05 64 - BUTTERFLY VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall furnish and place into satisfactory operating condition butterfly valves, where required, in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

1.	ANSI/AWWA C504	Rubber-Seated Butterfly Valves.
2.	ANSI/AWWA C540	Power Actuating Devices for Valves and Sluice Gates
3.	ANSI/AWWA C550	Protective Epoxy Interior Coatings for Valves and Hydrants
4.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
5.	ANSI B16.5	Pipe Flanges and Flanged Fittings
6.	ASTM A48	Specifications for Gray Iron Castings
7.	ASTM A126	Gray Iron Castings for Valves, Flanges and Pipe Fittings
8.	STM A276	Specifications for Stainless and Heat-Resisting Steel Bars and Shapes
9.	ASTM A436	Austenitic, Gray Iron Castings
10.	ASTM A536	Ductile Iron Castings
11.	MSS SP67	Butterfly Valves

1.3 SUBMITTALS

A. Provide shop drawings per Section 01 30 00 – Vendor Submittals and Section 40 05 51 – Valves, General including:

1. Complete Shop Drawings of butterfly valves and actuators.

2. Drawings showing valve port diameter complete with dimensions, part numbers and materials of construction.

3. Certification of proof-of-design test from the valve manufacturer.

4. If automatically actuated, provide actuator information in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.

5. For above grade installations, provide literature regarding valve position indicators and installation information to indicate if valves must be installed in the upright position. If valve must be installed in upright position, provide modified valve position indicator that can be seen from the floor when opening or closing the valve.

1.4 QUALITY ASSURANCE

A. Valves shall be subjected to performance, leakage, and hydrostatic test in accordance with procedures and acceptance criteria established by AWWA C504.

PART 2 - PRODUCTS

2.1 GENERAL

A. Butterfly valves shall comply with the requirements of Section 40 05 51 – Valves, General.

2.2 BUTTERFLY VALVES FOR GENERAL PURPOSE SERVICE

A. Butterfly valves shall be rubber seated butterfly valves that conform to AWWA C504, rated for water working pressures up to 150 psig, subject to the following requirements. Butterfly valves for general purpose service shall be rubber seated butterfly valves that conform to AWWA C504, rated for water working pressures up to 150 psig, subject to the following requirements. Valves shall be of the size and class indicated, suitable for bubble tight shut-off service as well as throttling service at rated pressure at ambient temperatures of 33 to 125 degrees F. Lug or wafer style valves shall have ANSI 125 lb flange bolt hole patterns.

B. Body: The valve body shall be of cast iron conforming to ASTM A126 - Specifications for Gray Iron Castings for Valves, Flanges and Pipe Fittings, Class B, with either wafer, lug, or flanged design, drilled to ANSI B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 125. The entire body shall be factory coated with an epoxy coating system in accordance with AWWA C550.

C. Disc: The disc shall be a ductile iron conforming to ASTM A536, with factory applied epoxy coating in accordance with AWWA C550. The disc shall have no holes drilled into it for securing the disc to the stem with pins, screws, or any other such hardware. If the disc design is such that securing hardware is required then the disc and securing hardware shall both be type 316 stainless steel.

D. Seat: The valve seat shall be Ethylene-Propylene-Diene Monomer (EPDM) or Buna N and shall be bonded or vulcanized to the valve body.

E. Stem: The valve stem shall be a Type 316 stainless steel ASTM A276, with keyed slots on the stem to make with receiving slots on the inner part of the disc requiring no disc screws or pins for connection of the tem to the disc. If connecting pins or screws are required for a particular manufacturer's design, then the disc as well as the connecting hardware shall be type 316 stainless steel.

F. Stem Bushing: The stem bushing shall be a non-corrosive, heavy duty acetal bushing.

G. Stem Seal: The stem shall be a double "U" cup seal or O-ring designed which is self-adjusting and provides positive sealing in both directions and is suitable for the service condition.

H. Flange / Style: Unless otherwise specified or noted on the drawings, the style of each butterfly valve shall be lug style. The Contractor shall not use any type of raised face type PVC flange on either side of any butterfly valve. Contractor shall be responsible to ensure that the selected butterfly valve will fully open and close without any physical interference at all.

I. Testing: Valves shall be factory leak tested in accordance with AWWA C504.

J. Manufacturers or equal:

1. DeZurik Water Controls
2. Henry Pratt Company
3. Bray
4. Val-matic

2.3 BUTTERFLY VALVES FOR AIR SERVICE

A. General: Butterfly valves for air service shall be specifically designed for this service and meet or exceed the design, strength, performance, and testing standards of AWWA C504. They shall be suitable for pressures from vacuum to 125 psi and temperatures from minus 40 degrees F to 300 degrees F.

B. Body: The valve body shall be of cast iron conforming to ASTM A126, Class B, with lug or flanged design as indicated, drilled to ANSI B16.1, Class 25, 125, 250, and 800, Class 125.

C. Disc: The disc shall be cast iron conforming to ASTM A126 with a nylon coating, bronze, or Type 316 stainless steel. The disc shall be designed with the air- profile or other suitable shape. Sprayed or plated disc edges are not acceptable.

D. Seat: The elastomer seat shall be in the body. It shall be field-replaceable without special tools. The seat material shall be Viton to provide a tight shut-off at the temperatures above.

E. Shaft: The valve shaft shall be of Type 316 or 304 stainless steel, with sufficient strength to allow for the increased torque for air service.

F. Bearings: Shaft bearings shall be of the self-lubricating corrosion resistant sleeve type.

G. Packing: The packing shall be of the adjustable or self-adjustable (a-ring) type, suitable for the temperature and service conditions.

H. Manufacturers, or Equal:

1. DeZurik water Controls

2. Henry Pratt Company

3. Bray

2.4 ACTUATORS

A. Manual Actuators: Actuators shall conform to Section 40 05 57 – Actuators for Process Valves and Gates and to ANSI / AWWA C540 - Power Actuating Devices for Valves and Sluice Gates, subject to the following requirements. Unless otherwise indicated, all manually-actuated butterfly valves of 6 inch diameter and larger shall be equipped with a handwheel and 2-inch square actuating nut and position indicator. Manual lever type actuators shall allow for positive throttling and have at minimum 10 stop positions from open to close for positive locking of the valve. The manual lever type actuators as well as handwheel actuators shall have an epoxy coating.

B. Electric Actuators: Provide electric actuators that meet the requirements of AWWA C 540 and are in accordance with Section 40 05 57 – Actuators for Process Valves and Gates. The maximum torque for the valve shall be input into the actuator program to be the maximum torque applied by the actuator.

2.5 PAINTING AND COATINGS

A. All valves inside of hydraulic structures shall be provided with a high build epoxy coating system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation, inspect interconnecting piping and end connections to ensure compatibility.

B. Prior to installation, inspect and verify condition of valve and appurtenances.

C. Ensure exposed piping is sufficiently supported to bear weight of valve when it is installed.

3.2 PRODUCT HANDLING

A. Protect valves and components against dirt and damage during shipment and storage.

B. Handle valves to prevent damage or contamination.

3.3 INSTALLATION

A. Install all valves in accordance with manufacturer’s recommendations and with Section 40 05 51 – Valves, General.

END OF SECTION 40 05 64

SECTION 40 05 65.23 – SWING CHECK VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall furnish and place into satisfactory operating condition swing check valves, where required, in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A.	ANSI/AWWA C 508	Swing-Check Valves for Waterworks Service, 2 in. through 24 in.
B.	ASTM A 126	Gray Iron Casting for Valves, Flanges, and Pipe Fittings
C.	ANSI/ASME B 16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 300
D.	ASTM B 584	Copper Alloy Sand Castings for General Applications
E.	ASTM B 584 or B 148	Aluminum-Bronze Castings, or of Buna-N
F.	ASTM B 763	Copper Alloy Sand Castings for Valve Application, or
G.	ANSI/ASME B1.20.1	Pipe Threads, General Purpose (inch)
H.	ASTM B 16	Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines.

1.3 SUBMITTALS

A. The Contractor shall furnish submittals in accordance with Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 SWING CHECK VALVES (3-INCH AND LARGER)

A. General: If not specified otherwise, swing check valves for water, sewage, sludge, and general service shall be of the outside lever and spring or weight type, in accordance with ANSI/AWWA C 508 - Swing-Check Valves for Waterworks Service, 2 in. through 24 in. NPS. Valves shall have full-opening passages, designed for a water-working pressure of 150 psi. They shall have a flanged cover piece to provide access to the disc.

B. Body: The valve body and cover shall be of ductile iron conforming to ASTM A 536 – Ductile Iron Castings for Valves, Flanges, and Pipe Fittings, with flanged ends conforming to ANSI/ASME B 16.1 - Ductile Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800, or mechanical joint ends, as indicated.

C. Disc: The valve disc shall be of ductile iron, or bronze conforming to ASTM B 584 - Copper Alloy Sand Castings for General Applications.

D. Seat and Rings: The valve seat and rings shall be of stainless steel T304 or T316 Type.

E. Lining & Coating: The valve shall be lined and coated with NSF 61 Fusion Bonded Epoxy.

F. Hinge Pin: The hinge pin shall be of bronze or stainless steel.

G. Manufacturers, or equal

1. Val-Matic, 7800LW Series
2. American Flow Control (Darling)
3. APCO (Valve and Primer Corp.)
4. Kennedy Valve
5. Mueller Company
6. Crane Valves and Fittings

2.2 SWING CHECK VALVES (2-1/2-INCH AND SMALLER)

A. Swing check valves for steam, water, oil, or gas in sizes 2-1/2 inch and smaller shall be suitable for a steam pressure of 150 psi and a cold-water pressure of 300 psi. They shall have screwed ends unless otherwise indicated, and screwed caps.

B. Body: The valve body and cap shall be of bronze conforming to ASTM B 763 - Copper Alloy Sand Castings for Valve Application, or ASTM B 584 with threaded ends conforming to ANSI/ASME B1.20.1 - Pipe Threads, General Purpose (inch).

C. Disc: Valves for steam service shall have bronze or brass discs conforming to ASTM B 16 - Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines, and for cold water, oil, and gas service replaceable composition discs.

D. Hinge Pin: The hinge pins shall be of bronze or stainless steel.

E. Manufacturers, or equal

1. Crane Company
2. Milwaukee Valve Company
3. Stockham Valves and Fittings
4. Wm. Powell Company

PART 3 - EXECUTION

3.1 GENERAL

A. Valves shall be installed in accordance with provisions of Section 40 05 51 – Valves, General.

END OF SECTION 40 05 65.23

SECTION 40 05 65.29 – DOUBLE-DISK CHECK VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall furnish and place into satisfactory operating condition check valves, where required, in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A.	ANSI/AWWA C 508	Swing-Check Valves for Waterworks Service, 2 in. through 24 in.
B.	ASTM A 126	Gray Iron Casting for Valves, Flanges, and Pipe Fittings
C.	ANSI/ASME B 16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 300
D.	ASTM B 584	Copper Alloy Sand Castings for General Applications
E.	ASTM B 584 or B 148	Aluminum-Bronze Castings, or of Buna-N
F.	ASTM B 763	Copper Alloy Sand Castings for Valve Application, or
G.	ANSI/ASME B1.20.1	Pipe Threads, General Purpose (inch)
H.	ASTM B 16	Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines.

1.3 SUBMITTALS

A. The Vendor shall furnish submittals in accordance with Section 01 30 00 – Vendor Submittals and Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 DOUBLE-DISK CHECK VALVES

A. Double-disk check valves for air and gas service and where indicated, shall be of the wafer-type designed to fit between ANSI B16.1 flanges for 125-lb rating. The check valve leaves shall be spring-loaded. Flow from one direction shall cause the valve to open, and upon valve shutoff, the spring shall shut the valve leaves before reverse flow starts, acting at a point of zero velocity, for non-slam closure. The spring-tension of each valve shall be designed for the individual operating condition.

B. Body: The valve body shall be of cast iron conforming to ASTM A 126 with integrally-cast seat, rated for minimum 150-lb working pressure at up to 250 degrees F.

C. Leaves: The leaves shall be of bronze, aluminum bronze, or ductile iron, revolving on stainless steel or monel hinge pins with retainers.

D. Seat: The valves shall have resilient seats for bubble-tight shut-off, suitable for temperatures up to 250 degrees F without sticking. The seats shall be Viton or other suitable material for the intended purpose. The seat rings shall be firmly attached a shoulder cast in the body or to the disc by compression-molding or similar acceptable method.

E. Springs: The springs shall be of Type 316 stainless steel or Inconel, as best suited for the service condition.

F. Manufacturers, or equal:

1. APCO (Valve and Primer Corporation)

2. Proquip International

3. VAL-MATIC (Valve and Manufacturing Corporation)

PART 3 - EXECUTION

3.1 GENERAL

A. Valves shall be installed in accordance with provisions of Section 40 05 51 – Valves, General.

END OF SECTION 40 05 65.29

SECTION 40 05 82 – SOLENOID VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide solenoid valves and appurtenances in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

1.	AWWA C511	Reduced-Pressure Principle Backflow Prevention Assembly
2.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
3.	C-510-97	Double Check Valve Backflow Prevention Assembly
4.	C-511-97	Reduced Pressure Principle Backflow Prevention Assembly
5.	NPFA 820	Standard for Fire Protection in Wastewater Treatment and Collection Facilities

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 30 00 – Vendor Submittals and Section 40 05 51 – Valves, General.

B. Technical Manual: Furnish operation and maintenance information in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

A. Comply with quality assurance requirements listed in Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 GENERAL

A. All valves specified in this Section shall meet the applicable requirements of Section 40 05 51 – Valves, General.

2.2 SOLENOID VALVES

A. All coil ratings shall be for continuous duty. For electrical characteristics see electrical drawings or specifications.

B. Explosion-proof valves shall be provided in Class 1, Division 1 areas as required under NPFA 820 guidelines.

C. Solenoid valves shall be of the size, type, and class indicated and shall be designed for not less than 150 psi water-working pressure. Valves for water, air, or gas service shall have stainless steel body with screwed ends, stainless steel trim and spring, Teflon or other resilient seals with material best suited for the temperature and fluid handled. Unless otherwise indicated, for chemicals and all corrosive fluids, solenoid valves with PVC, CPVC, polypropylene (PP), polyvinylidene fluoride (PVDF), or Teflon materials of construction, suitable for the specific application shall be provided. Enclosures shall be NEMA rated in accordance with the area designations.

D. Solenoid valves shall be pilot controlled and shall be water hammer free.

E. Solenoid valves shall fail in the closed position unless otherwise indicated on the project drawings.

F. Where solenoid valves are a part of a packaged equipment system, those solenoids valves shall be specified and provided by the equipment manufacturer.

G. Manufacturers, or Equal:

1. For general duty

    a. Automatic Switch Co. (ASCO), Model "RED HAT"

    b. Skinner Valve (Parker Hannifin Corporation)

    c. Magnatrol Valve Corporation

    d. J. D. Gould Co.

2. Metallic valves for corrosive fluids

    a. Valcor Engineering Corporation

3. Plastic valves for corrosive fluids

    a. GF Plastic Systems, Inc.

    b. Spears Mfg. Co.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Valves shall be installed in accordance with the manufacturer's printed recommendations, and with provisions of Section 40 05 51 – Valves, General.

B. After installation is complete, the solenoid valve shall be tested for proper operation.

END OF SECTION 40 05 82

SECTION 40 05 93 – COMMON MOTOR REQUIRMENTS FOR PROCESS EQUIPMENT

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Vendor shall provide electrical motors, accessories, and appurtenances complete and operable, in conformance with the individual driven equipment specifications and the Contract Documents.

B. The provisions in this Section apply to all low voltage AC squirrel cage induction motors except as indicated otherwise.

C. All motors shown on the Drawings or specified in other divisions of the Specifications shall in general, be furnished with the driven equipment and connected under Division 26 of the Specification.

D. If motors are specified in other divisions of the Specification, then in the event of conflicts, the more restrictive specification shall apply.

E. The Vendor shall select suitable electric motors for the equipment. The choice of motor manufacturer shall be subject to review by the Engineer. Such review will consider future availability of replacement parts and compatibility with driven equipment.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Motors shall be designed, built, and tested in accordance with the latest revision of the following standard documents. In the case of conflict between the requirements of this Section and those of the standard documents, the requirements of this Section shall prevail.

1.	NEMA MG 1	Motors and Generators
2.	ANSI/IEEE 112	Test Procedures for Polyphase Induction Motors and Generators
3.	UL l004	Motors, Electric

1.3 VENDOR SUBMITTALS

A. Refer to Section 01 30 00 – Vendor Submittals and individual equipment specification requirements.

B. Submit the motor manufacturer's certification of bearing life on motors where application conditions suggest significant belt drive or thrust loads.

C. A Motor Data form (sample Form follows section) shall be submitted for each and every motor furnished under this Contract.

D. Motor outline, dimensions, and weight.

E. Manufacturer's descriptive information relative to specified features.

F. Motor Performance Characteristics:

1. Guaranteed minimum efficiency at rated load at rated voltage.
2. Guaranteed minimum power factor at rated load at rated voltage.
3. Expected efficiency at 1/2, 3/4, and full load at rated voltage.
4. Expected power factor at 1/2, 3/4, and full load at rated voltage.
5. Motor no-load current at rated voltage.
6. Full load current at rated voltage.
7. Full load current at 110 percent voltage.
8. Starting current at rated voltage.
9. Full load speed.
10. Certified copy of test report for identical motor tested in accordance with NEMA MG 1-12.53a and IEEE Standard 112, Test Method B, showing full load efficiency and power factor not less than specified value. Motors not as specified will be rejected.

G. Vertical Motor Data:

1. Thrust bearing life
2. Type of thrust bearing lubrication.
3. Type of guide bearing lubrication.

H. Operation and Maintenance Manuals (provided before training of treatment plant staff), including:

1. Complete information for storage and installation.
2. Complete operating and maintenance instructions.
3. Bill of Materials.

1.4 EQUIPMENT GUARANTEE

A. Guarantees shall cover:

1. Faulty or inadequate design.
2. Improper assembly or erection.
3. Breakage, or other failure.
4. Defective workmanship or materials

1.5 FACTORY TESTS

A. Provide factory test and test reports as listed below for all polyphase motors. For motors 7 1/2 hp and above, provide test reports for the actual motor being supplied. For motors under 7 1/2 hp, test reports of an identical motor may be provided. Perform all tests in accordance with the Procedures for Polyphase Induction Motors and Generators No. 112A and NEMA MG 1.

B. Measurements of no-load current and speed at nominal voltage and frequency

1. Measurement of locked rotor current at rated frequency.

2. Results of high-potential test.

3. Determination of efficiency and power factor at ½ load, ¾ load, full-load, and service factor load.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide squirrel-cage induction motors unless otherwise noted.

B. Electric motors driving identical machines shall be identical.

C. Coordination: Provide motors especially suitable both electrically and mechanically to drive the loads specified. The speed, horsepower, torque base, bearing, shaft, insulation and enclosure shall be closely coordinated with this specification so as to provide a satisfactory, efficient drive without overloading, overheating, abnormal noise or vibration. The BHP required of the driven equipment under the most severe operating conditions for the equipment served shall not exceed the rated nameplate horsepower of the motor when operating at its rated service factor, nor shall it exceed the rated nameplate horsepower of the motor when operated at specified conditions at a service factor of 1.0. The "most severe operating conditions" shall include the full possible range of normal operating conditions but shall not include unusual conditions such as equipment failure.

D. Standards: All motors shall be in accordance with NEMA-MG 1 "T" Line, IEEE and ANSI latest revision insofar as they are applicable.

E. Service Conditions: Provide motors designed and built for long, trouble-free life in industrial service capable of operating successfully under the following application conditions:

1. 40°C maximum ambient temperature to -20 degrees Celsius minimum ambient temperature.

2. Altitude at the facility site shall be verified.

3. Voltage variations to + 10 percent of nameplate rating.

4. Frequency variations to + 5 percent of nameplate rating.

5. Multiple speed motors suitable for use with multiple speed starter furnished.

6. Inverter duty motors suitable for use with variable frequency drives, if furnished.

F. Operating Characteristics: All motors shall be rated for full-voltage starting, NEMA Design B, normal torque, normal starting current, unless otherwise required by the driven equipment or specified.

G. Installation Environment: Provide motors suitable for the environment in which they are to be installed. Where the installation environment is specified, provide motors suitable for the environment indicated and in conformance with the specification.

H. Exempt Motors: Motors for valve operators, submersible pumps, or motors which are integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven element, or part of domestic or commercial uses apparatus may be excepted from these specifications to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

2.2 ENCLOSURES

A. Horizontal: Dripproof NEMA Standard MG 1, unless otherwise specified. Provide screen over all air openings.

B. Vertical: Motors shall be weather protected Type 1 (WP-l) NEMA Standard MG 1, with inlet and outlet openings screened unless otherwise specified.

C. TEFC and TENV: Totally enclosed fan cooled (TEFC) where specified. Provide horizontal TEFC motors with condensate drain holes. Totally enclosed non- ventilated (TENV) may be substituted for TEFC at Contractor's option.

D. Cast iron or extruded aluminum or die cast aluminum stator frames and end shields, rigid construction.

E. Heavy fabricated steel, cast iron or aluminum frames for single phase motors.

2.3 ACCESSORY REQUIREMENTS

A. Motor Assembly: Provide NEMA conduit entrance box. Provide conduit entrance box size and drilling to conform to the conduit or wiring requirements indicated on the electrical drawings. Include motor leads and all accessory leads in a common conduit entrance box.

B. Motor Leads: Provide motor leads compatible with motor insulation systems, permanently identified.

C. Eyebolts: Provide drilling and tapping for eyebolts on all motors weighing more than 83 pounds.

D. Nameplates: Provide one or more engraved stainless-steel stamped metal nameplates with the information required by NEMA-MGI-IO.38 and the following additional information:

1. Maximum ambient temperature for which motor is rated.

2. Class of insulation.

3. Service factor.

4. Bearing number.

5. Motor connection diagram if more than three leads.

6. Power rating in KW if driven equipment ratings are given in metric units.

E. Oil Lubricated Polyphase Motors: Provide lubricating oil reservoirs and sight gauges.

F. Painting: As specified in Section 43 05 01 - Equipment General Provisions.

G. Provide motor grounding lug suitable to terminate ground wire, sized as indicated.

2.4 INSULATION CLASS

A. Provide NEMA Class B insulation for all polyphase squirrel-cage induction motors, unless otherwise specified.

1. Provide additional anti-abrasion protection for non-enclosed motors, per NEMA MGl-l.27.

2. Provide additional moisture protection for enclosed motors, per NEMA MGl-20.48a.

B. Class F insulation with additional nonhygroscopic moisture protection as specified in paragraph 2.03A above may be utilized at the Contractor's option, however, the temperature rise as measured by resistance when operating at rated service factor and load shall conform to the limiting observable temperatures in NEMA-MGl, for class of insulation used.

C. Class A insulating materials shall not be utilized except in single-phase fractional horsepower motors or used in dry locations, with a standard reduction in rated temperature rise.

D. Encapsulation: Where specified. Provide insulating resin encapsulation by a molded or equivalent process in which the resin completely surrounds the conductors in the slots and end turns, leaving no voids between the conductors or adjacent stator steel. Allowable temperature rise shall not exceed the limits of NEMA-MGl.

E. Motors to be operated from adjustable frequency drives shall be provided with insulation systems to withstand 1600-volt spikes, with dV/dt as defined in NEMA MG 1-31 and shall be labeled as “Inverter Duty”.

2.5 SERVICE FACTOR

A. Provide the service factor indicated, or NEMA standard for the specified insulation and enclosure, whichever is greater. Minimum service factor shall be 1.15.

2.6 NEMA TYPE

A. Provide motors in accordance with standard NEMA type classifications as specified. The use of industry standard subclassifications such as "mill and Chemical" motors and similar" standard" heavy-duty designs are encouraged where they meet or exceed the specified minimum requirements.

2.7 POWER RATINGS

A. Motor horsepower or kw ratings, if indicated in the detailed equipment specifications, are minimum size acceptable.

B. Ratings indicated on the electrical drawings are for guidance only and do not limit the equipment size.

C. Frame/hp relationships shall conform to the latest NEMA standards for "T" or "U" frames and all dimensions shall meet NEMA standards.

2.8 STANDARD RATED VOLTAGE PHASE AND FREQUENCY

A. Provide motors nameplate-rated for 60 Hertz power supply as follows unless otherwise specified or shown on the drawings:

1. Motor less than 1/6 hp, single-phase, 115 volts.

2. Motors 1/6 hp through 1 hp, single phase, 115/230 volts.

3. Motors 1 hp and greater, three phase, 460 volts.

4. Multi-speed motors may have single voltage rating if manufacturer's standard.

B. Conform to the specified service conditions and the equipment specifications without reduction in the service factor.

2.9 BEARINGS AND SHAFTS

A. Motors greater than 2 HP shall have bearings designed for 17,500 hours (belted) or 100,000 hours (coupled) L-10 life.

B. Fractional Horsepower: Motors with fractional horsepower through 2 HP shall be provided with Lubricated-for-Life ball bearings.

C. Horizontal Motors Over 2 HP: Motors larger than 2 HP shall be provided with relubricatable ball bearings. Lubrication shall be per manufacturer’s recommendation for smooth operation and long life of the bearings.

D. Vertical Motors Over 2 HP: Vertical motors larger than 2 HP shall be provided with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

E. Shafts: Shafts shall be in accordance with NEMA "T" or "TS" dimensions. Long shafts shall be suitable for belt, chain or gear drive within limits established by good industrial practice and documented by NEMA. Short shafts shall be used for direct connection. Vertical motors shall be the solid-shaft type except where application requires a hollow-shaft design.

F. Inverter Duty Motors: Motors to be used in VFD applications must have bearing protection from shaft currents. Provide AEGIS shaft grounding rings, ceramic bearings or equivalent means to prevent premature bearing failure due to shaft current discharge.

2.10 DUTY CYCLE

A. Provide motors rated for continuous duty unless otherwise specified. Short time rated motors may be provided where the application is well documented by NEMA, is usual industrial practice and the driven equipment and motor is a tested combination under the specified performance conditions.

2.11 LUBRICATION

A. Horizontal polyphase motors shall be grease lubricated. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent relubrication, but facilities shall be provided for adding new grease and draining out old grease without major motor disassembly. Motors 180T frame and smaller may utilize grease release fitting in lieu of grease drain plug. The bearing housing shall have long, tight, running fits or rotating seals to protect against the entrance of foreign matter into the bearings or leakage of grease out of the bearing cavity.

B. Vertical polyphase motor lubrication shall conform to the motor manufacturer's recommendations. Except as otherwise recommended, guide bearings shall be ball bearings, grease lubricated; thrust bearings shall be grease lubricated through frame 28OT, oil lubricated in larger frame sizes.

2.12 MOTOR THERMAL PROTECTION

A. Provide one heat-sensing detector per phase, embedded in the windings to provide even temperature protection on motors 75 hp or larger. Coordinate over-temperature protection system with motor starter overload relays.

B. Single Phase Motor: Single phase 120, 208, or 230-volt motor shall have integral thermal overload protection or shall be inherently current limited.

C. Thermostats: Winding thermostats shall be snap action, bi-metallic, temperature-actuated switch, and shall be factory mounted integral to the motors. Thermostats shall be provided with one normally closed contact. The thermostat switch point shall be precalibrated by the manufacturer.

2.13 HIGH EFFICIENCY MOTORS

A. All motors provided shall be high efficiency as specified below.

B. High efficiency motors shall have minimum and nominal efficiencies which meet or exceed the efficiencies specified below when tested in accordance with the latest version of IEEE Test Procedure 112A. Method B. using accuracy improvement by segregated loss determination including stray load loss improvement as specified in NEMA Standard MGl-12.S3A. latest revision. Minimum efficiencies shall be guaranteed in writing.

C. Single speed induction high efficiency motors, three-phase, NEMA Design B, 460V, continuous duty, 40°C ambient shall meet or exceed the efficiencies specified in the following table.

Energy Efficiency Horizontal					
		Percent Guaranteed Minimum Rated Load Efficiencies		Percent Guaranteed Minimum Rated Load Power Factor	
HP	Nominal Speed RPM	DP	TEFC	DP	TEFC
1	1,800	80.0	81.5	85.0	85.0
	1,200	78.5	79.3	74.0	74.0
1.5	3,600	79.3	81.5	86.0	86.0
	1,800	79.3	82.0	88.0	88.0
	1,200	82.5	84.0	69.5	69.5
2	3,600	82.0	84.0	88.0	88.0
	1,800	81.5	83.7	84.0	84.0
	1,200	85.5	85.5	69.0	69.0
	900	82.9	82.5	54.0	54.0
3	3,600	82.0	84.0	91.0	88.0
	1,800	84.8	86.5	79.0	79.5
	1,200	87.5	88.1	71.0	71.5
	900	84.1	82.9	62.0	62.5
5	3,600	84.8	86.5	87.0	91.5
	1,800	86.5	86.5	81.0	81.0
	1,200	87.5	88.1	75.5	75.5
	900	87.5	86.5	70.0	70.5
7.5	3,600	86.5	88.1	90.0	90.0
	1,800	89.3	89.5	86.5	86.5
	1,200	88.5	88.5	80.0	80.0
	900	87.5	86.5	72.0	72.0
10	3,600	89.3	89.5	90.0	90.0
	1,800	89.3	89.5	86.0	86.0
	1,200	89.5	89.5	80.5	81.0
	900	89.3	88.5	77.5	78.0

2.14 ACCEPTABLE MANUFACTURER

A. U.S. Motors

B. General Electric

C. Equal

PART 3 - EXECUTION

3.1 ERECTION

A. Motors shall be factory installed on common bases, stands, etc., with the driven equipment. Provide suitable couplings and guards between motor and driven equipment.

B. Align and connect to driven equipment.

C. Connect motors to power supply and controllers and verify correct rotation of equipment.

3.2 INSTALLATION CHECK

A. Provide services of an experienced, competent, and authorized representative of the manufacturer to visit site of work and inspect, check, adjust if necessary, and approve equipment installation for motors 25 hp and larger.

B. Assure that equipment manufacturer's representative is present when equipment is placed in operation.

C. Verify that equipment representative revisits jobsite as often as necessary until all trouble is corrected and equipment installation and operation are satisfactory, in the opinion of the Owner.

D. The Installing Contractor shall perform the following field checks:

1. Inspect each motor installation for any deviation from rated voltage, phase, or frequency and improper installation.

2. Visually check for proper phase and ground connections. Verify that multi-voltage motors are connected for proper voltage.

3. Check winding and bearing temperature detectors and space heaters for functional operation.

4. Test for proper rotation prior to connection to the driven equipment.

5. Test insulation (megger test) of all new and re-used motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

END OF SECTION 40 05 93

MOTOR DATA FORM

Equipment Name: _____ Equipment Number(s): _____

Site Location: _____

Nameplate Markings

Mfr: _____ Mfr Model: _____ Frame: _____ HP: _____

Volts: _____ Phase: _____ RPM: _____ Service Factor: _____

FLA: _____ LRA: _____ Freq: _____ Ambient Temp Rating: _____°C

Time Rating: _____ (NEMA MG-10.35) Design Letter _____ (NEMA MG-1.16)

KVA Code Letter: _____ Insulation Class: _____

The following information is required for high efficiency motors only:

A. Guaranteed minimum efficiency at full load at NEMA efficiency index:

_____
(NEMA MG1-12.53B)

B. Nameplate or nominal efficiency: _____

Data Not Necessarily Marked on Name Plate

Type of enclosure: _____ Enclosure Material: _____

Temp rise: _____ °C (NEMA MG1-12.41, 42)

Space heater included: _____ Yes _____ No;

If yes, _____ Watts _____ Volts

Type of Rotor winding over-temperature protection, if specified:

Use the space below to provide additional information on other motor modifications, if specified:

_____

_____

SECTION 40 61 96 - CONTROL STRATEGIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The following equipment is included in the control strategies. Refer to equipment specifications for control narratives

1. IFAS System
2. Upflow Sand Filtration
3. Sludge Dewatering System

1.2 ABBREVIATIONS

A. The following abbreviations are used in this Section:

F/R:	Forward or Reverse
HOR:	HAND/OFF/REMOTE
VFD:	Variable Frequency Drive
HOA:	Hand/Off/Auto
MOV:	Motor Operated Valve
LCP:	Local Control Panel
LCS:	Local Control Station
PLC:	Programmable Logic Controller

1.3 SUBMITTALS

A. Provide submittals in accordance with Sections 01 30 00 – Vendor Submittals.

B. Develop detailed loop descriptions based on the information in the Contract Documents.

1. For each control loop, provide a detailed functional description of the operation of the equipment, signals, and controls shown on the P&IDs:
    a. Include all functions depicted or described in the Contract Documents.
    b. Include the following within each loop description:
        a) All requirements specific to that loop.
        b) Common control requirements applicable to that loop.
        c) List of all ranges, setpoints, timers, values, counters, etc.

c. Where there are similar loops with identical control, only 1 loop description needs be developed, and the remaining loops may reference that loop description.

C. Loop description format:

1. Loop number and title.

2. References:

a. List P&IDs that are specifically referenced.

3. Abstract:

a. General description of how the loop works, what devices are involved, and how the process shall be controlled.

b. Process values, setpoints, and limits, including units and ranges:

1) Show span and range values for analog inputs and outputs, and operating point and dead band for discrete inputs.

4. Hardwired control:

a. Detailed description of the control functions at the local level.

b. Function of local operator interfaces.

c. Operation of hardwired field pilot controls:

1) Pushbuttons.

2) Selector switches.

3) Potentiometers.

4) Pilot lights, indicators, and other displays.

5. Hardwired interlocks:

a. Explanation of the operation of system interlocks and hardwired permissive conditions.

6. PLC control:

a. Detailed description of the control functions that are under control of the PLC.

b. Operator controls and automatic controls.

c. Setpoints, alarms, etc.:

1) Include units and ranges for analog values.

2) Include span and range for analog inputs and outputs.

3) Include operating point and dead band for discrete inputs, and identify conditions where contacts are open, and when they close.

d. Control sequences.

7. Software interlocks:

a. Operation of system software interlocks.

8. HMI/HIM control:

a. Detailed description of the operator controls.

9. SCADA control:

a. Detailed description of the operator controls.

b. Setpoints, alarms, etc.

10. Indicators and alarms:

a. List any indicators and alarms specific to the loop that are not covered in the common control strategies.

11. Failure modes:

a. List any failure modes specific to the loop that are not covered in the common control strategies.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 COMMON FUNCTIONS

A. Common functions that are generally applicable to all loops or to many similar loops are described under the heading "General Control Loop Functions." These functions are not repeated in the descriptions for each individual control strategy.

B. General Control Loop Functions: The following general control system functions shall be provided:

1. All analog and discrete inputs to the dialers shall be displayed. Both RUNNING and OFF input states shall be displayed.

2. All analog inputs shall have instrument failure alarms when the input is below 0 percent or above 100 percent for a tunable time initially set at 10 seconds.

3. All discrete FAIL inputs shall be alarmed for a tunable time initially set at 10 seconds. Other discrete inputs shall be alarmed as noted in the control strategy descriptions.

4. Operational Readiness Testing (ORT) should include all discrete and analog alarms as well as status alarms. This should also include all operations (e.g., lift station pump controls for lead, lag alarms, etc.). All alarm should be tested through voice or text notification as needed.

5. Where alarms are specified in the control strategy descriptions or on the Drawings, alarms shall be initiated from the applicable inputs. If discrete inputs are not available, the specified alarms shall be initiated from the applicable analog input; alarm set-points shall be operator adjustable.

6. All flow inputs and equipment run times shall be totalized and recorded. All totalized values shall be displayed. Runtime shall be displayed in tenths of an hour and be based on real-time accumulation.

7. When a level is less than 10 (e.g., ft, psi, mg/L, etc.) the precision shall be recorded in hundredths.

8. Displays shall be grouped functionally for ease of operation. Both analog and discrete functions associated with an item of equipment or a group of equipment shall be provided on the same display.

9. All PID control functions shall be provided with standard analog controller functions and operator interfaces including, but not limited to, the following:

    a. AUTO/MANUAL mode selection: In AUTO, the output of controller shall be based on the PID control calculation. In MANUAL, the output of the controller shall be constant, but operator adjustable. Transfer between operational modes shall be bumpless.

    b. OPERATOR/PROGRAM set point selection: In OPERATOR, the set point shall be operator adjustable from the equipment. In PROGRAM, the set point shall be adjusted by the associated PLC.

    c. Set point, process variable, and controller output shall be displayed.

    d. Provisions shall be included to prevent reset windup.

10. When equipment is tagged OUT OF SERVICE, by the operator all associated equipment shall have their alarms inhibited until the tagged equipment is re-tagged IN SERVICE.

11. Speed indications and speed control set-points shall be displayed in Hz.

12. Wherever two or more pieces of equipment are provided for the same functions, the equipment shall be alternated after each use.

13. All motorized equipment with status contact indication in SCADA shall have:

    a. Totalized elapsed time (non-resetting)

    b. Totalized elapsed time (24-hour). Midnight reset, store and log previous day.

14. All VFD controlled equipment shall be configured for Ethernet control and monitoring by the associated PLC. SCADA display shall include, but not be limited to, the following:

    a. VFD Running Status

    b. VFD Fault

    c. VFD Speed Output (%)

    d. VFD Speed Feedback (%)

    e. Motor KW

    f. Motor Amps

END OF SECTION 40 61 96

SECTION 40 67 00 - CONTROL PANELS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall provide control panels, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section apply to local panels provided in equipment systems specified in other sections unless indicated otherwise in those sections.

1.2 REFERENCE STANDARDS

A. ASTM A 283 Low and Intermediate Tensile Strength Carbon Steel Plates

B. UL 508A Industrial Control Panels

1.3 SUBMITTALS

A. Submittals shall be furnished in accordance with Sections 01 30 00 – Vendor Submittals.

B. Shop Drawings: The Contractor shall submit shop drawings for each panel and enclosure provided under Division 40. The shop drawings shall completely define and document the construction, finish, layout, power circuits, signal and safety grounding circuits, fuses, circuit breakers, signal circuits, internally mounted instrumentation, face plate mounted instrumentation components, internal panel arrangements, and external panel arrangements. The submittal shall include the following:

1. A complete index shall appear in the front of each bound volume. Drawings and data sheets associated with a panel shall be grouped together with the panels being indexed by systems or process areas. Panel tagging and nameplate nomenclature shall be consistent with the requirements of the Contract Documents.

2. Scaled physical arrangement drawings drawn to scale that define and quantify the physical groupings comprising control panel sections, auxiliary panels, subpanels, and racks. Cutout locations with nameplate identifications shall be shown.

3. Front of panel layouts for all control panels.

4. Schematic/elementary diagrams shall depict all control devices and circuits and their functions.

5. Interconnection diagrams shall locate and identify all external connections between the control panel/control panel devices and associated equipment. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all panel ingress and egress points.

6. A bill of material that enumerates all devices associated with the control panel.

PART 2 - PRODUCTS

2.1 GENERAL

A. Environmental Suitability: Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided, as indicated, in order to maintain all instrumentation devices within 20 percent of the minimums and maximums of their rated environmental operating ranges. The Contractor shall provide all power wiring for these devices. Instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

B. The control panel shall be the source of power for any 120 VAC solenoid valves interconnected with the control panel. Equipment associated with the control panel shall be ready for service after connection of conductors to equipment, controls, and control panel.

C. Instrument power circuits shall be fed from the associated PLC panel.

D. Control panels shall not contain any voltages greater than 120VAC.

E. Unless indicated otherwise, control panels shall be housed in NEMA rated enclosures in accordance with Section 26 05 00 – Electrical, General. Panels shall be either freestanding, pedestal-mounted or equipment skid-mounted, as indicated. Internal control components shall be mounted on an internal back-panel or side-panel as required.

F. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks. Each control panel shall be provided with identified terminal strips for the connection of all external conductors. The Contractor shall provide sufficient terminal blocks to connect 25 percent additional conductors for future use.

G. Motor starters, where required, shall be in accordance with the specifications. Each motor starter shall be provided with contact closures for motor overload, local indication, and remote alarm. Discrete outputs from the control panel shall be provided by electrically isolated interposing relay contacts. Analog inputs and outputs leaving the envelope of the building shall be isolated 4-20 mA, 2-wire signals with power supply. All analog inputs and outputs shall be individually fused.

H. Control panel mounted devices shall be mounted a minimum of 3 feet above finished floor elevation.

2.2 CONTROL PANELS

A. Each PLC and remote I/O system and corresponding housing, including I/O modules, power supply modules, communication interface devices, and peripheral equipment shall be mounted inside a NEMA enclosure in accordance with Section 26 05 00 – Electrical, General. I/O wiring from the field to the remote I/O system shall be terminated on terminal blocks in the lower portion of the enclosure.

B. Materials: Panels shall be made of Grade 304 stainless steel. Panel section faces shall be No. 10 gauge minimum thickness for free standing panels and No. 14 gauge minimum thickness for wall mounted or pedestal mounted panels. Materials shall be selected for levelness and smoothness.

1. Relay rack high density type panels shall utilize standard relay racks with No. 14 gauge steel frame and supports.

2. Structural shapes and strap steel shall comply with ASTM A 283 - Low and Intermediate Tensile Strength Carbon Steel Plates, Grade C.

3. Bolting Material: Commercial quality carbon steel bolts, nuts, and washers shall be 1/2-inch diameter with UNC threads. Carriage bolts shall be used for attaching end plates. All other bolts shall be hex end machine bolts. Nuts shall be hot pressed hex, American Standard, heavy. Standard wrought washers shall be used for foundation bolts and attachments to building structures. Other bolted joints shall have SAE standard lock washers.

4. Enclosures shall be NEMA Type 3R if located in the Process Room and NEMA Type 12 if located in the electrical room.

C. Construction: Dimensions shall be in accordance with vendor's requirements. Elevations and horizontal spacing shall be subject to Engineer's approval.

D. Fabrication: End plates, top plates, and top closure panels (to hung ceiling) shall be provided when required by the material requisition. End plates, top plates, and top closure panels shall be removable with countersunk bolts to match panels. Top closure panels shall be furnished in lengths which match the widths of standard panels, except that one top closure panel may extend across two 4-foot 6-inch wide or five 2-foot wide standard panels. The vertical joints of these panels shall align with the vertical joints of the standard panels.

1. End closure or rear closure doors shall be provided where required. Such doors shall be flush fitting, gasketed, and be of the hinged lift-off type with lockable door handles. A common key shall be provided for all doors on one panel assembly. Removable access panels shall be provided with dished handle fasteners. Screwdriver 1/4 turn or Dzus type fasteners are not acceptable.

2. The flanged edges of all panels shall be straight and smooth. Corners shall be welded and ground smooth.

3. The face of the panel shall be true and level after angling.

4. All panel cutouts and holes may be cut or drilled by any standard method that does not cause deformation. Burrs shall be ground smooth.

5. Adjacent panels shall assemble with races flush. Gaps or cracks shall not be visible from the front of the assembled instrument board.

6. Stiffeners shall be welded to the back of panels, as required to prevent panel deformation due to the weight of face mounted instruments.

7. Panels shall be self-supporting as defined below.

E. Framework and Supports: The rear of each panel section shall have a steel framework assembled to it for supporting conduit, wireways, switches, piping, and instrument accessory Items such as relay or terminal enclosures, transducers, pressure switches, valves, and air relays.

1. The main framework shall be constructed of standard structural shapes. Special shapes such as "Unistrut" may be used for secondary supports. Framework must neither interfere with instrument connections nor interfere with access needed for maintenance or adjustments.

2. Steel framework shall extend 2-feet 4-inches back from the panel face or as indicated in the material requisition. Where indicated, individual adjustable leg supports shall be provided at the back of the framework so that the entire panel is self-supporting.

F. Preparation of Panel Surface: The following requirements apply to the front and rear face of the panel, both sides and the edges of all flanges, and the periphery of all holes or cutouts.

1. High spots, burrs, and rough spots shall be ground smooth.

2. The surfaces shall be sanded or sandblasted to a smooth, clean, bright finish.

3. All traces of oil shall be removed with a solvent.

4. The first coat of primer shall be applied immediately.

G. Instrument Finishing: The final coats applied to painted surface of instrument cases, doors, or bezels which are visible from the front of panels shall be manufacturer's standard unless otherwise indicated. Black Japan or "crinkle" finishes on instrument cases are not acceptable.

H. Mounting of Instruments: The panel vendor shall provide cutouts, and shall mount all instrument items indicated to be panel mounted, including any instruments indicated to be furnished by other vendors but installed in the panel.

1. The panel vendor shall also mount behind the panels other instrument accessory items as required for functionality as indicated.

2. Equipment mounted at the rear of panel shall be installed to allow for commissioning adjustments, servicing requirements, and cover removal.

3. Spare space shall be kept clear of wiring, etc., to give maximum space for future additions.

I. Panel Components:

1. Terminal Blocks.

a. Terminal blocks for power distribution and digital signals shall comply with the following requirements

a) Terminal blocks shall be UL rated for 600V, 30A minimum.

b) Terminal blocks shall have a compression-style screw clamp connection.

c) Terminal blocks shall be capable of accepting #12 AWG wire.

d) Terminal blocks directly associated with digital I/O signals shall be two-tier with pre-manufactured jumper bars for distribution of common signals.

b. Terminal blocks for analog signals shall comply with the following requirements:

a) Terminal blocks shall be UL rated for 300V, 20A minimum.

b) Terminal blocks shall have a compression-style screw clamp connection.

c) Terminal blocks shall be capable of accepting #16 AWG wire.

d) Terminal blocks shall be three-tier sensor blocks for termination of signal positive, negative, and shield with pre-manufactured jumper bars for distribution of common signals.

c. Fuse blocks shall comply with the following requirements:

a) Fuse blocks shall be UL rated for 600V, 10A minimum.

b) Fuse blocks shall incorporate a hinged lever that accepts 5x20 mm fuses.

c) Fuse blocks shall have a compression-style screw clamp connection.

d) Fuse blocks shall be capable of accepting #12 AWG wire.

e) Fuse blocks shall contain blown-fuse indication through the use of a neon lamp or an LED.

d. All terminal blocks and fuse blocks shall be designed for DIN rail mounting. Extra deep 15 mm DIN rail shall be used.

e. Contractor shall provide terminal block end sections and end stops as necessary for a complete installation.

f. Terminal blocks and fuse blocks shall be provided with pre-printed snap-on label strips. Stick-on labeling is not acceptable. Labeling shall be consistent with Contractor's control panel drawings. Contractor shall clearly label all terminal blocks in every control panel; unlabeled terminal blocks are not acceptable.

g. Terminal blocks and fuse blocks shall be ABB, Allen-Bradley, or approved equal.

2. Instrument Power: All instruments requiring power that are wired to a PLC shall also have power supplied from the same PLC control panel. All instrument power sources shall be individually fused.

3. Signal surge suppressors. Signal surge suppressors shall be provided for all analog signals leaving the envelope of the building.

a. Signal surge suppressors shall be Phoenix Contact TT-2-PE-24DC or equal.

4. Control Relays. Control relays shall comply with the following requirements:

a. Relays shall be plug-in style with a DIN-rail mountable base.

b. Relays shall have on/off indication.

c. General purpose control relays shall have 24VDC or 120VAC coil as required for application. Relay contacts shall be rated 10 Amp at 120VAC or 125VDC. Contractor shall be responsible for quantity of contacts as required for application. New general purpose control relays shall be Allen Bradley 700-HA series or equal.

d. Digital output interposing relays shall be terminal block style. Allen Bradley 700-HL series or equal.

5. Intrinsically Safe Barriers. Relays shall be solid-state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe use in hazardous areas. Relays shall be located in non-hazardous areas. Relays shall be manufactured by GEMS, MTL, R.Stahl, Inc., or Turck.

6. Circuit Breakers. Circuit breakers for use in control panels shall be rated for 600V service.

a. Control panel circuit breakers shall be DIN-rail mounted.

b. Control panel circuit breakers shall be Allen-Bradley, Square D, or approved equal.

7. Surge Suppression. PLC control panels shall incorporate a transient-voltage surge suppressor on the incoming line. Surge suppressors shall be properly sized by the Contractor based upon the maximum current draw of the control panel.

    a. Surge suppressors shall be Innovative Technology, Leviton, or equal.

8. DC Power Supplies. PLC control panels shall be provided with a redundant DC power supply system containing two identical 24VDC power supplies and a redundancy module to regulate loading.

    a. DC Power Supplies shall be redundant. A redundancy module shall be used to regulate loading.

    b. Size DC power supplies based upon the actual 24V load. Power supplies shall not be loaded more than 50% of rated capacity.

    c. DC power supply systems shall be Sola HD SDN Series, ABB CP Series, or equal.

9. Digital Panel Indicators. Digital indicators shall be designed for semi-flush mounting in a panel. The indicator shall be a 3 1/2 digit LED, LCD, or gas discharge type display, with digits at least 0.5 inch high. The indicator shall be easily read at a distance of 10 feet in varying control room lighting environments. Operating temperature range shall be 32°F to 140°F. Accuracy shall be ±0.1 percent. The indicator shall be scaled in engineering units, with the units engraved on the display face or on the associated nameplate. The indicator shall have a selectable decimal point and shall provide over-range indication. Digital indicators shall be manufactured by Invensys/Eurotherm/Action Instruments, Newport Electronics, Precision Digital Corporation, or Red Lion Controls.

10. Selector Switches. Selector switches shall be 30.5-mm, heavy-duty, oil-tight type with gloved-hand or wing lever operators. Position legends shall be engraved on the switch faceplate. Switches for electric circuits shall have silver butting or sliding contacts, rated 10 amperes continuous at 120 V ac. Contact configuration shall be as indicated on the Drawings or for the application. Switches used in electronic signal circuits shall have contacts suitable for that duty. Switches shall be Eaton/Cutler-Hammer "10250T", General Electric "CR104P", or Allen Bradley “800T”.

11. Indicating Lights. Indicating lights shall be 30.5-mm, heavy-duty, oil-tight type, with full voltage LED lamps. Legends shall be engraved on the lens or on a legend faceplate. Lights shall be push-to-test type. Indicating lights shall be Eaton/Cutler Hammer "10250T", General Electric "CR104P", or Allen Bradley “800T”.

12. Pushbuttons. Push buttons shall be 30.5-mm, heavy-duty, oil-tight type. Legends shall be engraved on the push-button faceplate. Contacts shall be rated 10 amperes continuous at 120 V ac. Push buttons shall be Eaton/Cutler-Hammer "10250T", General Electric "CR104P", or Allen Bradley “800T”.

13. Alarm Horns. Horns shall be high-decibel, panel-mount, vibrating type designed for heavy-duty use. Horn volume shall be field-adjustable from 78 to 103 dB at 10 feet. Horns shall operate at 120 volts ac. Horns shall be weatherproof NEMA Type 4X. Horns shall be panel front mounted and shall be supplied with gasket. Horns shall be Edwards Signals "870P Series."Horns shall be supplied with a field mounted enclosure. Horns shall be Edwards Signals "876 series."

J. Electrical Requirements:

1. All conduit, wireways, switches, wire, and electrical fittings for 120 volt circuits to instruments and other electrical devices as required for a complete and operable installation.

2. Conduit, wireways, junction boxes and fittings shall be provided for signal wire, thermocouple, or resistance thermometer lead wire. Conduit or wireway runs shall include those required between temperature sensors and temperature transmitters and between the thermocouple wireway or junction box and instruments.

3. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. Wiring shall be identified with stamped tubular wire end markers.

4. PLC control panels shall be provided with a 15 amp, 120 volt, service outlet circuit within the back-of-panel area.

5. PLC control panels shall be provided with fluorescent light and door activated switch.

6. Wall mounted or pedestal mounted panels shall be so sized as to adequately - dissipate heat generated by equipment mounted in or on the panel.

7. Control panels mounted outside shall be provided with thermostatically controlled heaters that maintain inside temperature above 40 degrees F.

8. Wiring Methods: Wiring methods and materials for all panels shall be in accordance with the NEC requirements for General Purpose (no open wiring) unless otherwise indicated. Control Panels shall be UL508A listed Control Panels.

9. Signal and Control Circuit Wiring: Wire type and sizes: Conductor shall be flexible stranded copper machine tool wire, UL listed Type MTW, and shall be rated 600 volts. Wires, including shielded cables, shall be No. 16 AWG minimum.

   a. Wire Insulation Colors: Ungrounded control circuit conductors operating at the supply voltage shall have a black insulation. Grounded circuit conductors shall have white insulation. Insulation for ungrounded AC control circuit conductors operating at less than the supply voltage shall be red. Wires energized by a voltage source external to the control panel shall have yellow insulation. Insulation for ungrounded DC conductors shall be blue. Insulation for grounded DC conductors shall be white with blue stripe. Twisted pair wiring shall be positive (+) black and negative(-) white/clear.

b. Wire Marking: Wire numbers shall be marked using white numbered wire markers made from plastic-coated cloth, Brady Type B 500 or equal, or shall be heat shrink plastic.

c. Flexible conduit is not acceptable except when specifically approved by the Engineer in writing. Conduit fittings shall be Crouse Hinds cast fittings or equal.

d. Splicing of wires will only be allowed in junction boxes. Splices shall be either soldered or pressure crimped type.

e. For case grounding, panels shall be provided with a 1/4-inch by 1-inch copper ground bus complete with soderless connector for one No.4 AWG bare stranded copper cable. The copper cable shall be provided by the Contractor and be connected to a system ground loop.

10. Power Supply: Unless otherwise indicated control panel primary power supplies shall be 120 volt, 60 Hz circuits. 24VDC subsystems shall be provided for PLC control panels.

K. Labor and Workmanship: Panels shall be fabricated, piped, and wired by fully qualified workmen who are properly trained, experienced, and supervised.

L. At a minimum, control panels shall be constructed in a UL shop and contain UL labels prior to shipment.

2.3 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Provide and install UPS(s) to power all PLC hardware furnished under this Specification.

B. The UPS shall receive a 120 VAC, 60 HZ power input, and generate a 120 VAC, 60 HZ output signal which is protected from incoming spikes, sags, noise, brownouts, and power outages.

1. The UPS shall incorporate a transformer, a battery pack, a battery charger, an inverter, and a microprocessor based controller to provide continuous, on-line, computer grade uninterruptible power. Lighting and surge protection shall meet ANSI/IEEE c62.41 categories A and B. The UPS shall be U.L. listed. Spike attenuation shall be 2000 to 1. The output neutral shall be bonded to ground. Noise isolation shall be 120 Db common-mode, 60 Db normal mode. Output voltage regulation shall be + 3% with less than 5% total harmonic distortion. UPS efficiency shall be at least 85%. The UPS shall be rated for ambient temperatures from 32 degrees F to 104 degrees F and relative humidity from 0 to 95%

2. Each UPS shall maintain power to all of its connected loads, including non-constant loads such as alarms and printers, for a minimum of 15 minutes with a 50% growth factor over the connected load. The equipment submittal shall include sizing calculations which support the model and size selected. The UPS shall be supplied with a low output voltage cutoff to prevent damage to loads when the battery power is exhausted.

C. The equipment shall include sizing calculation which support the unit selected being able to power all its connected loads for the indicated time period with a 50% growth factor.

D. The uninterruptible power supply shall be Eaton Ferrups UPS series, Liebert, IPM or equal.

2.4 SPARE PARTS AND SPECIAL TOOLS

A. Control panel spare parts selected by the Engineer and special tools shall be furnished by the Vendor.

PART 3 - EXECUTION

3.1 LISTING AND INSTALLATION

A. Control panels shall be installed in accordance with the applicable specifications.

B. Control Panels shall be fabricated in accordance with UL 508A, and shall be UL Listed Industrial Control Panels.

3.2 EQUIPMENT DELIVERY

A. Panels shall be crated for shipment using a heavy framework and skids. Panel sections shall be cushioned to protect the finish of the instruments and panel during shipment. Instruments which are shipped with the panel shall further have suitable shipping stops and cushioning material installed to protect parts which could be damaged due to mechanical shock. Each separate panel unit shall be provided with removable lifting lugs to facilitate handling.

B. Shipments by air ride van unless otherwise indicated. Control panel testing and inspection, if required, shall be performed prior to shipping.

3.3 CONTROL PANEL SIGNAL AND CONTROL CIRCUIT WIRING

A. Wiring Installation: Wires shall be run in plastic wireways except (1) field wiring, (2) wiring between mating blocks in adjacent sections, (3) wiring from components on a swing out panel to components on a part of the fixed structure, and (4) wiring to panel mounted components. Wiring run from components on a swing out panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals.

B. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and be secured to the inside face of the panel using adhesive mounts.

C. Wiring to rear terminals on panel-mount instruments shall be in plastic wireways secured to horizontal brackets above or below the instruments in about the same plane as the rear of the instruments.

D. Shop Drawings shall show conformance to the above wiring installation requirements.

E. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on Shop Drawings. These numbers shall be marked on conductors at every terminal.

3.4 CALIBRATION, TESTING, AND INSTRUCTION

A. Calibration, testing, and instruction shall be performed.

B. Inspection and Approval: Panel fabricator shall conduct the following tests before shipment.

1. Alarm circuits rung out to determine their operability.

2. Electrical circuits checked for continuity and where applicable, operability.

3. Any other test required to place the panel in an operating condition.

C. It shall be the responsibility of the Contractor to furnish all necessary testing devices and sufficient manpower to perform the tests required by the Engineer.

D. Factory Acceptance Testing: PLC control panels shall be factory tested as required by Division 40 specifications.

E. Field Testing: Each control panel shall be tested again for functional operation in the field after the connection of external conductors and prior to equipment startup.

END OF SECTION 40 67 00

SECTION 40 71 76 - INSERTION-TYPE AIR FLOW METER

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall provide insertion-type flowmeters capable of measuring direct mass, volumetric, or velocity flow measurement. The flow measuring system must be in accordance with the Contract Documents. The transmitter and sensor will be remote design with appropriate length of interconnecting cable. Communications between the transmitter and receiving devices will be accomplished through dual analog outputs available on the transmitter.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 30 00 – Vendor Submittals.

1.3 QUALITY ASSURANCE

A. The insertion element shall be stainless steel and the electronics must be housed in a NEMA 4X (IP66) rated enclosure. The flowmeter must come with a one-year unconditional warranty from the date of substantial completion.

PART 2 - PRODUCTS

2.1 FLOWMETER

A. All meters shall be capable of operating at an ambient temperature ranging from 0 to 140 degrees F.

B. Temperature Compensation: 0 to 250 degree F

C. Media Compatibility: Air, compressed air, and Nitrogen

D. Pipe/Line Size Compatibility: 2 to 24 inches

E. Instrument Range: .75 to 400 SFPS

F. Flow Element Installation: Insertion

G. Flow Element Type: Thermal Dispersion using constant current measurement principle

H. Flow Element Construction: 316 stainless steel

I. Transmitter Enclosure: NEMA 4X aluminum with epoxy coating.

J. Transmitter Output Signal: 4-20mA or 0-10VDC, user assignable to flow rate and/or temperature.

K. Input Power: 18-36VDC or 85-265VAC

L. Digital Display: +/-9999 Counts LED, 0.45" H characters, user scalable flow rate units or 0-100%.

M. Manufacturers, or equal:

1. FCI ST50 Series Flowmeters

2. Equal must be approved during bidding process.

2.2 FLOW CONDITIONERS

A. A flow conditioning panel shall be applied with flow meters with inadequate straight-run conditions to ensure flow meter accuracy and repeatability.

B. A flow conditioner pressure drop calculation for the design flow rates shall be provided. Excessive pressure drop across the conditioner is unacceptable.

C. The air flow meter manufacturer shall provide a flow conditioner with each flow meter that is approved for use by their company. The flow meter shall be factory calibrated for use with the flow conditioner provided. Flow conditioner and meter shall be calibrated as single system on an NIST traceable calibration stand and shall be from the same manufacturer. A NIST calibration certificate shall be provided.

D. Flow conditioners shall be flanged or shall mount between flanges and be constructed of 316 stainless steel. Conditioners that mount inside of piping or are welded to piping shall not be acceptable.

E. Manufacturers, or approved equal:

1. FCI Vortab VIP insertion panel

2. Equal must be approved during bidding process.

PART 3 - EXECUTION

3.1 GENERAL

A. Insertion-type air flow meter shall be mounted in accordance with manufacturer instructions.

B. Final acceptance of the equipment is contingent on satisfactory operation after installation.

C. Flowmeters shall be calibrated in accordance with the Manufacturer's recommendations and Section 40 79 23 – Testing, Calibration, and Commissioning.

3.2 INSTALLATION

A. The meters shall be installed in easily accessible locations for ease of reading and maintenance. Where possible, all meters shall be installed in such a way to provide the manufacturer's recommended straight approach and straight piping downstream.

B. Install flow conditioner in the location required by the flow meter manufacturer to maintain the flow meter factory-calibration.

3.3 TESTING

A. Equipment shall be prepared for operational use in accordance with manufacturer's instructions, including bench test and calibration, where required.

B. Each item shall be subjected to an operating test over the total range of capability of the equipment.

3.4 MANUFACTURERS SERVICE REPRESENTATIVE

A. Erection and Startup Assistance: During erection and startup of the flow meters, the Vendor shall provide all necessary assistance from an experienced factory service representative to ensure a correct and first-class installation.

B. Instruction of Owner's Personnel: After completion of the installation and during startup of the plant, the Vendor shall instruct the Owner's personnel in the proper operation, maintenance and repair of all metering equipment.

END OF SECTION 40 71 76

SECTION 40 72 00 - LEVEL MEASURING SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall provide level sensing equipment in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 30 00 – Vendor Submittals.

1.3 QUALITY ASSURANCE

A. Calibration: All level sensing equipment shall be shipped to the project site factory calibrated and accompanied with certificate of such.

B. Warranty: All sensors shall be provided with manufacturer's standard one-year product warranty.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE PRESSURE SENSOR

A. Submersible pressure sensors shall consist of a transducer, transmitter/receiver, and control relays. The pressure sensing unit shall consist of a top half of a 316 stainless steel seal with a welded 316 stainless steel diaphragm. The liquid level shall be obtained by converting pressure sensed across a diaphragm-protected transducer element. A microprocessor shall amplify and convert the signal into a digital representation from pressure to a liquid level surface reading. An output is produced when manually determined trip values are exceeded. The microprocessor-based electronics shall enable user selection of range, span, setpoints, time delay, units of distance, and selectable failsafe mode. Relay setpoints shall be adjustable over the entire span without the use of reference targets. Automatic temperature compensation circuitry shall be incorporated.

1. Diaphragm: The diaphragm shall be glycerin-filled and be welded 316 stainless steel with a 0.13 cubic inch displacement.

2. Material: All wetted parts, including standoff ring, spacers, nuts and bolts shall be of 316 Stainless steel. The body shall be made of 300 stainless steel and shall be explosion-proof design. Cable shall be polyurethane-jacketed, and 40-ft shall be provided as standard.

3. Signal Output: A 4-20 MADC using 2-wire twisted pair grounded shield cable. FM and CSA explosion-proof and intrinsically safe with a response time less than 5 ms.

4. Accuracy: the pressure sensing transducer shall have a static accuracy of 0.25% FSO BFSL and a 1-year stability accuracy of 0.20% FSO.

5. Remote mounted units shall be provided with connecting cable provided by the manufacturer of the switches. Input power shall be 120 VAC.

6. Switches shall be SPBT with a minimum rating of 10 Amps at 120 V AC.

7. Repeatability shall be 0.1-inch or less with a response time of less than one second and an accuracy of plus or minus 0.25 percent of full scale.

B. Manufacturers, or equal

1. Blue Ribbon, Model BC001Birdcage TM

2. WIKA, LS-10 LevelGuard

3. Equal must be approved during bidding process.

2.2 NON-INTRUSIVE ULTRASONIC LEVEL SENSORS

A. Non-intrusive ultrasonic level sensors shall consist of a transducer, transmitter/receiver, and control relays. The sonic level switch transmitter shall generate pulses that are directed to the liquid level. The returning echo/signal shall be detected by the receiver. A microprocessor shall amplify and convert the signal into a digital representation of the distance from the reflecting surface. An output is produced when manually determined trip values are exceeded. The microprocessor-based electronics shall enable user selection of range, span, setpoints, time delay, units of distance, and selectable failsafe mode. Relay setpoints shall be adjustable over the entire span without the use of reference targets. Automatic temperature compensation circuitry shall be incorporated.

1. The transducer housing shall be PVC with corrosion resistant sensor element.

2. Remote mounted units shall be provided with connecting cable provided by the manufacturer of the switches. Input power shall be 120 V AC.

3. Switches shall be SPBT with a minimum rating of 10 Amps at 120 V AC.

4. Repeatability shall be 0.1-inch or less with a response time of less than one second and an accuracy of plus or minus 0.25 percent of full scale.

B. Manufacturer, or equal

1. SIEMENS HydroRanger 200

2. Equal must be approved during bidding process.

2.3 FLOAT SWITCHES

A. Float switch shall be a non-floating (tilting switch action only) SPDT submersible switch. The switch shall be intrinsically safe with a zener barrier between the switch contacts and the power source. The switch shall be sealed in a polypropylene housing with a submersible cable sealed in the float switch body. The switch shall be supplied with a cable with adequate length to reach the barrier location without splicing the cable.

PART 3 - EXECUTION

3.1 GENERAL

A. Final acceptance of the equipment is contingent on satisfactory operation after installation.

B. Level measuring systems shall be calibrated in accordance with the Manufacturer's recommendations and Section 40 79 23 – Testing, Calibration, and Commissioning.

3.2 INSTALLATION

A. The level measuring systems shall be installed in easily accessible locations for ease of reading and maintenance.

3.3 TESTING

A. Each item shall be subjected to an operating test over the total range of capability of the equipment.

3.4 MANUFACTURERS SERVICE REPRESENTATIVE

A. Erection and Startup Assistance: During erection and startup of the level measuring systems, the Vendor shall provide all necessary assistance from an experienced factory service representative to ensure a correct and first-class installation.

B. Instruction of Owner's Personnel: After completion of the installation and during startup of the plant, the Vendor shall instruct the Owner's personnel in the proper operation, maintenance, and repair of the equipment.

END OF SECTION 40 72 00

SECTION 40 73 00 - PRESSURE MEASURING AND DETECTION SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall provide pressure measuring systems in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Shop Drawings and Technical Manual shall be submitted in conformance with the requirements of Section 01 30 00 – Vendor Submittals.

1.3 QUALITY ASSURANCE

A. Warranty: All pressure measuring, and detection systems shall be provided with manufacturer's standard one-year warranty.

PART 2 - PRODUCTS

2.1 GENERAL

A. Pressure gauges shall be provided on suction and discharge connections to pumps; discharge connections from blowers and compressors; and each side of pressure reducing valves. Vacuum gauges shall be provided for vacuum pumps. In all locations (such as certain pump suction connections) where pressures may vary below and above atmospheric head, compound gauges shall be installed.

B. Diaphragm Seals: Pressure sensing devices shall be equipped with diaphragm seals, or equal protective pressure or vacuum sensing devices as per standard details shown on the drawings. Diaphragm seals shall be provided for all gauges, pressure transmitters, or pressure switches where fluid has medium solids (i.e., nonpotable or plant effluent), contains chemicals, is of a corrosive nature, or high temperature which could affect the accuracy of the pressure sensing device. Materials shall be suitable for the intended application.

C. Annular Seals: Gauges and pressure sensing devices shall be provided with a flanged annular seal for all high solids (raw sewage, scum, and sludge) applications, including clarifier scum and sludge, waste activated sludge, and return activated sludge.

2.2 PRESSURE AND VACUUM GAUGES

A. Gauges shall be industrial quality type with Type 304 or 316 stainless steel movement and stainless steel or alloy case. Unless otherwise shown or specified, gauges shall have a 4½-inch dial, ¼-inch threaded connection, a Type 304 or 316 stainless steel snubber adapter, and shut-off valve. Gauges shall be calibrated to read in applicable units, with an accuracy of ± 1 percent, to 150 percent of the working pressure or vacuum of the pipe or vessel to which they are connected. Gauges for pumps shall read in feet of water and all gauges for air piping shall read in psi. All gauges shall be vibration and shock resistant.

B. Approved manufacturers, or equal, as approved by Engineer

1. Ashcroft
2. Foxboro
3. Rosemont

2.3 DIFFERENTIAL AND GAUGE PRESSURE TRANSMITTERS

A. Electronic differential transmitters shall consist of a capsule assembly, bottom works, vent plug, drain plug, cover flange, process connector and connection, amplifier unit, integral indicator, terminal box with cover, block and bleed valves, and conduit connections. Pressure applied to the unit shall be transmitted by a sealed fill fluid to both sides of a sensing diaphragm. The sensing diaphragm and the sensor body shall function as the moving and fixed electrodes, respectively, of a differential capacitor. As the applied pressure causes the diaphragm to move, the capacitance of the cell shall change.

B. Performance Requirements: The amplifier unit shall convert the change in capacitance to a 4 - 20 mA DC signal, 2 wire type, with an allowable loop load of no less than 600 ohms. Static pressure rating shall be a minimum of 500 psig. The maximum overrange pressure limit shall be a minimum of 150 percent of the range. Span shall be adjustable over a minimum of 5:1 range. External adjustments shall include zero and span. Output signal damping shall be provided as an internal adjustment.

1. Equipment shall be suitable for an ambient operating range of minus 40 degree F to plus 212 degrees F.
2. The integral indicator shall be calibrated in process units.
3. Power supply shall be 24 VDC.
4. Accuracy, including linearity and repeatability, shall be a plus or minus 0.2 percent of span.
5. Differential pressure transmitters used for flow service shall include square root extraction to produce an output signal linearly proportional to flow.

C. Wetted parts, including block and bleed valve parts, shall be constructed of Type 316 stainless steel.

D. Approved manufacturers, or equal, as approved by Engineer

1. With local indicator and controller:

    a. Foxboro

    b. Rosemount

    c. Yokogawa

2. Without local indicator and controller:

    a. Noshok

    b. SICK

2.4 ADJUSTABLE PRESSURE SWITCH

A. Adjustable pressure switches shall be diaphragm-actuated, dual adjustment pressure switches with SPDT contacts rated for a minimum of 5 Amps at 120 V AC. The dead band shall be adjustable up to 60 percent of full scale. Set points shall fall between 20 and 80 percent of the adjustable range. The diaphragm shall be Buna-N, and the lower housing shall be brass with a 1/4-inch bottom sensing connection, unless otherwise indicated.

B. Approved manufacturers, or equal, as approved by Engineer

1. United Electric

2. Ashcroft

2.5 DIAPHRAGM SEALS

A. Diaphragm seals shall consist of bottom housing, lower ring, diaphragm capsule, fill screw, flushing connection, and a top housing.

1. The diaphragm seal shall have a removable bottom housing to permit servicing.

2. The diaphragm seal shall be factory assembled to the corresponding pressure instrument and be factory-filled. The assembly shall be shipped with a tag reading "Do not disassemble for installation”.

3. Exposed surfaces housings shall be constructed of Type 316 stainless steel.

4. The diaphragm seal shall attach to the inlet connection of a pressure instrument to isolate its measuring element from the process fluid. The space between the diaphragm and the pressure element shall be completely filled with a suitable liquid. Displacement of the liquid fill in the pressure element through the movement of the diaphragm shall transmit process pressure changes directly to a gauge, transmitter, switch, or other pressure instrument.

B. Materials of Diaphragm: Seals shall be of Type 304 or 316 stainless steel with stainless steel diaphragm for pressure over 15 psi and elastomer diaphragm for pressure of 15 psi and less. Type 316 stainless steel nuts and bolts, fill connection and valved flush port size ¼-inch NPT capable of disassembly without loss of filler fluid.

C. Approved manufacturers, or equal, as approved by Engineer

a. Ashcroft Model 101

b. U.S. Gauge (Ametek) SG

c. Marshalltown Series 225-01

2. Snubber Manufacturers, or equal

a. Cajon Company

b. Weksler Instruments, Corp.

2.6 ANNULAR SEALS FOR PRESSURE MEASURING SYSTEMS

A. Annular seals shall consist of a bolt-through Isolator Ring and Type 304 or 316 stainless steel calibration/evacuation accessory. Any required instrument manifolds shall be Type 316 stainless steel, minimum size of ½" with NPT connection of size required for pressure sensing device. Pressure transmitters, switches and gauges shall be shipped to annular seal manufacturer for factory assembly, evacuation and calibration.

B. Isolator ring shall include a valve and/or quick release device to allow instruments to be removed while the piping is in service and to prevent loss of fill fluid.

C. Materials of Diaphragm: Seals shall be of Type 304 or 316 Stainless Steel for center section and end plates with Neoprene or EPDM diaphragm. Fill fluid shall be Silicone Fluid.

D. Approved manufacturers, or equal, as approved by Engineer

a. Onyx Valve

b. Ashcroft

PART 3 - EXECUTION

A. Pressure measuring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested.

END OF SECTION 40 73 00

SECTION 40 74 00 - TEMPERATURE MEASURING SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall provide temperature-measuring systems in accordance with the Contract Documents.

1.2 SUBMITTALS

A. The Vendor shall submit manufacturer's information for Engineer review in accordance with Section 01 30 00 – Vendor Submittals.

1.3 QUALITY ASSURANCE

A. Warranty: All temperature measuring systems shall be provided with manufacturer's standard one-year product warranty.

PART 2 - PRODUCTS

2.1 TEMPERATURE MEASURING SYSTEMS

A. Insertion type resistance temperature detectors (RTDs) shall be 100 ohms nominal at 0 degree C, tip-sensitive, 3 wire platinum in 1/4-inch Type 316 stainless steel sheath with watertight potting. Time constant in agitated water shall not exceed 6.0 seconds. RTD shall comply with International Practical Temperature Scale (IPTS) 68 standards. Accuracy shall be plus or minus 0.1 degree C. Temperature transmitters shall be 2 wire devices with continuously adjustable span and zero adjustments, integral direct reading indicator, solid state circuitry, and a 4 - 20 mA DC output linearly proportional to the indicated temperature span. Where indicated with thermowells, RTDs shall be provided with 316 stainless steel thermowell, spring-loading device, extensions, union coupler, and explosion-proof aluminum connection head. Union shall extend out beyond the pipe lagging. Surface type RTDs shall be a 100 ohm nominal at 0 degree C, 3 wire platinum element in a flexible watertight case for strapping to a pipe surface.

B. Temperature transmitters shall be 2 wire devices with continuously adjustable span and zero adjustments, integral direct reading indicator, solid state circuitry, and a 4 - 20 mA DC output linearly proportional to the indicated temperature span.

C. Where indicated with thermowells, RTDs shall be provided with 316 stainless steel thermowell, spring-loading device, extensions, union coupler, and explosion-proof aluminum connection head. Union shall extend out beyond the pipe lagging.

D. Surface type RTDs shall be a 100 ohm nominal at 0 degree C, 3 wire platinum element in a flexible watertight case for strapping to a pipe surface.

E. Resistance temperature detector assemblies shall be Rosemount Series 78, Moore Industries Ready to Install, or equal. Transmitter shall be Rosemount Model 3144/644, Moore Industries Ready to Install RTI2, or equal.

F. Resistance temperature for room detection shall be Versis Industries TE Series wall temperature sensor or equal.

2.2 BIMETALLIC TEMPERATURE DETECTION SWITCHES

A. Temperature switches shall be bimetallic type with 3/4-inch NPT thermowell process connection per applicable piping code. Switches shall have SPOT -contacts and be provided with an adjustable setpoint.

B. Bimetallic temperature detection switches shall be Mercoid Series FM-437 (water and oil service), Honeywell, or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Temperature measuring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested.

END OF SECTION – 40 74 00

SECTION 40 75 43 – DISSOLVED OXYGEN MEASURING SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall provide dissolved oxygen (D.O.) measuring equipment in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 30 00 – Vendor Submittals.

1.3 QUALITY ASSURANCE

A. Calibration: All D.O. measuring equipment shall be shipped to the project site factory calibrated and accompanied with certificate of such.

B. Warranty: A written Manufacturer's warranty shall be provided for the equipment specified in this Section. The warranty shall be for a minimum period of one (1) year from the date of Substantial Completion equipment. The Vendor shall repair or replace all defects of materials or workmanship in the equipment.

PART 2 - PRODUCTS

2.1 DISSOLVED OXYGEN MEASURING SYSTEM

1. The dissolved oxygen (D.O.) monitoring system shall consist of a sensor, analyzer, and auxiliary equipment to facilitate mounting the D.O. monitoring system.

2. The system shall output a signal proportional to the dissolved oxygen level and the measured temperature. The analyzer shall meet NEMA 4X/IP66 requirements and shall be supplied with sufficient cable to connect the probes to the transmitter/indicators (22.9 feet minimum). The system shall be able to display the following parameters at a minimum:

    a. Dissolved Oxygen Concentration

    b. Temperature

    c. Relay Status

    d. Selected Salinity at Calibration

    e. Selected Value for Alarm Relays (High and Low Dissolved Oxygen)

    f. Error Pending and Error Log

    g. The system shall be able to perform automatic calibration of the dissolved oxygen monitoring system. The Power supply shall be 115 VAC, +10%, -15%.

3. The wetted probe shall sense the dissolved oxygen concentration via a luminescent sensor. The signal from the sensor shall be tied to the interface unit that will send all pertinent data to the PLC via ethernet cable. The dissolved oxygen transmitter shall be utilized for monitoring the dissolved oxygen concentration in the tank.

4. The measuring principle shall be based on luminescent material that is sensitive to oxygen.

5. Sensor replacement shall not require factory service personnel to be present. Calibration shall be accomplished in free air and will not require special chemical baths.

6. The interface unit shall be housed in a NEMA 4X/IP66 metal enclosure with a corrosion-resistant finish. The panel must be complete with terminal strips and wire ducts (if needed).

7. The interface unit shall be capable of managing a minimum of six (6) inputs.

8. Operation Characteristics:

    a. The dissolved oxygen probe shall be a continuous-reading probe that utilizes luminescent sensor technology.

    b. The probe will not require calibration more frequently than once every six months.

    c. The probe material shall be formed either Noryl® and 316 Stainless Steel or 316Ti, POM, and PVC. All parts of the probe shall be corrosion resistant and fully immersible.

    d. The sensor material shall be either poly butyl methacrylate or PMMA, PVC and silicone.

    e. The measurement range shall be 0.00 to 20.00 mg/L dissolved oxygen with an accuracy of ±0.2 ppm.

    f. The operation of the analyzers shall not be affected by H_2S, pH, K^{+1}, Na^{+1}, Mg^{+2}, Ca^{+2}, NH_4^{+1}, Al^{+3}, Pb^{+2}, Cd^{+2}, Zn^{+2}, $Cr_{(total)}$, Fe^{+2}, Fe^{+3}, Mn^{+2}, Cu^{+2}, Ni^{+2}, Co^{+2}, CN^{-1}, NO_3^{-1}, SO_4^{-2}, S^{-2}, $PO_4^{+}3$, Cl^{-1}, anion-active tensides, crude oils, or Cl_2.

    g. The sensor shall be supplied with a microprocessor-based analyzer. The analyzer shall contain a digital display with menu-driven software, two analog 4-20 mA outputs and 3 unpowered SPDT form ‘C’ alarm contacts. The controller shall be enclosed in a corrosion resistant IP66 enclosure.

    h. The probe shall provide electrolyte-free operation without the requirements of sample conditioning.

    i. The probe shall be furnished with a mounting kit.

    j. The temperature range is 0 to 50°C.

    k. The temperature accuracy is ± 0.2°C.

9. The dissolved oxygen sensor shall be suitable for submerged or flow through installation.

10. Spare Parts

    a. Supplier shall provide a minimum of one (1) spare DO probe for shelf stock.

    b. Supplier shall provide a minimum of one (1) spare interface unit (transmitter) for shelf stock.

11. Manufacturer of D.O. sensors and analyzers, or equal

    a. Hach LDO2 transmitter (Part No. 9020000) with Hach SC1000 controller (Part No. LXV402.99.12002) and Hach Sunroof and Mounting Hardware for SC1000 Controller (Part No. LZX957).

    b. YSI Optical DO with System 2020 3G – 20 Channel Terminal/Controller, IQ Sun Shield, and Rail Mounting Kit.

    c. Equal must be approved during bidding process

PART 3 - EXECUTION

3.1 SERVICE REPRESENTATIVE

A. Erection and Startup Assistance: During erection and startup, the Vendor shall obtain all necessary assistance from an experienced factory service representative to ensure a correct and first-class installation, in accordance with the manufacturer's instructions.

B. Instruction of Owner's Personnel: After completion of the installation and during startup of the plant, the Vendor shall instruct the Owner's personnel in the proper operation, maintenance, and repair of all equipment.

END OF SECTION 40 75 43

SECTION 40 79 23 – TESTING, CALIBRATION, AND COMMISSIONING

PART 1 - GENERAL

1.1 GENERAL PROCEDURES FOR INSPECTION, TEST, AND INSTRUMENT CALIBRATION

A. Each instrument shall be checked against the latest version of the design documents for tagging, manufacturer, model number, range, action, etc., before functional testing or calibration.

B. Any air system, permanent or temporary, used for energizing instrumentation shall be dry and clean at all times, and be blown down thoroughly before use. Any connection between the air supply system shall be via proper filter and regulator.

C. Plastic sealing plugs shall be used for all pneumatic connections and tubing except during test and immediately before final connection in the field.

D. Care shall be observed when connecting electric power supplies to the instrumentation. Insure correct voltage and frequency on AC power supplies. Insure correct voltage, polarity, and superimposed ripple on DC power supplies. Ensure correct polarity of the supply and proper grounding before connecting instruments.

E. The Vendor shall satisfy the requirement that the installation, calibration, and checkout of the instruments meet the requirements of the project specifications.

F. The calibration procedures for verifying instrument precision should conform to accepted practices as outlined in ASTM, ASHRAE, ISA, etc. specifications.

G. Copies of the manufacturer's installation and calibration instructions shall be provided to the calibration technicians prior to the commencement of calibration.

1.2 INSTRUMENT QUALITY LEVELS AND METEROLOGY

A. Instrumentation supplied for the calibrating sensing instruments for facility control system shall include documentation concerning the calibration method and traceability to the National Institute for Standards and Testing (NIST).

B. Process instrumentation shall be field checked for accuracy before installation even if the instruments have been calibrated by the manufacturer's metrology facilities.

PART 2 - PRODUCTS

2.1 CALIBRATION AND TEST EQUIPMENT

A. All calibration and test equipment shall be in proper working order and calibrated using traceable standards and equipment set by the NIST. Certificates of traceability shall be kept on file in the field calibration office or field project office. Copies of the traceability documents shall be included with the submittal of the calibration forms.

B. All calibration and test equipment shall carry a documented current calibration sticker reflecting the date of the last calibration and the name or initials of the technician who performed the calibration. A current calibration will be performed before the equipment is shipped to the site. The calibration equipment shall be shipped directly from the calibrating authority to the site, in packaging provided by the calibrating authority. A current calibration will be performed for all calibration or test equipment every 180 days or within the normal calibration interval, whichever is less.

C. Any field instruments calibrated with test equipment whose calibration has expired will be rejected and will be required to be recalibrated.

D. All calibration and test equipment shall be of a higher accuracy than the instrument being calibrated.

E. The Vendor shall supply calibration and test equipment of sufficient quantity, quality, and type to calibrate the instruments and sensors used in the installation.

2.2 BENCH TEST AND CALIBRATION FORMS AND METHODOLOGY

A. Calibration forms and calibration procedures for each instrument type shall be generated by the Vendor and approved by the Owner or his representative before proceeding with any calibrations. The manufacturer's procedures or the Owner's existing procedures shall form the basis for the calibration procedure.

B. The following format shall be used for instrument calibration form:

1. A separate calibration form shall be generated for similar types of instruments that have different accuracy and tolerance requirements.

2. The form shall contain as found and as calibrated data areas. The form shall contain areas for the calibrating and test instruments manufacture, serial number, and date of calibration.

3. The forms shall be filled out and signed in black ink.

4. Those instruments that can shall be calibrated on the bench under controlled conditions. Care shall be taken with those instruments that must be calibrated in the field to approximate the conditions of the bench test.

PART 3 - EXECUTION

3.1 GENERAL

A. The Vendor shall calibrate all instrumentation in an environment suitable to quality testing procedures. High accuracy comparative instruments or mechanisms shall be the standard against which instrument calibration is tested.

B. Verify that all process and test instruments have been calibrated and traceable to the NIST or other appropriate reference standards. Verify that a calibration sticker has been affixed to the instrument and that each instrument is within its calibration period at the time that the calibration is performed.

C. Each instrument shall be calibrated as per Owner approved calibration procedures and forms.

D. Each instrument shall have a calibration sheet completely filled out with all pertinent data related to the calibration and system. These calibration sheets shall be organized in a binder by system and turned over to the Owner at the completion of the project.

E. Instruments shall have a calibration sticker placed on the instrument. The sticker shall not be placed until the instrument has successfully completed the calibration procedure and the associated calibration form has been filled out and signed. The sticker shall bear the date of calibration and expiration and initials of the technician certifying calibration.

END OF SECTION 40 79 23

SECTION 43 05 01 – EQUIPMENT, GENERAL PROVISIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish each piece of equipment complete with its base, drives, shafting, couplings, controls, guards, and other appurtenances which are specified or are required for proper and safe operation.

B. Furnish any special tools or equipment required for proper operation maintenance, testing, or adjusting.

1.2 REFERENCE STANDARDS

A. Equipment shall be in accordance with the following standards, as applicable and as indicated in each equipment specification:

1.	AFBMA	Anti-Friction Bearing Manufacturers Association, Inc.
2.	ASTM	American Society for Testing and Materials
3.	ANSI	American National Standards Institute
4.	ASME	American Society of Mechanical Engineers
5.	AWWA	American Water Works Association
6.	ASHREA	American Society of Heating, Refrigerating, and Air Conditioning Engineers
7.	AWS	American Welding Society
8.	NFPA	National Fire Protection Association
9.	NEMA	National Electrical Manufacturers Association
10.	OSHA	General Industry Safety Orders

B. The following standards are referenced in this and other sections:

1.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800
2.	ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy and other Special Alloys
3.	ANSI B46.1	Surface Texture

4.	ANSI S12.6	Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors
5.	ASME B1.20.1	General Purpose Pipe Threads (Inch)
6.	ASME B31.1	Power Piping
7.	AWWA C206	Field Welding of Steel Water Pipe
8.	AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144-inches (100 mm through 3,600 mm)
9.	AWWA D100	Welded Steel Tanks for Water Storage
10.	ASTM A48	Gray Iron Castings
11.	ASTM A108	Steel Bars, Carbon, Cold-Finished, Standard Quality
12.	ASME B17.1	Keys and Keyseats
13.	ASME B106.1M	Design of Transmission Shafting

1.3 SUBMITTALS

A. Submittals shall be made in accordance with Section 01 30 00 – Vendor Submittals and the specific equipment specifications sections.

B. Shop Drawings: Furnish complete drawings and technical information for equipment, piping, valves, electrical and controls. Where indicated or required by the Engineer, Shop Drawings shall include clear, concise calculations showing equipment anchorage forces and the capacities of the anchorage elements.

C. Spare Parts List: The Vendor shall obtain from the manufacturer and submit at the same time as Shop Drawings a list of suggested spare parts for each piece of equipment. Vendor shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.

D. Operation and Maintenance Manual: Provide technical operation and maintenance manuals in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 ADAPTATION OF EQUIPMENT

A. The Vendor shall furnish equipment readily adaptable for installation and operation. Equipment furnished shall be compatible with all other equipment furnished under the Contract.

B. The Vendor shall assume full responsibility for all modifications of mechanical and electrical controls, equipment, wiring, piping, as required to accomplish function intended by the Contract Documents.

1.5 QUALITY ASSURANCE

A. Guarantees: Unless otherwise accepted herein, guarantee all equipment and its install required. Guarantees shall cover the following: (1) Faulty or inadequate design; (2) Improper assembly or erection; (3) Leakage, breakage, or other failure; and (4) Defective workmanship or materials.

B. Inspection, Start-up and Field Adjustment: The Vendor shall demonstrate that all equipment meets the specified performance requirements. Vendor shall provide the services of an experienced, competent, and authorized service representative of the manufacturer of each item of major equipment who shall visit the site of Work to perform the following tasks:

1. Assist the Installation Contractor in the installation of the equipment.

2. To inspect, check, adjust if necessary and approve the equipment installation.

3. To start-up and field-test the equipment for proper operation, efficiency, and capacity.

4. To perform necessary field adjustments, including programming services for set point adjustment, during the test period until the equipment installation and operation are satisfactory to the Engineer.

5. To instruct the Owner's personnel in the operation and maintenance of the equipment. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.

C. Quality and Tolerances: Tolerances and clearances shall be as shown on the Shop Drawings and shall be closely adhered to.

D. Machine Finish: The type of finish shall be the most suitable for the application and shall be shown in micro-inches in accordance with ANSI B46.1

PART 2 - PRODUCTS

2.1 GENERAL

A. Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damages and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weather-tight storage facilities prior to installation. For extended storage period, plastic equipment wrappers shall be avoided to prevent accumulation of condensate in gears and bearings. Equipment delivered to the Site with rust or corroded parts shall be rejected. If equipment develops defects during storage, it shall be disassembled, cleaned and recoated to restore it to original condition.

B. Identification Equipment Items: At the time of shipping, each item of equipment shall have a legible identifying mark corresponding to the equipment number in the Contract Documents for the particular item.

C. Protective Coating: Equipment shall be painted or coated in accordance with manufacturer recommendations. Non-ferrous metal and corrosive-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly and shipping.

D. Controls: Equipment and system controls shall be in accordance with the Contract Documents.

E. All flanges on equipment and appurtenances provided under this Section shall conform to ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise shown. All pipe threads shall be in accordance with ANSI/ASME B1.20.1.

F. Nameplates: Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate date describing the machine performance ratings.

G. Tools: The Vendor shall furnish one complete set of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of the equipment. Tools shall be of best quality hardened steel forgoing with bright finish. Wrench heads shall have work faces dressed to fit nuts. Tools shall be suitable for professional work and manufactured by Snap On, Crescent, Stanley, or equal. The set of tools shall be neatly mounted in a labeled toolbox of suitable design provided with a hinged cover.

H. Lubricants: Vendor shall lubricate all equipment prior to initial testing of the equipment. After successful initial testing, final testing, and satisfactory completion of startup testing as specified in Section 01 75 16 – Startup Procedures, the Vendor shall conduct one complete lubricant change on all equipment. In addition, the Vendor shall be responsible for the proper disposal of all used lubricants. The Owner will then be responsible for subsequent lubricant changes.

2.2 NOISE REQUIREMENTS

A. Noise Level: When in operation, no single piece of equipment shall exceed the OSHA noise level requirement of 105 dBA for one-hour exposure per day.

2.3 VIBRATION LIMITATIONS

A. Vibration frequencies shall span the range from 5.0 to 5,000 Hz. Where specified, measurements shall be obtained while the installed equipment is operating within the specified speed range.

B. Centrifugal Machines with Sleeve Bearings: Unless otherwise specified, centrifugal machines with sleeve bearing shafts shall not exhibit unfiltered RMS readings for vibration displacement in excess of the following:

Shaft speed range range, rpm	Displacement peak to peak, mils
Up to 900	3.5
901-1800	3.0
1801-3000	2.5
3001-4500	2.0
Above 4500	1.6

Displacement measurements shall be taken radially on the shaft at two points at each bearing. Measuring points shall be 90 degrees apart.

C. Centrifugal Machines with Antifriction Bearings: Unless otherwise specified, centrifugal machines with antifriction bearing shafts shall not exhibit unfiltered RMS readings for vibration velocity in excess of 0.12 inches per second. Velocity measurements shall be taken on one point of each bearing housing.

D. Positive Displacement Machines: Unless otherwise specified, positive displacement machines of the rotary, reciprocating and controlled volume types shall operate without any lateral or torsional vibration characteristics that may accelerate wear of the equipment. The Vendor shall provide manufacturer's certification that the manufacturer has inspected the machine under operating conditions and found it to comply with the manufacturer’s requirements.

E. Vibration Isolators: Air compressors, blowers, engines, and inline fans shall be provided with restrained spring-type vibration isolators or pads per manufacturer's written recommendations. Vibration isolations shall be provided with seismic restraint.

2.4 CRITICAL SPEED REQUIREMENTS

A. Unless otherwise specified, rotating mechanical equipment shall not exhibit critical speeds within the specified range of operating speeds and impeller blade pass frequencies. Critical speeds for equipment with rigid rotor systems shall be at least 20 percent greater than maximum operating speed and maximum impeller blade pass frequency, whichever is greater. Critical speeds for equipment with flexible shaft-rotor systems shall be at least 15 percent below minimum operating speed and 20 percent above maximum operating speed and blade pass frequency.

2.5 DRIVE TRAINS AND SERVICE FACTORS

A. Drive Trains and Service Factors: Service factors shall be applied in the selection or design of mechanical power transmission components. All components of drive train assemblies between the prime mover and the driven equipment shall be designed and rated to deliver the maximum peak or starting torque, speed, and horsepower. All of the applicable service factors shall be considered, such as mechanical (type of prime mover), load class, start frequency, ventilation, ambient temperature, and fan factors. Drive train components include couplings, shafts, gears, and gear drives, drive chains, sprockets, and V-belt drives. Unless otherwise indicated, the following load classification shall apply in determining service factors:

Type of Equipment	Service Factor	Load Classification
Centrifugal Fans	1.0	Uniform
Pumps		
Centrifugal or Rotary	1.0	Uniform
Reciprocating	1.8	Moderate Shock
Cranes or Hoists	1.25	Moderate Shock

B. Mechanical Service Factors

	Mechanical Service Factors
Uniform	1.25
Moderate Shock	1.50
Heavy Shock	2.0

C. For thermal rating adjustments such as start frequency, ambient temperature, and hourly duty cycle factor, ventilation factor, and fan factor, refer to gear manufacturer sizing information.

D. For service factors of electric motor, see Section 40 05 93 – Common Motor Requirements for Process Equipment.

E. Where load classifications are not indicated, service factors based on AGMA 514.02 shall be used for standard load classification and for flexible couplings.

2.6 SHAFTING

A. Shafting shall be continuous between bearings and shall be sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. Shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.

B. Design Criteria: All shafts shall be designed to carry the steady state and transient loads suitable for unlimited number of load applications, in accordance with ASME B 106.1 M - Design of Transmission Shafting. Where shafts are subjected to fatigue stresses, such as frequent start and stop cycles, the mean stress shall be determined by using the modified Goodman Diagram. The maximum torsional stress shall not exceed the endurance limit of the shaft after application of the factor of safety of 2 in the endurance limit and the stress concentration factor of the fillets in the shaft and keyway. Stress concentration factor shall be in accordance with ASME Standard B17.1 - Keys and KeySeats.

C. Materials: Shafting materials shall be appropriate for the type of service and torque transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as indicated unless furnished as part of an equipment assembly.

1. Low carbon cold-rolled steel shafting shall conform to ASTM A 108, Grade 1018.

2. Medium carbon cold-rolled shafting shall conform to ASTM A 108, Grade 1045.

3. Other grades of carbon steel alloys shall be suitable for service and load.

4. Corrosion-resistant shafting shall be stainless steel or Monel, whichever is most suitable for the intended service.

D. Differential Settlement: Where differential settlement between the driver and the driven equipment may occur, a shaft of sufficient length with sets of universal type couplings shall be provided.

2.7 BEARINGS

A. Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA).

B. To assure satisfactory bearing application, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and lubrication shall be considered in bearing selection.

C. All re-lubricatable type bearings shall be equipped with a hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.

D. All lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to insure maximum bearing life and best performance.

E. Anti-Friction Type Bearing Life: Except where otherwise indicated, bearings shall have a minimum L-10 life expectancy of 10 years or 20,000 hours, whichever occurs first. Where so indicated, bearings shall have a minimum rated L-10 life expectancy corresponding to the type of service, as follows:

Type of service	Design Life, years	L-10 Design Life, hours
	(Whichever comes first)	
8-hour shift	10	20,000
16-hour shift	10	40,000
Continuous	10	60,000

F. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as indicated or as recommended in the published standards of the manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.

G. Sleeve Type Bearings: Sleeve-type bearings shall have a steel, cast iron or ductile iron housing and Babbitt or bronze liner. Bearing housing shall be bolted and doweled to the lower casing half. These housings shall be provided with cast iron caps bolted in place and the bearing end caps shall be bored to receive the bearing shells. Sleeve bearings shall be designed on the basis of the maximum allowable load permitted by the bearing manufacturer. If the sleeve bearing is connected to an equipment shaft with a coupling, the coupling transmitted thrust will be assumed to be the maximum motor or equipment thrust. Lubricant, lubrication system, and cooling system shall be as recommended by the bearing manufacturer.

H. Plate Thrust Bearings: Thrust bearings shall be the Kingsbury Type, designed and manufactured to maintain the shaft in the fixed axial position without undue heating or the necessity of adjustment or attention. Bearings shall be oil lubricated to suit the manufacturer's standard method of lubrication for the specific bearing. If bearing cooling is required, manufacturer shall provide necessary piping, filters, and valves.

2.8 ELECTRIC MOTORS

A. All motors shall comply with requirements listed in Section 40 05 93 – Common Motor Requirements for Process Equipment. All variable frequency drive (VFD) controlled motors shall comply with NEMA MG-1 Design “B” requirements.

2.9 SPARE PARTS

A. Spare parts, where specified, shall be provided in clearly labeled boxes. Labels shall display “City of Aberdeen WWTP”, the major piece of equipment to which the part belongs, the part name, and the manufacturer's part number.

PART 3 - EXECUTION

3.1 PROTECTION

A. Box, crate, or otherwise completely enclose and protect all equipment during shipment, handling, and off-site storage. Responsibility for storage on the job site will be assigned to the Installation Contractor.

3.2 INSTALLATION

A. Equipment shall be installed in accordance with the manufacturer’s written recommendations. The Vendor shall select or recommend the size and type of coupling required to suit each specific application; installation shall be per equipment manufacturer's printed recommendations. All insulating connections shall be installed in accordance with the manufacturer's printed instructions.

B. Alignment: Equipment shall be field tested to verify proper alignment.

3.3 SERVICES OF MANUFACTURER

A. Inspection, Startup, and Field Adjustment: Where required by individual sections, an authorized, experienced, and competent service representative of the manufacturer shall visit the Site for the number of days indicated in those sections to witness or perform the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.

1. Installation of equipment

2. Inspection, checking, and adjusting the equipment and approving its installation

3. Startup and field testing for proper operation, efficiency, and capacity

4. Performing field adjustments during the test period to ensure that the equipment installation and operation comply with requirements

B. Instruction of the Owner's Personnel: Where required by the individual equipment sections, an authorized training representative of the manufacturer shall visit the Site for the number of days indicated in those sections to instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.

1. The representative shall have at least two years’ experience in training. A resume of the representative shall be submitted.

2. Proposed training material and a detailed outline of each lesson shall be submitted for review. Review comments from the Engineer shall be incorporated into the material.

3. The training materials shall remain with the trainees after the session. The Vendor shall videotape the training for later use by the Owner's personnel.

3.4 PACKAGED EQUIPMENT

A. When any system is furnished as pre-packaged equipment, the Vendor shall coordinate all necessary space and structural requirements, clearances, utility connections, signals, and outputs with Installation Contractor to avoid later change orders.

B. If the packaged system has any additional features (as safety interlocks, etc.) other than required by the Contract Documents, the Vendor shall coordinate such features with the Engineer and provide all material and labor necessary for a complete installation as required by the manufacturer.

3.5 FIELD TESTS

A. Where indicated by the individual equipment sections, equipment shall be field-tested after installation to demonstrate satisfactory operation without excessive noise, vibration, or overheating of bearings or motor.

B. The following field testing shall be conducted:

1. Start, check, and operate the equipment over its entire operating range. Vibration level shall be within the amplitude limits as indicated or as recommended by the reference applicable Standards.

2. Obtain, record and provide to Engineer concurrent readings of motor voltage, amperage, capacity, vibration, and bearing temperatures for each piece of major equipment.

C. The Engineer shall witness field testing. The Installation Contractor shall notify the Engineer of the test schedule seven days in advance.

D. In the event that any equipment fails to meet the test requirements, the equipment shall be modified and re-tested until it complies with the specified operating criteria.

END OF SECTION 43 05 01

SECTION 43 05 50 - EQUIPMENT MOUNTING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section specifies mounts, supports, and the anchorage for equipment and accessories.

1.2 REFERENCE STANDARDS

A. Federal Specifications

1.	MIL-A-907E	Anti-seize Thread Compound, High Temperature

B. Commercial Standards

1.	ASTM A 48	Gray Iron Castings
2.	ASTM A 193	Alloy Steel and Stainless Steel Building Materials for High Temperature Service
3.	ASTM A 194	Carbon and Allow Steel Nuts for Bolts for High Pressure and High Temperature Service
4.	ASTM A 307	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
5.	ASTM A 325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

1.3 SUBMITTALS

A. Calculations and shop drawings shall be submitted for all of the work required above in accordance with Section 01 30 00 – Vendor Submittals. Anchor bolt and expansion bolt submittals shall be in accordance with requirements specified herein. All calculations must be made and signed by a civil or structural engineer currently registered in the State of Idaho.

1.4 QUALITY ASSURANCE

A. Equipment anchorage calculations shall be provided by the Vendor according to manufacturer's recommendation, 2018 International Building Code and industry standards requirements, unless otherwise specified. All elements required to resist the calculated forces described herein or required by the equipment manufacturer shall be provided by the Vendor. The Installation Contractor shall furnish the anchoring hardware in accordance with the Vendor’s calculations.

PART 2 - PRODUCTS

2.1 GENERAL

A. Equipment mountings shall be as shown. All equipment located in floor slabs shall be mounted on concrete pads. Where a steel or cast base is shown or specified between the equipment and the concrete pedestal, it shall be hot-dip galvanized after fabrication.

B. For belt driven equipment shown as in-line and piggyback, the base shall be, rectangular and the motor shall always be behind and above the driven equipment and never over the driven equipment unless approved by the Engineer. Motor mounting hardware for any belt driven configuration shall allow for belt tension adjustment.

2.2 EQUIPMENT SUPPORTS AND FOUNDATIONS

A. Steel Bases: Structural steel bases shall be rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases, which may be "T" or "L"- shaped where shown. Pump bases for split case pump shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the base. Beam depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Grout holes shall be provided for the bases of all equipment where vibration isolation is not specified. Where vibration isolation is required, height saving brackets shall be employed in all mounting locations to provide a base clearance of one (1) inch.

2.3 CONNECTIONS

A. All pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment by Installation Contractor.

B. Flanges and Pipe Threads: All flanges on equipment and appurtenances provided under this Section shall conform to ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise shown. All pipe threads shall be in accordance with ANSI/ASME B1.20.1.

C. Unless otherwise indicated, equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greater of that noted in the general structural notes or as required by the governing building code, or 10 percent of gravity. Submitted design calculations for equipment supports shall bear the signature and seal of an engineer registered in the state wherein the project is to be built, unless otherwise indicated.

D. Couplings: Mechanical couplings shall be provided between the driver and the driven equipment. Flexible couplings shall be provided between the driver the driven equipment to accommodate sight angular misalignment, parallel misalignment, end float, and to cushion shock loads.

1. Unless otherwise indicated or recommended by the equipment manufacturer, coupling type shall be furnished with the respective equipment as follows:

Equipment Type	Coupling Type
Horizontal and end suction pumps	Gear or flexible spring
Vertical non-clog pumps, closed coupled	Flexible disk pack
Single stage centrifugal blowers	Flexible disk pack
Air compressors	Gear or flexible pack

2. Each coupling size shall be determined based on the rated horsepower of the motor, speed of the shaft, and the load classification service factor. The Contractor shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.

3. Taper-Lock or equal bushing may be used to provide for easy installation and removal of shafts of various diameters.

2.4 ANCHOR BOLTS

A. The Installation Contractor shall be responsible in providing anchor bolts for all equipment supplied to this project.

B. Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 25 percent, up to a limiting maximum oversizing of 1/4 inch. Minimum anchor bolt diameter shall be 1/2 inch. Anchor bolts shall be furnished with leveling nuts, the faces of which shall be tightened against flat surfaces as shown to not less than 10 percent of the bolt's safe tensile stress.

C. Tapered washers shall be provided where mating surface is not square with the nut.

D. Bolts, anchor bolts, nuts, and washers shall be Type 316 stainless steel, Class 1, conforming to ASTM A193 for bolts and to ASTM A194 for nuts. All threads on stainless steel bolts shall be protected with an antiseize lubricant suitable for submerged stainless steel bolts, to meet government specification MIL-A-907E. Buried bolts in poorly drained soil shall be coated the same as the buried pipe.

1. Antiseize lubricant shall be "PURE WHITE" by Anti-Seize Technology, Franklin Park, IL, 60131, AS-470 by Dixon Ticonderoga Company, Lakehurst, NJ, 08733, or equal.

E. Bolt Requirements: The bolt and nut material shall be free-cutting steel. The nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. All bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.

F. Bolts and nuts shall be installed with washers fabricated of material matching the base material of bolts, except that hardened washers for high strength bolts shall conform to the requirements of the AISC Specification. Lock washers fabricated of material matching the bolts shall be installed where indicated.

G. The length of each bolt shall be such that after the joint is made up, the bolt extends through the entire nut, but in no case more than 1/2-inch beyond the nut.

H. Adhesive Anchors: Unless otherwise indicated, all drilled, concrete or masonry anchors shall be adhesive anchors. No substitutions will be considered unless accompanied with ICBO report verifying strength and material equivalency.

1. Adhesive anchors are required for drilled anchors for indoor installations, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring reinforcing bars. Threaded rod shall be stainless steel Type 316. Epoxy adhesive shall be Hilti HIT RE 500 V3.

2. Unless otherwise indicated, glass capsule, polyester resin adhesive anchors will be permitted in locations not included above and shall be Hilti HVA or Cobra Anchors. Threaded rod shall be galvanized steel.

I. Expanding-Type Anchors: Expanding-type anchors if indicated or permitted, shall be galvanized steel expansion type ITW Ramset/Redhead "Trubolt" anchors; Hilti "Kwik-Bolt;" or equal. Lead caulking anchors will not be permitted. Size shall be as indicated. Embedment depth shall be as the manufacturer recommends for the load to be supported. Expansion type anchors which are to be embedded in grout may be steel. Non-embedded buried or submerged anchors shall be stainless steel.

J. Overhead Applications: Use Hilti HDA undercut anchors.

K. Miscellaneous Bolts and Nuts: ASTM A307

L. High Strength Bolts and Nuts: ASTM F3125 Grade A325

M. Concrete Anchors: Use cast in anchor bolts where required. Provide attachment to concrete with concrete anchors where shown on the drawings conforming to the following types. Use only type of concrete anchor shown on the drawings.

1. Expansion Anchors: Expansion anchors shall be wedge-type with a single piece three section wedge to anchor the stud in the hole. The stud nut and wedge shall be ANSI 304 stainless steel.

2. Adhesive Anchors: Adhesive anchors shall be an all thread rod with a nut. The all thread rod and nut shall be ANSI 304 stainless steel. The rod shall be anchored in the hole using a premeasured adhesive capsule consisting of vinyl urethane methacrylate adhesive.

3. Undercut Anchors: Undercut anchors shall be an undercut style with a brazed tungsten carbide edge on the undercutting end to perform the self-cutting undercut as the anchor is installed. The anchor shall cut and undercut bearing area of at least 2.5 times the nominal anchor bolt size. The anchor stud shall be ANSI 316 stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Each piece of equipment shall be anchored to resist a minimum lateral force required by the code, the manufacturer of the equipment or a lateral seismic force of 40 percent of the operating weight of the equipment, whichever is greater. This force shall be considered acting at the center of gravity of the piece under consideration. No equipment shall be anchored to vertical structural elements without written approval of the Engineer.

B. Equipment which is not vibration isolated shall be anchored directly to the, supporting floor system. In addition to the anchorage, all such equipment shall be internally designed so that all static and moving parts are anchored to the supporting framework to resist the imposed seismic force. All forces must be transmitted to the base in order to be anchored as required. Vibration isolated equipment shall be specially designed to meet these same requirements.

C. All piping, accessories, and appurtenances furnished with equipment shall be anchored to resist a lateral seismic force of 40 percent of its operating weight without excessive deflection. This force shall be considered acting at the center of gravity of the piece under consideration.

END OF SECTION 43 05 50

SECTION 43 05 60 – PROCESS EQUIPMENT TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Testing of mechanical equipment and systems.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. S1.4 Specification for Sound Level Meters.

B. Hydraulic Institute (HI).

1.3 SUBMITTALS

A. Schedule of factory tests and field tests as specified in Section 01 75 16 – Startup Procedures and this Section.

B. Test instrumentation calibration data.

C. Start-up plan as specified in Section 01 75 16 – Startup Procedures.

D. Test plan specified in this section.

E. Test result reports.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 QUALITY CONTROL TESTING AND REPORTING

A. Scheduling and notification:

1. Witnessed source quality control tests: Schedule test date and notify Engineer at least 30 days prior to start of test.

2. Field quality control tests: Schedule test date and notify Engineer at least 7 days prior to start of test.

B. Testing levels:

1. Test equipment based on test levels specified in the equipment section of this Project.

2. Requirements for Test Levels 1 to 4 are defined below.

3. Test levels apply for both Source (Factory) Quality Control Tests and Field Quality Control Tests as specified in the equipment sections of this Project.

4. If testing is not specified in the equipment section, provide Level 1 testing.

5. Requirements of Section 01 75 16 – Startup Procedures apply to Test Levels.

C. Witnessing: Source Quality Control Tests not witnessed unless specified otherwise in the equipment section or Section 01 75 16 – Startup Procedures; Field Quality Control Tests shall be witnessed.

D. Instrumentation: Provide necessary test instrumentation which has been calibrated within 1 year from date of test to recognized test standards traceable to the National Institute of Standards and Technology, Washington, D.C. or approved source. Properly calibrated field instrumentation permanently installed as a part of the Work may be utilized for Field Quality Control Tests.

E. Temporary facilities and labor: Provide necessary fluids, utilities, temporary piping, temporary supports, temporary access platforms or access means and other temporary facilities and labor necessary to safely operate the equipment and accomplish the specified testing. With Owner's permission, some utilities may be provided by fully tested permanently installed utilities that are part of the Work.

F. Test fluids:

1. Factory tests: Use water or air as appropriate at ambient conditions unless specified otherwise in the equipment section.

2. Field tests: Use specified process fluid at available conditions.

G. Pressure testing: Hydrostatically pressure test pressure containing parts in the factory at the appropriate standard or code required level above the equipment component specified design pressure or operating pressure, whichever is higher. Submit pressure test reports before shipping.

H. Test measurement and result accuracy:

1. Use test instruments with accuracies as recommended in the appropriate referenced standards. When no accuracy is recommended in the referenced standard, use 1 percent or better accuracy test instruments. Improved (lower error tolerance) accuracies specified elsewhere prevail over this general requirement.

2. Do not adjust results of tests for instrumentation accuracy. Measured values and values directly calculated from measured values shall be the basis for comparing actual equipment performance to specified requirements.

I. Field testing:

1. Submit test plan as specified in Section 01 75 16 – Startup Procedures and this section. Indicate test start time and duration, equipment to be tested, other equipment involved or required; temporary facilities required, number and skill or trade of personnel involved; safety issues and planned safety contingencies; anticipated effect on Owner's existing equipment and other information relevant to the test. Provide locations of all instruments to be used for testing. Provide calibration records for all instrumentation.

2. Perform general start-up and testing procedures as specified in Section 01 75 16 – Startup Procedures.

3. Prior to testing, verify equipment protective devices and safety devices have been installed, calibrated, and tested.

J. Reports: Submit reports for source and field-testing. Submit Source Quality Control Test result reports before shipping equipment to the field. Report features:

1. Report results in a bound document in generally accepted engineering format with title page, written summary of results compared to specified requirements, and appropriate curves or plots of significant variables in English units.

2. Include appendix with a copy of raw, unmodified test data sheets indicating test value, date and time of reading, and initials of person taking the data.

3. Include appendix with sample calculations for adjustments to raw test data and for calculated results.

4. Include appendix with the make, model, and last calibration date of instrumentation used for test measurements.

5. Include in body of report a drawing or sketch of the test system layout showing location and orientation of the test instruments relative to the tested equipment features.

3.2 EQUIPMENT TESTING, GENERAL

A. Tests for pumps, all levels of testing:

1. Test in accordance with applicable HI Standards in addition to the requirements in this and other sections.

2. Test tolerances: In accordance with appropriate HI Standards, except the following modified tolerances apply:

a. From 0 to plus 5 percent of head at the specified flows.

b. From 0 to plus 5 percent of flow at the rated design point head.

c. No negative tolerance for the efficiency at the specified flows.

d. No positive tolerance for vibration limits. Vibration limits and test methods in HI Standards do not apply, use limits and methods specified in this or other sections of the Specifications.

B. Tests for drivers: Test motors as specified in Section 40 05 93 Common Motor Requirements for Process Equipment. Test other drivers as specified in the driver equipment section.

3.3 REQUIREMENTS FOR VIBRATION TESTING

A. Definitions:

1. Peak-to-peak displacement: The root mean squared average of the peak-to-peak displacement multiplied by the square root of 2.

2. Peak velocity: The root mean squared average of the peak velocity multiplied by the square root of 2.

3. Peak acceleration: The root mean squared average of the peak acceleration multiplied by the square root of 2.

4. High frequency enveloping: A process to extract very low amplitude time domain signals associated with impact or impulse events such as bearing or gear tooth defects and display them in a frequency spectrum of acceleration versus frequency.

a. Manufacturers: One of the following or equal:

1) Rockwell Automation, Entek Group, "Spike Energy" analysis.

2) CSI, "PeakVue."

5. Low speed equipment: Equipment or components of equipment rotating at less than 600 revolutions per minute.

6. High speed equipment: Equipment and equipment components operating at or above 600 revolutions per minute.

B. Vibration instrumentation requirements:

1. Analyzers: Use digital type analyzers or data collectors with anti-aliasing filter, 12 bit A/D converter, fast fourier transform circuitry, phase measurement capability, time wave form data storage, high frequency enveloping capabilities, 35 frequency ranges from 21 to 1,500,000 cycles per minute, adjustable fast fourier transform resolution from 400 to 6,400 lines, storage for up to one hundred 3,200 line frequency spectra, RS232C data output port, circuitry for integration of acceleration data to velocity or double integration to displacement.

a. Manufacturers: One of the following or equal:

1) Entek-IRD, Division of Rockwell Automation, Enpac 1200 with applicable data analysis software or Entek Model 838 analyzer with built in printer.

2) Computational Systems Inc., (CSI) Division of Emerson Electric, Model 2120A, Data Collector/analyzer with applicable analysis software.

2. Analyzer settings:

   a. Units: English, inches/second, mils, and gravitational forces.

   b. Fast fourier transform lines: Most equipment 1,600 minimum; for motors, enough lines as required to distinguish motor current frequencies from rotational frequencies, use 3,200 lines for motors with a nominal speed of 3,600 revolutions per minute; 3,200 lines minimum for High Frequency Enveloping; 1,600 lines minimum for low speed equipment.

   c. Sample averages: Four (4) minimum.

   d. Maximum frequency (Fmax): 40 times rotational frequency for rolling element bearings, 10 times rotational frequency for sleeve bearings.

   e. Amplitude range: Auto select but full scale not more than twice the acceptance criteria or the highest peak, whichever is lower.

   f. Fast fourier transform windowing: Hanning Window.

   g. High pass filter: Minus 3 dB at 120 cycles per minute for high speed equipment. Minus 3 dB at 21 cycles per minute for low speed equipment.

3. Accelerometers:

   a. For low speed equipment: Low frequency, shear mode accelerometer, 500 millivolts per gravitational force sensitivity, 10 gravitational force range, plus/minus 5 percent frequency response from 0.5 hertz to 850 hertz, magnetic mount.

      1) Manufacturers: One of the following or equal:

      2) Wilcoxon Research, Model 797L.

      3) PCB, Model 393C.

   b. For high speed equipment: General purpose accelerometer, 100 millivolts per gravitational force sensitivity, 50 gravitational force range, plus/minus 3dB frequency response range from 2 hertz to 12,000 hertz when stud mounted, with magnetic mount holder.

      1) Manufacturers: One of the following or equal:

      2) Wilcoxon Research, Model 793.

      3) Entek-IRD Model 943.

C. Accelerometer mounting:

1. Use magnetic mounting or stud mounting.

2. Mount on bearing housing in location with best available direct path to bearing and shaft vibration.

3. Remove paint and mount transducer on flat metal surface or epoxy mount for High Frequency Enveloping measurements.

D. Vibration testing results presentation:

1. Provide equipment drawing with location and orientation of measurement points indicated.

2. For each vibration measurement take and include appropriate data on equipment operating conditions at the time vibration data is taken; for pumps, compressors, and blowers record suction pressure, discharge pressure, and flow.

3. When Vibration Spectra Data required:

a. Plot peak vibration velocity versus frequency in cycles per minute.

b. Label plots showing actual shaft or part rotation frequency, bearing inner and outer race ball pass frequencies, gear mesh frequencies and relevant equipment excitation frequencies on the plot; label probable cause of vibration peaks whether in excess of specification limits or not.

c. Label plots with equipment identification and operating conditions such as tag number, capacity, pressure, driver horsepower, and point of vibration measurement.

d. Plot motor spectra on a log amplitude scale versus frequency.

4. For low speed equipment, plot peak vibration displacement versus frequency as well as velocity versus frequency.

5. Provide name of manufacturer and model number of the vibration instrumentation used, including analyzer and accelerometer used together with mounting type.

3.4 TESTING LEVELS

A. Level 1 Quality Control Tests:

1. Level 1 General Equipment Performance Test:

a. For equipment, operate, rotate, or otherwise functionally test for 15 minutes minimum after components reach normal operating temperatures.

b. Operate at rated design load conditions.

c. Confirm that equipment is properly assembled, equipment moves or rotates in the proper direction, shafting, drive elements and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.

2. Level 1 Pump Performance Test:

a. Measure flow and head while operating at or near the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.

b. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in 40 05 93 Common Motor Requirements for Process Equipment or the applicable equipment section. Use actual driver for field tests.

c. Record measured flow, suction pressure, discharge pressure, and make observations on bearing temperatures and noise levels.

3. Level 1 Vibration Test:

a. Test requirement:

1) Measure filtered vibration spectra versus frequency in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component.

2) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.

b. Equipment operating condition: Test at specified maximum speed.

4. Level 1 Noise Test:

a. Measure unfiltered overall A-weighted sound pressure level in dBA at 3 feet horizontally from the surface of the equipment and at a mid-point of the equipment height.

B. Level 2 Quality Control Tests:

1. Level 2 General Performance Test:

a. For equipment, operate, rotate, or otherwise functionally test for at least 2 hours after components reach normal operating temperatures.

b. Operate at rated design load conditions.

c. Confirm that equipment is properly assembled, equipment moves or rotates in the proper direction, shafting, drive elements and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.

2. Level 2 Pump Performance Test:

a. Test 2 hours minimum for flow and head at the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.

b. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in 40 05 93 Common Motor Requirements for Process Equipment. Use actual driver for field tests.

c. Test for flow and head at 2 additional conditions; 1 at 25 percent below the rated flow and 1 at 10 percent above the rated flow.

d. Record measured flow, suction pressure, discharge pressure, and observations on bearing temperatures and noise levels at each condition.

3. Level 2 Vibration Test:

a. Test requirement:

1) Measure filtered vibration spectra versus frequency and measure vibration phase in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component; measure actual rotational speeds for each vibration spectra measured using photometric or other tachometer input connected directly to the vibration data collector.

2) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.

b. Equipment operating condition: Repeat test requirements at design specified maximum speed and at minimum speed for variable speed equipment.

c. Natural frequency test of field installed equipment:

1) Excite the installed equipment and support system in 3 perpendicular planes, use same planes as operating vibration measurement planes, and determine the as-installed natural resonant frequency of the driven equipment, the driver, gears and supports.

2) Perform test at each bearing housing, at each support pedestal, and for pumps on the suction and discharge piping.

3) Perform with equipment and attached piping full of intended service or process fluid.

4. Level 2 Noise Test:

a. Measure filtered A-weighted overall sound pressure level in dBA for each of 8 octave band mid-points beginning at 63 hertz measured at 3 feet horizontally from the surface of the equipment at mid-point height of the noise source.

C. Level 3 Quality Control Tests:

1. Level 3 General Equipment Performance Tests:

a. For equipment, operate, rotate, or otherwise functionally test for at least 4 hours after components reach normal operating temperatures.

b. Confirm that equipment is properly assembled, equipment rotates in the proper direction, shafting and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual noise, vibration or temperatures are observed.

c. Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure and temperature readings using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.

d. Bearing temperatures: During maximum speed or capacity performance testing, measure and record the exterior surface temperature of each bearing versus time.

2. Level 3 Pump Performance Test:

a. Test 4 hours minimum for flow and head at or near the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.

b. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in 40 05 93 Common Motor Requirements for Process Equipment. Use actual driver for field tests.

c. Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 15 minutes; for factory testing, test at other speeds may be omitted if test driver at reduced speeds is used for rated condition testing.

d. Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices are not required by the equipment section) and record observations on noise levels.

3. Level 3 Vibration Test:

a. Requirements: Same as Level 2 vibration test except data taken at each operating condition tested and with additional requirements below.

b. Perform High Frequency Enveloping Analysis for gears and bearings.

1) Measure bearing element vibration directly on each bearing cap in a location close as possible to the bearing load zone that provides a smooth surface and direct path to the bearing to detect bearing defects.

2) Report results in units of acceleration versus frequency in cycles per minute.

c. Perform Time Wave Form analysis for gears, low speed equipment and reciprocating equipment; plot true peak amplitude velocity and displacement versus time and label the period between peaks with the likely cause of the periodic peaks (relate the period to a cause).

d. Plot vibration spectra on 3 different plots; peak displacement versus frequency, peak acceleration versus frequency and peak velocity versus frequency.

4. Level 3 Noise Test: Measure filtered, un-weighted overall sound pressure level in dB at 3 feet horizontally from the surface of the equipment at mid-point height and at 4 locations approximately 90 degrees apart in plan view; report results for each of 8 octave band mid-points beginning at 63 hertz.

D. Level 4 Quality Control Tests:

1. Level 4 General Equipment Performance Test:

a. For equipment, operate, rotate, or otherwise functionally test for at least 8 hours after components reach normal operating temperatures.

b. Operate at rated design load conditions for1/2 the specified time; operate at each of any other specified conditions for a proportionate share of the remaining test time.

c. Confirm that equipment is properly assembled, equipment rotates in the proper direction, shafting and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual noise, vibration or temperatures are observed.

d. Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure and temperature readings using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.

e. Bearing temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.

2. Level 4 Pump Performance Test:

a. Test 8 hours minimum for flow and head; begin tests at or near the rated condition; for factory and field-testing, test with furnished motor at full speed.

b. Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 20 minutes or longer as necessary to measure required performance, vibration and noise data at each test condition.

c. Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices not required by the equipment section) and record observations on noise levels.

d. Bearing temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.

e. Perform efficiency and/or Net Positive Suction Head Required (NPSHr) and/or priming time tests when specified in the equipment section in accordance with the appropriate HI standard and as follows:

1) Perform NPSHr testing at maximum rated design speed, head and flow with test fluids at ambient conditions; at maximum rated speed, test at 15 percent above rated design flow, and 25 percent below rated design flow.

2) Perform efficiency testing with test fluids at maximum rated speed.

3) Perform priming time testing with test fluids at maximum rated speed.

3. Level 4 Vibration Test: Same as Level 3 vibration test.

4. Level 4 Noise Test: Same as Level 3 Noise Test except with data taken at each operating condition tested.

3.5 SOURCE QUALITY CONTROL

A. Test equipment as specified for each type of test at the test levels specified in equipment sections. Prepare and submit test reports as specified.

B. Inspection and balancing:

1. Statically and dynamically balance each of the individual rotating parts as required to achieve the required field vibration limits. Statically and dynamically balance the completed equipment rotating assembly and drive shaft components.

2. Furnish copies of material and component inspection reports including balancing reports for equipment system components and for the completed rotating assembly.

C. Critical speed of rotating equipment: Satisfy the following:

1. The first lateral and torsional critical speed of all constant, variable, and 2-speed driven equipment that is considered rigid such as horizontal pumps, all non-clog pumps, blowers, air compressors, and engines shall be at least 25 percent above the equipment's maximum operating speed.

2. The first lateral and torsional critical speed of all constant, variable, and 2-speed driven equipment that is considered flexible or flexibly mounted such as vertical pumps (vertical in-line and vertical non-clog pumps excluded) and fans shall at least 25 percent below the equipment's lowest operating speed.

3. The second lateral and torsional critical speed of all constant, variable, and 2-speed equipment that is considered flexible or flexibly mounted shall be at least 25 percent above the maximum operating speed.

3.6 FIELD QUALITY CONTROL

A. Test equipment as specified for each type of test at the test levels specified in equipment sections. Prepare and submit test reports as specified. Comply with latest version of applicable standards.

B. For variable speed equipment, conduct test to establish performance over the entire speed range and at the average operating condition. Establish performance curves for:

1. The speed corresponding to the rated maximum capacity.

2. The speed corresponding to the minimum capacity.

3. The speed corresponding to the average operating conditions.

3.7 VIBRATION ACCEPTANCE CRITERIA

A. Testing of rotating mechanical equipment: Tests are to be performed by an experienced, factory trained, and independent authorized vibration analysis expert.

B. Vibration displacement limits: Unless otherwise specified, equipment operating at speeds 600 revolutions per minute or less is not to exhibit unfiltered readings in excess of following:

Operating Speed (revolutions per minute)	Unfiltered (Overall) Peak-to-Peak Amplitude (mils)
	All Rotating Equipment
0 - 300	6.5
301 - 600	4.5
Note: For all equipment, axial shaft displacements not to exceed 50 percent of the maximum radial shaft displacements shown in the table relative to the casing.	

C. Vibration velocity limits: Unless otherwise specified, equipment operating at speeds greater than 600 revolutions per minute is not to exceed the following peak velocity limits:

Item	Unfiltered Overall Limit (inches per second)	Any Filtered Peak Limit (inches per second)
Non-Clog Solids Handling Centrifugal Pumps	0.35	0.25
Horizontal and Vertical In-Line Centrifugal Pumps (other than Non-Clog type)	0.18 (Input BHP 25 or less)	0.14 (Input BHP 25 or less)
	0.22 (Input BHP more than 25 but less than 100)	0.18 (Input BHP more than 25 but less than 100)
	0.25 (Input BHP 100 or more)	0.20 (Input BHP 100 or more)
Vertical Turbine, Mixed Flow, and Propeller Pumps	0.31 (Input BHP 100 or less)	0.22
	0.35 (Input BHP 125 or more)	0.25
Vertical Turbine, Mixed Flow, and Propeller Short Set Pumps	0.28 (Input BHP 100 or less)	0.21
	0.33 (Input BHP 125 or more)	0.24
Motors	See Applicable Motor Specification	
Gear Reducers, Radial	Not to exceed AGMA 6000-A88 limits	
Other Reducers, Axial	0.10	0.10
Centrifugal Fans and Blowers	0.15	0.10
Other Equipment, Radial	0.16	0.10
Other Equipment, Axial	0.10	0.10

D. Equipment operation: Measurements are to be obtained with equipment installed and operating within capacity ranges specified and without duplicate equipment running.

E. Additional criteria:

1. No narrow band spectral vibration amplitude components, whether sub-rotational, higher harmonic, or synchronous multiple of running speed, are to exceed 40 percent of synchronous vibration amplitude component without manufacturer's detailed verification of origin and ultimate effect of such excitation.

2. The presence of discernable vibration amplitude peaks in Test Level 2 or 3 vibration spectra at bearing inner or outer race frequencies shall be cause for rejection of the equipment.

3. For motors, the following shall be cause for rejection:

a. Stator eccentricity evidenced by a spectral peak at 2 times electrical line frequency that are more than 40 percent of the peak at rotational frequency.

b. Rotor eccentricity evidenced by a spectral peak at 2 times electrical line frequency with spectra side bands at the pole pass frequency around the 2 times line frequency peak.

c. Other rotor problems evidenced by pole pass frequency side bands around operating speed harmonic peaks or 2 times line frequency side bands around rotor bar pass frequency or around 2 times the rotor bar pass frequency.

d. Phasing problems evidenced by 1/3-line frequency side band spectral peaks around the 2 times electrical line frequency peak.

4. The presence of peaks in a High Frequency Enveloping spectra plot corresponding to bearing, gear or motor rotor bar frequencies or harmonics of these frequencies shall be cause for rejection of the equipment; since inadequate lubrication of some equipment may be a cause of these peaks, lubrication shall be checked, corrected as necessary and the high frequency envelope analysis repeated.

3.8 NOISE REQUIREMENTS AND CONTROL

A. Make measurements in relation to reference pressure of 0.0002 microbar.

B. Make measurements of emitted noise levels on sound level meter meeting or exceeding ANSI S1.4, Type II.

C. Set sound level meter to slow response.

D. Unless otherwise specified, maximum free field noise level not to exceed 85 dBA measured as sound pressure level at 3 feet from the equipment.

3.9 FUNCTIONAL AND OPERATIONAL TESTING OF EQUIPMENT

A. Functional testing as specified in Section 01 75 16 – Startup Procedures and this Section.

B. General checkout: Prior to operating equipment, inspect, test, and check supporting systems, including but not limited to power systems, control systems, piping systems, lubrication systems, and safety systems.

1. Test and calibrate instrumentation and electrical devices as recommended by manufacturer.

2. As a minimum for control systems associated with the equipment, perform the following:

a. Individual Loop Tests: Test from field device to intermediate terminations to controller and back to controlled element.

b. End-to-end test: Simulate input at field device and observe control system response at the final field control element.

3. Prior to testing, provide signed and dated certificates of calibration for test instrumentation and equipment.

C. Operation of related existing equipment: Owner will operate related existing equipment or facilities necessary to accomplish the testing.

D. Acceptable tests: Demonstrate the equipment performance meets the requirements of this Section and the equipment section; when the equipment fails to meet the specified requirements, perform additional more detailed testing to determine the cause, correct, repair, or replace the causative components and repeat the testing that revealed the deficiency.

E. Operational testing: As specified in Section 01 75 16 – Startup Procedures, and individual equipment specifications.

END OF SECTION 43 05 60

SECTION 43 11 31 – ROTARY HELICAL SCREW BLOWERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The secondary treatment process Vendor (Section 46 53 36 – Integrated Fixed Film Activated Sludge System) shall provide positive displacement blowers for the secondary treatment process.

B. Furnish blowers complete with intake filter, intake and discharge silencers, pressure relief valve, check valve, discharge butterfly valve, pressure and temperature gauges, motor, v-belt drive, base plate, and all appurtenances specified. All piping required between the blower and the discharge butterfly valve shall be provided. Complete unit shall be assembled at the manufacturer's factory so that testing of operation and noise levels can be conducted and then disassembled for shipment to the jobsite.

C. Acoustic enclosures shall be provided with each blower.

D. Blowers will be installed by the Installation Contractor.

1.2 QUALITY ASSURANCE

A. Factory Testing: The supplier shall perform an open field noise test on the complete blower assembly (per ISO 2151) and submit certified noise test curves prior to shipment. The noise level shall be measured at four separate locations around the blower at the specified distance. The Owner reserves the right to witness this test at his own expense.

B. The blower shall be factory performance tested prior to shipment. A factory slip test of 1 psi shall be conducted. In addition, a performance test in accordance with ISO 1217 and the draft ASME PTC-13 shall be conducted. Certified test results shall be submitted.

C. Blower and blower accessories described by this Section shall be furnished by one supplier who shall be responsible for equipment start-up and the blower warranty.

D. Warranty: A written manufacturer’s warranty shall be provided for the equipment specified in this Section. The warranty shall be for a minimum period of one (1) year from the date of Substantial Completion equipment. The manufacturer shall repair or replace all defects of materials or workmanship in the equipment.

1.3 SUBMITTALS

A. The following submittals shall be made in accordance with Section 01 30 00 – Vendor Submittals:

1. Drawings showing general dimensions and confirming blower's piping connections, construction details, wiring diagrams and weight of major components.

2. Complete Performance Data at the Design Point and all specified operating points including:

    a. Actual Operating Speed (RPM) and % of maximum rated speed

    b. Capacity – scfm and icfm

    c. Design inlet conditions, pressure, temperature and RH%

    d. Discharge pressure

    e. dB(A) noise pressure level

    f. Blower Shaft HP, Motor HP and Package HP

3. List of recommended spare parts broken down into on hand parts and long term for 2 years operation and 3 to 5 years operation.

4. Descriptive Brochures

5. Performance Curves (for VFD applications)

6. Premium Efficiency Motor Data

7. Instrumentation and Wiring Diagram

8. ISO 1217 Factory Performance Test Results

9. Wire-to-Air Factory Performance Test Results based on the draft publication of PTC-13

10. ISO 8573-1 Class Zero Oil Free Certificate

11. Vibration isolation system.

12. The Vendor shall provide anchor bolt calculations made and signed by a civil or structural engineer currently registered in the State of Idaho.

B. Operation and Maintenance Manual consistent with Section 01 78 23 – Operation and Maintenance Data and including the following information:

1. V-belt drive adjustment instructions including sheave changes to adjust blower rotary speed

2. Impeller replacement

3. Bearing replacement

PART 2 - PRODUCTS

2.1 ENVIRONMENTAL CONDITIONS

A. Outdoor Air Temperature: 10°F to 105°F

B. Indoor Air Temperature: 40° to 90°F

C. Relative Humidity: 32-85%

D. Altitude: 4,400 feet MLS datum.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. The blowers shall meet the minimum performance requirements specified below.

Design Point	Corresponding Influent Load	% RH	Inlet Temp
1	25% More Air than needed for Design Load	32	105°F
2	Design Load	32	105°F
3	75% of Design Load	85	30°F
4	40% of Design Load	85	30°F

B. The blower noise shall not exceed 85 dBA at 3 feet per ISO Standard 2151. The blower manufacturer shall perform open field noise test as specified in paragraph 1.2 of this Section meeting the above condition. A sound attenuating enclosure shall be provided to meet the noise limitations.

1. The sound attenuating enclosure shall completely enclose the blower and intake/discharge silencers.

2. The sound attenuating enclosure shall accommodate HVAC ductwork to separately vent the blower from the rest of the building.

C. All blowers to be same model series. The blower shall be of the positive displacement type and rated for continuous duty.

D. Balance: Accurately machine rotating parts and place these parts in as perfect rotational balance as practicable.

1. The mass of each unit shall be such that resonance at normal operating speeds is avoided.

2. Excessive vibration shall be sufficient cause for rejection of the equipment.

2.3 CONSTRUCTION

A. GENERAL

1. Blower Packages shall be designed to minimize the life-cycle costs and maximize plant reliability. The design and the selection of the components shall be based on a minimum useful life of 20 years and a Mean Time between Overhauls of 5 years of continuous operation.

2. No special foundations shall be required. The packages will be installed directly on a concrete slab without grouting the base frame. There shall be only 4 easily accessible anchor points.

3. Manufacturer shall guarantee that the blower shall provide oil-free operation and be certified to ISO 8573-1 Class Zero.

4. The casing shall be of one-piece construction, with separate side plates that are bolted and pinned to the housing. Materials shall be close-grained cast iron ASTM A48 suitably ribbed to prevent distortion under the specified operating conditions. Inlet and outlet shall be flanged connections, not threaded.

5. The vibration level as measured at the casing, in the X/Y planes of the bearings, shall not exceed 0.3 "/ sec RMS when operating at the design operating pressures and speeds. The vibration level shall be checked at start-up and documented in the field start up report.

6. Each blower stage shall be factory performance tested in accordance with ISO 1217 and the draft ASME PTC-13 standards to verify flow and brake horsepower. A slip test shall not be acceptable. The acceptance criteria are +5% tolerance on power and –5% tolerance on flow regardless of the size of the machine.

7. Each rotor (male and female) shall be of the "stiff" design with first lateral critical speed at least 120% of the maximum allowable operating speed. The rotors shall operate without rubbing and shall not require lubrication. Rotors shall be drop forged in one single piece of AISI 1043 or equivalent. GG20 Cast Iron and open rotors are not acceptable. Rotors shall be statically and dynamically balanced per ISO1940/ANSI S2.19 G2.5.

8. Each impeller/shaft shall be supported by anti-friction bearings and fixed to control the axial location of the impeller/shaft in the unit. Regardless of theoretical bearing life calculations, the bearings shall be sized for a minimum expected life of 5 years between overhauls.

9. The impellers shall be timed by a pair of single helical gears with quality equivalent to AGMA 12. Gears shall have hardened and ground teeth and a minimum AGMA service factor of 1.70. Gears shall be mounted via hydraulic expansion onto the shafts with a tapered interference fit and secured by a locknut.

10. Seals shall be designed to prevent lubricant from leaking into the air stream as well as to prevent oil from leaking out of the machine. The seal shall consist of four rotary slip rings mounted in a retainer with an atmospheric air gap in the center. The rotor shaft shall be protected by a shaft sleeve. An O-ring shall be provided under the shaft sleeve to prevent oil migration along the shaft into the air conveying chamber.

11. The timing gears and the bearings shall be oil lubricated. Grease lubrication shall be not acceptable.

12. An oil sight glass shall be provided on the exterior of the noise enclosure so the operator can easily view the oil level. Sight glasses inside the enclosure or that cannot be easily viewed by the operator are not acceptable.

13. Painting shall be per supplier's standard meeting the following criteria. Excepted for machined sealing and machined mounting surfaces, the package shall be painted dark blue. Aluminum, stainless steel, and brass shall not be painted. The supplied motor shall not be over sprayed and will be supplied with the motor manufacturer's standard protection and paint color. Painted Cast Iron and Carbon Steel shall be Alkyd Resin Primer and Final coat with a total dry film thickness of 70 mils. Surface preparation SSPC10 or better. Sound enclosure shall be powder-coated polyester base total dry film thickness 80 mils. Galvanized components may only be painted with appropriate surface preparation.

14. Blower shall be in installed indoors and have a direct intake from the outside of the building.

B. BLOWER ACCESSORIES

1. Each package shall be supplied with one combination inlet filter and silencer. The filter media efficiency must meet the requirements of ASHRAE 52.2 MERV7 50-70% @3-10 microns corresponding to EN779 G4. The inlet filter and silencer shall be mounted directly to the inlet flange of the blower. The silencer portion shall be located upstream of the inlet filter. The filter element shall be designed to trap dirt on the inside so that upon changing, dirt does not fall into the machinery. Filter and silencer performance losses (clean element) shall be included in the entire package performance calculation.

2. Each package shall be supplied with one combination base frame/discharge silencer.

   a. The silencer shall be a chamber type design for maximum sound attenuation and shall not use internally any absorption materials of any kind (fibrous or otherwise). Fabricated of a single shell of pressure vessel quality steel with continuous welds, the silencer must be subject to a pressure test for tightness and strength at a minimum of 1.65 times the maximum design pressure. The silencer shall have a machined flanged inlet connection and bolts directly (to the discharge flange of the blower, with no intermediary or interconnecting pieces. Insulation shall be provided surrounding the discharge silencer to reduce the heat loss within the sound enclosure and keep the air temperature at the inlet of the blower as low as possible therefore contributing to a high -compression efficiency. Discharge silencer performance losses shall be included in the entire package pressure calculation.

b. The base frame is to be constructed from welded carbon steel that shall be designed to maintain alignment of the blower internal components and the drive during operation. It shall be designed to resist distortion while being installed on vibration isolating mounts. The manufacturer shall supply a stainless-steel grounding lug fully welded to the base.

3. Each package shall be provided with a flexible ANSI style discharge connector (and inlet connector if the specifications require the inlet air to be piped from outside). They shall prevent the transmission of noise and vibrations from the blower package into the piping. The flexible connectors shall be Proco or similar, with a standard ANSI flange connection.

4. Each package shall be supplied with a WEG manufactured TEFC high efficiency EFF1 motor that shall operate on 460 Volts, 3 Phase, 60 Hertz current, 3600 RPM, or equal. The motor will be mounted on a pivoting base to provide automatic tensioning of the belts. The motor nominal rating after any corrections for ambient conditions shall be 10% above the maximum operating horsepower. The motor shall have a 1.15 service factor and designed for inverter duty operation with a minimum 4 to 1 turndown. Domestic NEMA frame motors must be supplied. Imported IEC motors are not acceptable. Motor shall be supplied with an Aegis SGR bearing protection ring on the drive end and insulated bearings on the non-drive end of the motor to discharge capacitive induced shaft voltage.

5. Manufacturer shall be responsible for coordinating the starting torque requirement of the blower and the motor. Should an unloading valve be required, the blower manufacturer shall supply it. It shall be an automatic-type pneumatically operated valve requiring no electrical nor compressed air connections mounted upstream of the check valve.

6. Each package shall be supplied with a V-belt drive that shall be of the high capacity type, oil and heat resistant. Drive shall be designed for a minimum service factor of 1.4 times operating power (bhp), or 1.1 times the motor nameplate Hp, whichever is larger to allow a minimum of 1.4-service factor based on the maximum blower bhp. Belt tensioning shall be automatic without the use of any spring devices or interaction on the part of the operator. Slide rails shall not be used as a tensioning device. Sheaves shall be dynamically balanced regardless of the operating speed and hydraulically mounted on the blower drive shaft.

7. Each package shall be supplied with vibration isolating feet with a minimum efficiency of 80%. The manufacturer shall be responsible for attenuating noise and vibration in the package such that no special installation base shall be required, nor shall any additional measures be required to reduce vibrations from the package being transmitted to the base or the piping.

8. The belt drive shall be guarded in compliance with OSHA regulations. Portions of the guard shall be easily removable allowing for belt inspection and replacement. Guard material shall be perforated galvanized carbon steel.

9. Each package shall be supplied with a single pressure safety valve on the discharge side of the blower mounted downstream of the discharge silencer and upstream of the check valve. The safety valve shall be set to protect the machine from exceeding its maximum pressure rating and shall be sized to pass 100% of the design flow. The valve shall be field adjustable, spring loaded, and have a certificate of conformity to PED if operating above 15 psig. Since the package is supplied with a sound enclosure, the pressure safety valve shall also be housed inside and attenuated by the sound enclosure. The safety valve shall relieve hot air into a segmented and sealed section of the sound enclosure so that the hot air cannot re-enter the inlet of the machine.

10. Each package shall be supplied with one check valve that shall be installed on the discharge line. It shall be of the full-bore low pressure-drop, flapper type design with a steel body, and steel flap embedded in EPDM with full-contact seal. The valve shall be easily removable without disturbing the piping. Pressure losses produced by the check valve shall be included in the entire package performance calculation.

11. Each package shall be supplied with the following instrumentation:

    a. Digital Controller option, complete with:

        1) Intuitive TFT color touch screen display

        2) Display, monitoring, alarm, and shutdown of inlet pressure, discharge pressure, and discharge temperature.

        3) Display run hours

        4) Log errors and first out indication

        5) Track and log maintenance

        6) Equipped with Ethernet IP communication for integration with an Allen Bradley PLC.

12. Each blower shall receive its initial oil filling at the factory. Oil to be fully synthetic and rated for 16,000 hours of operation between change intervals.

13. Each package shall be supplied with a sound enclosure covering the entire blower package. The enclosure shall provide suitable protection for outdoor installation under the specified site conditions (wind load and snow load). The enclosure shall be designed to be able to install them side-by-side with all maintenance done from the front or back of the package. Details are as follows:

    a. Enclosure Panels shall be made of galvanized steel sheet, powder coated in a light reflecting, blue color per RAL 5001. The skid shall be of the same color. Sound enclosure acoustic material shall comply with UL 94 - HF1 for fire-retardant, self-extinguishing, non-dripping materials.

b. The enclosure and the blower package must be both mounted on a skid / oil-drip pan designed for meeting environment protection standards and for easy transportation and installation.

c. A grounding strap shall be installed between the blower base and the package skid to bypass any vibration isolating mounts for grounding continuity.

d. Quick release panels, each less than 50 lbs. (as mandated by MSHA) must provide easy and quick access for routine maintenance of the blower and the package components.

e. Ventilation fan shall be provided for cooling the sound enclosure. The fan shall be sized for sufficient heat removal from the sound enclosure, even when the blower is operated with a VFD. Cooling fan shall be driven separately by an electric motor (460v/60Hz). With the digital controller, a simple 460v/60Hz feed to the controller is sufficient and a built-in starter will feed power to the fan. The Installation Contractor shall provide wiring with the enclosure as well as a safety interlock that will shut down the main motor if the cooling fan stops operating.

f. To prevent possible operator damage, electrical components, instrumentation and instrument connections shall not be mounted or interface with moving panels of the sound enclosure.

g. Both blower oil sumps shall be piped to a common fill and drain, located at the front of the package for easy maintenance. An oil level indicator shall be mounted on the outside of the enclosure, which gives an accurate oil level indication while the blower is in operation. All oil lines shall be industrial-quality hydraulic hose and fittings.

14. Inlet Filter: The inlet filter shall be of heavy-duty flanged construction with high quality black paint and shall employ a high efficiency paper element. The paper element shall be replaceable and shall be of the dry, pleated paper type. The removal efficiency shall be 99.5 percent on 2-micron particles and 97 percent on 1-micron particles. The filter assembly shall be CCF series as manufactured by Universal Silencers or equal. The maximum initial pressure drop across the filter at the rated flow shall not exceed 2.5 inches W.C.

15. Pressure and Temperature Gauges: Each blower shall be provided with a 0-20 psig dial type discharge pressure gauge, a 0 to -40 inches water dial type inlet vacuum gauge, and a 0-350°F dial type temperature gauge connected to the discharge piping.

a. Pressure Gauges:

1) Inlet: The range shall be 0 to 40 inches water column vacuum and provide with vent valve.

2) Discharge: Provide a stainless-steel case, stem mount gauge with a shatter resistant window and a 2½-inch diameter face. The gauge shall be oil-filled measured units in psi. Suitable for use with 275 °F process air.

3) Minimum Accuracy: plus or minus 1.5% of full scale

4) Measurement Range: 0 to 20 psi

5) Furnish with compatible gage cock, snubber, and fittings for mounting to tap inside of blower piping.

b. Temperature Gauges: Provide suction and discharge gauges with stainless steel housing, multi-angle dial or straight form, Industrial bimetal type, Single scale, with a stem length sufficient to extend to middle of blower pipe plus or minus 1 inch (minimum length of 4 inches). The gauge shall measure in Degrees Fahrenheit and have two degrees maximum scale range. The blower suction shall read from -20 to 120 Degree F and the blower discharge shall read from 50 to 300 Degree F.

1) Minimum Accuracy: plus or minus 1.5% of full scale

2) Furnish with compatible fittings for mounting to tap inside of blower piping.

16. Air High Temperature Switch: A high temperature switch shall be mounted in the discharge piping of the blower. The switch shall be set at the maximum operating temperature of the blower and shall be wired to shut down the blower motor via the MCC in the event of excess discharge temperature. The temperature switch shall feature two normally open and one normally closed contact. Include a red-light alarm indicator and a manual reset pushbutton at the MCC.

C. Drives

1. Variable Frequency Drives shall be provided for each blower by the Installation Contractor.

2.4 ANCHORAGE AND FASTENERS

A. GENERAL

1. The Installation Contractor shall furnish all anchoring hardware for the supplied equipment.

2. The Installation Contractor shall furnish all epoxy and dispensing equipment for chemical anchoring.

3. The Vendor shall provide anchor bolt calculations made and signed by a civil or structural engineer currently registered in the State of Idaho.

2.5 SPARE PARTS

A. The following spare parts, unless not applicable to a certain blower, shall be furnished for each blower unit:

Blower Spare Parts	Quantity Furnished
Shaft Bearings	2
End Cover Oil Seal	1
Main Oil Seals	2
Gear Keys	1 pair
End Cover O-Rings	1
Gearbox Gasket	1
Gear End Bearing Carrier Gasket	1
Drive Belts	1

2.6 ACCEPTABLE MANUFACTURERS

A. The blower shall be furnished by one of the following manufacturers, or equal:

1. Aerzen
2. Kaeser
3. Equal must be approved during bidding process.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Follow manufacturer’s recommendations for equipment storage and handling.

B. Ship with openings sealed after injection of rust inhibiting powder.

C. Protect equipment, materials and accessories form exposure to the elements and keep thoroughly dry.

D. Store blowers, blower accessories, motors, and electrical equipment in a weathertight warehouse or comparable enclosure.

E. Box, crate and properly wrap and protect all spare parts.

F. Label spare parts containers indicating contents.

G. Hand rotate motor and blower shafts at frequency required by manufacturer to keep bearings properly lubricated and prevent flat spots form forming.

3.2 START-UP AND TESTING

A. Testing shall be conducted in accordance with Section 43 05 60, Process Equipment Testing.

B. After installation of all equipment has been completed and as soon as conditions permit, the manufacturer shall provide one (1) trip for a total of four (4), 8-hour days to verify the installation and conduct an acceptance test under actual operating conditions. The test shall consist of 3 hours operation of each package. The test shall insure that all package components are working properly, and vibration levels are within acceptable limits. Where possible, flow and pressure readings shall be recorded at 30-minute intervals. If required, the manufacturer shall make any changes, at his own expense, to the installation that may be necessary to assure satisfactory operation.

C. Open field noise tests shall be performed on each blower using metering equipment provided by the manufacturer. Noise levels shall be measured four (4) separate times at four (4) separate locations at a distance of three (3) feet from the blower. In the event the test results show that the blowers do not meet the specified noise level, modifications shall be made, and noise testing shall be repeated as required until the specified noise level is attained.

D. Manufacturer shall provide a written field test / start up report after completion of testing.

E. The manufacturer’s representative shall provide onsite operation and maintenance training to the Owner’s personnel for a minimum of four (4) hours. The Installation Contractor shall video tape the training session and provide a copy on DVD to the Owner.

END OF SECTION 43 11 31

SECTION 43 11 33 – ROTARY LOBE BLOWERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The secondary treatment process Vendor (Section 46 53 36 – Integrated Fixed Film Activated Sludge System) shall provide positive displacement blowers for the secondary treatment process.

B. Furnish blowers complete with intake filter, intake and discharge silencers, pressure relief valve, check valve, motor, coupling, base plate, and all appurtenances specified. Complete unit shall be assembled at the manufacturer's factory so that testing of operation and noise levels can be conducted and then disassembled for shipment to the jobsite.

C. Acoustic enclosures shall be provided with each blower.

D. Blowers will be installed by the Installation Contractor.

1.2 QUALITY ASSURANCE

A. Blower and blower accessories described by this Section shall be furnished by the blower manufacturer to the Vendor (Section 46 53 36 – Integrated Fixed Film Activated Sludge System). A packager who does not manufacture the specified blower will not be acceptable.

B. Factory Testing: The blower manufacturer shall perform an open field noise test on the complete blower assembly (per ISO 2151) and submit certified noise test curves prior to shipment. The noise level shall be measured at four separate locations around the blower at the specified distance. The Owner reserves the right to witness this test at his own expense.

C. The blower shall be factory performance tested prior to shipment. A factory slip test of 1 psi shall be conducted. In addition, a performance test in accordance with ISO 1217, Part 1, Annex C shall be conducted. Certified test results shall be submitted.

D. Warranty: A written manufacturer’s warranty shall be provided for the equipment specified in this Section. The warranty shall be for a minimum period of one (1) year from the date of Substantial Completion. The manufacturer shall repair or replace all defects of materials or workmanship in the equipment.

1.3 SUBMITTALS

A. The following submittals shall be made in accordance with Section 01 30 00 – Vendor Submittals:

1. Motor data submittal information.

2. Drawings showing general dimensions and confirming blower's piping connections, construction details, wiring diagrams and weight of major

components.

3. Parts list noting materials of construction.

4. Performance curves showing rated capacity, pressure, horsepower, and efficiency. Data shall include predicted temperature increase at each specified operating condition.

5. Lubrication requirements.

6. Rated bearing life.

7. Manufacturer's descriptive literature for intake filter and inlet and discharge silencers, including dimensional drawings, materials of construction and weights. Include noise attenuation data for silencers and particle removal efficiency data for filter.

8. The Vendor shall provide anchor bolt calculations made and signed by a civil or structural engineer currently registered in the State of Idaho.

B. The Vendor shall submit a copy of the equipment specification section with all addenda and all referenced specification sections. Each paragraph shall be check-marked to indicate specification compliance or marked to indicate deviations from the specification requirements. Check marks shall indicate complete compliance with the paragraph requirements. Deviations from the specification shall be indicated by underlining the deviation and marking the paragraph or line with a number or letter. The remainder of the paragraph not marked as a deviation shall indicate compliance with the requirements of the paragraph. The manufacturer shall prepare a detailed justification for each deviation. Failure to include the required specification sections and justification for deviations will indicate non-compliance and shall be rejected without further consideration.

C. Provide Operation and Maintenance Manual in accordance with Section 01 78 23 – Operation and Maintenance Data.

PART 2 - PRODUCTS

2.1 ENVIRONMENTAL CONDITIONS

A. Outdoor Air Temperature: 10°F to 105°F

B. Indoor Air Temperature: 40° to 90°F

C. Relative Humidity: 32-85%

D. Altitude: 4,400 feet MLS datum.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. The blowers shall meet the minimum performance requirements specified below.

Design Point	Corresponding Influent Load	% RH	Inlet Temp
1	25% More Air than needed for Design Load	32	105°F
2	Design Load	32	105°F
3	75% of Design Load	85	30°F
4	40% of Design Load	85	30°F

B. The blower noise shall not exceed 85 dBA at 3 feet per ISO Standard 2151. The blower manufacturer shall perform open field noise test as specified in paragraph 1.2 of this Section meeting the above condition. A sound attenuating enclosure shall be provided to meet the noise limitations.

1. The sound attenuating enclosure shall completely enclose the blower and intake/discharge silencers.

2. The sound attenuating enclosure shall accommodate HVAC ductwork to separately vent the blower from the rest of the building.

C. All blowers to be same size and model. The blower shall be of the positive displacement type and rated for continuous duty.

D. Balance: Accurately machine rotating parts and place these parts in as perfect rotational balance as practicable.

1. The mass of each unit shall be such that resonance at normal operating speeds is avoided.

2. Excessive vibration shall be sufficient cause for rejection of the equipment.

2.3 CONSTRUCTION

A. General

1. Blower(s) shall be installed indoors and have a direct intake from the outside of the building.

B. Materials

1. Casing and Impellers: Cast or ductile iron

2. Shaft: High carbon steel or ductile iron; turned, ground, and polished

3. Timing Gears: Alloy steel

4. Bearings: Antifriction, grease packed or oil lubricated. AFBMA rated L10 for 60,000 hours minimum life, continuous operation

5. Base: Fabricated steel; minimum moment of inertia 20 inches to the fourth power in X axis

6. Vibration Isolators: Rubber, Cork, or Cork-Rubber

7. Gaskets (if applicable): Durabla, Durlon 8500 Green

C. Casing

1. One piece with headplate(s).

2. Design to withstand at least twice the maximum required discharge pressure and reinforce with integrally cast ribs.

D. Impellers

1. Reinforced by internal ribs with outside surfaces machined.

2. Two lobe involute type, straight, and operate without rubbing.

3. Operate without liquid seals or lubrication and be positively timed by a pair of accurately machined heat-treated alloy steel, spur tooth, timing gears.

4. Statically and dynamically balance each impeller.

5. Impeller permanently fastened or part of the shaft.

E. Shaft

1. Cast integrally with the impeller or shall pass completely through the impeller, or stub shafts with impeller securely fastened.

F. Timing Gears and Lubrication

1. Mount on impeller shafts on a tapered fit and properly secured.

2. Enclosed in oil-tight housings.

3. Timing gears and bearings splash oil lubricated from oil slingers mounted on the driven shaft and dipping in oil.

4. Provide a lip type or piston ring oil seal, designed to prevent lubricant from leaking into the air stream.

5. Provide rotary piston ring shaft seals at the point where the shaft passes through the headplate.

6. Make provision to vent the impeller side of the oil seal to atmosphere to eliminate carry-over of lubrication into the air stream.

7. Provide lubricant level sight glass.

G. Drives

1. Type: Simple V-belt

2. V-belt Sheaves: Split tapered keyed hubs

3. V-belt drive guard

a. Enclose V-belt drives in a separate OSHA-approved sheet metal guard.

b. Guards of rugged design and fabricated from 16 gage steel (minimum).

c. Smooth exterior finish.

H. Base

1. Mount each blower and motor unit on a single full-length base with anchor bolt holes and jack screws for leveling.

2. If fabricated steel bases are furnished, continuously weld and grind smooth all seams and contact edges, plates and shapes. The base shall have an OSHA approved coupling guard and also anchor bolt holes and jack screws for leveling.

3. If cast iron bases are furnished, machine mounting surfaces.

4. Mount each base on suitable isolation pad.

2.4 ACCESSORIES

A. Inlet Filter: The inlet filter shall be of heavy-duty construction. The removal efficiency shall be 99.5 percent on 2-micron particles and 97 percent on 1-micron particles. The maximum initial pressure drop across the filter at the rated flow shall not exceed 2.5 inches W.C.

B. Inlet/Outlet Silencer: The inlet/outlet silencers shall be a chamber-absorptive type designed to provide pulse and noise control. The silencer shall be heavy duty, all welded construction, of carbon steel sheet and plate. Inlet and discharge nozzles shall be flanged. Exterior surfaces shall be shop-coated with a rust inhibitive primer and finish painted in the field. The silencer shall feature a drain plug. The blower inlet silencer shall be RIS series silencer and the blower discharge silencer shall be RD series silencer, both as manufactured by Universal Silencer, or preapproved equals.

C. Valves: A weight-loaded type pressure relief valve shall be provided on the blower discharge. The relief valve shall be sized to discharge 100 percent of the blower capacity and shall be set 0.5 psig above maximum blower discharge pressure.

1. Check valves shall also be supplied with each unit.

D. Flexible Connectors: The blower shall be provided with single arch flexible connectors on the outlet and inlet to eliminate any stresses on the blower. The flexible connectors shall have flanged ends suitable for service pressure of 15 psig maximum and 300°F temperature. The connector shall be constructed of chlorobutyl with a fiberglass/Kevlar fabric and shall be specifically designed for service at elevated temperatures.

E. Pressure and Temperature Gauges: Each blower shall be provided with a 0-20 psig dial type discharge pressure gauge, a 0-20 inch water column dial type inlet vacuum gauge, and a 0-350°F dial type temperature gauge connected to the discharge piping. Furnish with compatible fittings for mounting to tap inside of blower piping.

1. Pressure Gauges:

a. Inlet: Provide a Dwyer Series 2000 Magnehelic, Manotherm/Beierfeld, or preapproved equal. The range shall be a minimum of 0 to 20 inches water column vacuum and provided with vent valve.

b. Discharge: Provide a stainless steel case, stem mount gauge with a shatter resistant window and a minimum 2 ½-inch diameter face. The gauge shall be oil-filled measured units in psi and suitable for use with 275°F process air.

c. Minimum Accuracy: plus or minus 1% of full scale

d. Minimum Measurement Range: 0 to 20 psig

e. Manufacturer for Discharge Gauges:

1) Ashcroft Type 1009 Duralife

2) Manotherm/Beierfeld

3) Or preapproved equal

2. Temperature Gauges: Provide gauge with stainless steel housing, multi-angle dial or straight form, Industrial bimetal type, Single scale, with a stem length sufficient to extend to middle of blower pipe plus or minus 1 inch (minimum length of 4 inches). The gauge shall measure in Degrees Fahrenheit and have two degrees maximum scale range. The blower suction shall read from -20 to 120 Degree F and the blower discharge shall read from 50 to 300 Degree F.

a. Minimum Accuracy: plus or minus 1% of full scale

b. Manufacturer

1) Cole-Parmer Instrument Company

2) Or preapproved equal

F. Air High Temperature Switch: A high temperature switch shall be mounted in the discharge piping of the blower. The switch shall be set at the maximum operating temperature of the blower and shall be wired to shut down the blower motor via the MCC in the event of excess discharge temperature. The temperature switch shall feature two normally opened and one normally closed contacts. Include a red light alarm indicator and a manual reset pushbutton at the MCC.

G. V-Belts and Sheaves: The blowers shall be driven by a motor utilizing a V-belt and sheaves which shall be designed for a minimum service factor of 1.5. Two sets of V-belts and one set of sheaves shall be supplied for each operating condition specified.

H. Vibration Sensor: A vibration sensor and cut-out switch shall be included to shut down the unit in the event of excessive vibration.

I. Vibration Isolation Pad: Suitable vibration isolators shall be furnished with the blower base.

2.5 MOTORS

A. Polyphase induction design, rating and speed to meet blower requirements with a 1.15 service factor. The service factor shall not be used in establishing the nameplate rating.

B. Horizontal, TEFC, 1800 rpm (nominal, maximum). Power: 480 volts, 3 phase 60 hertz. Motor shall not overload over range of inlet air temperatures and discharge pressures.

C. Motors shall be high efficiency as tested per IEEE Procedure 112A, Method B.

D. Motor shall be provided with an OSHA approved belt guard.

E. Motors shall meet requirements specified in Section 40 05 93 - Common Motor Requirements for Process Equipment.

F. Blowers shall have inverter type motors for VFD drives.

2.6 SPARE PARTS

A. The following spare parts, unless not applicable to a certain blower, shall be furnished for each blower unit:

Blower Spare Parts	Quantity Furnished
Shaft Bearings	2
End Cover Oil Seal	1
Main Oil Seals	2
Gear Keys	1 pair
End Cover O-Rings	1
Gearbox Gasket	1
Gear End Bearing Carrier Gasket	1
Drive Belts	1

2.7 ANCHORAGE AND FASTENERS

A. GENERAL

1. The Installation Contractor shall furnish all anchoring hardware for the supplied equipment.

2. The Installation Contractor shall furnish all epoxy and dispensing equipment for chemical anchoring.

3. The Vendor shall provide anchor bolt calculations made and signed by a civil or structural engineer currently registered in the State of Idaho.

2.8 MANUFACTURER

A. The blower shall be furnished by one of the following manufacturers:

1. Gardner Denver

2. Kaeser

3. Aerzen

4. Or preapproved equal.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Follow manufacturer’s recommendations for equipment storage and handling.

B. Ship with openings sealed after injection of rust inhibiting powder.

C. Protect equipment, materials and accessories form exposure to the elements and keep thoroughly dry.

D. Store blowers, blower accessories, motors, and electrical equipment in a weather-tight warehouse or comparable enclosure.

E. Box, crate and properly wrap and protect all spare parts.

F. Label spare parts containers indicating contents.

G. Hand rotate motor and blower shafts at frequency required by manufacturer to keep bearings properly lubricated and prevent flat spots form forming.

3.2 START-UP AND TESTING

A. Testing shall be conducted in accordance with Section 43 05 60, Process Equipment Testing.

B. After installation of all equipment has been completed and as soon as conditions permit, the manufacturer shall provide one (1) trip for a total of four (4), 8-hour days to verify the installation and conduct an acceptance test under actual operating conditions. The test shall consist of 3 hours operation of each package. The test shall insure that all package components are working properly, and vibration levels are within acceptable limits. Where possible, flow and pressure readings shall be recorded at 30-minute intervals.

C. If required, the manufacturer shall make any changes, at his own expense, to the installation that may be necessary to assure satisfactory operation.

D. Open field noise tests shall be performed on each blower using metering equipment provided by the manufacturer. Noise levels shall be measured four (4) separate times at four (4) separate locations at a distance of three (3) feet from the blower. In the event the test results show that the blowers do not meet the specified noise level, modifications shall be made, and noise testing shall be repeated as required until the specified noise level is attained.

E. Manufacturer shall provide a written field test / start up report after completion of testing.

F. The manufacturer's representative shall provide onsite operation and maintenance training to the Owner's personnel for a minimum of four (4) hours. The Installation Contractor shall video tape the training session and provide a copy on DVD to the Owner.

END OF SECTION 43 11 33

SECTION 46 33 33 - POLYMER MIX UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The **Screw Press Manufacturer** (Section 46 76 27 – Sludge Dewatering Screw Press) shall furnish one skid-mounted polymer mix/feed unit per screw press (**one skid total**) provided together with all drives, motors, pumps, valves, piping, supports, tanks, wiring, and controls for complete and operable systems, in accordance with the requirements of the Contract Documents. The Installation Contractor shall provide complete installation of the polymer mix units.

B. Polymer mix/feed units shall be provided as part of the screw press equipment. Polymer units to be sized by the screw press manufacturer.

C. Manufacturer shall provide accessories indicated below.

D. The requirements of Section 43 05 01 - Equipment General Provisions apply to this section.

1.2 SUBMITTALS

A. Shop Drawings: The Manufacturer shall submit shop drawings in accordance with the requirements of Section 01 30 00 – Vendor Submittals.

B. At a minimum, shop drawings shall include complete fabrication, assembly, foundation, and installation drawings, together with detailed specifications and data covering materials used, parts, devices, supports, and other accessories forming a part of the equipment. In addition, shop drawings shall include the following information:

1. Polymer metering pump performance data showing head, capacity, horsepower demand, NPSH required, and pump efficiency.

2. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights. Assembly and installation drawings

3. Elevation of proposed local control panel showing panel-mounted devices, details of enclosure type, single line diagram of power distribution, and current draw of panel, and list of all terminals required to receive inputs or to transmit outputs from the local control panel.

4. Wiring diagram of field connections with identification of terminations between local control panels, junction terminal boxes, and equipment items.

5. Complete electrical schematic diagram.

C. The dilution water and post dilution water requirements shall be identified by the Manufacturer.

D. Owner's Manual: Provide operation and maintenance manuals in accordance with Section 01 78 23 – Operation and Maintenance Data.

E. Spare Parts List: A spare parts list shall contain the required information for each pump section.

1.3 QUALITY CONTROL

A. Warranty: The polymer blending system shall be covered by a minimum TWO (2) YEAR conventional warranty. The mixing chamber shall be covered by a LIFETIME warranty covering the repair or replacement of the mixing chamber or any part of the mixing chamber which fails for any reason, excluding weather related or over-pressure failures. In addition, the mixing chamber shall be warranted against plugging for any reason. If plugging occurs the mixing chamber shall be repaired or replaced at no cost to the owner. Metering pumps, options and accessories shall be covered by a minimum conventional one-year warranty. The full warranty shall be valid regardless of whether potable or non-potable dilution water having high solids content is used. The start of the warranty is from the date of Substantial Completion.

B. Manufacturer Qualifications: The polymer activation/feed system manufacturer shall have a record of at least ten installations during the previous 5 years.

C. Pre-assemble and factory test system to ensure compliance with pressure and operational requirements.

D. The approved system shall produce a completely homogenous polymer and water solution free of visible polymer agglomerations, or "fish-eyes".

PART 2 - PRODUCTS

2.1 GENERAL

A. The polymer mix/feed units shall be integrated equipment packages to automatically meter, dilute, mix, activate, and feed liquid/emulsion polymer and water. Concentrated polymer and water shall be blended in a completely back-mixed environment with a minimum 3 seconds of detention time at maximum throughput. Each unit shall include progressive cavity type polymer metering pumps, capable of pumping liquid or emulsion polymers with viscosities up to 75,000 cps. At no time shall the polymer be exposed to a rotating centrifugal pump impeller or other excessive shear.

B. The system shall be designed for use with either potable or non-potable dilution water. Where non-potable water is to be provided, supplier shall identify all water quality requirements necessary to produce a satisfactory polymer/water solution.

C. All components that require periodic maintenance shall be readily accessible.

2.2 MATERIALS OF CONSTRUCTION

A. The following material requirements will be strictly adhered to:

1. System skid: 304 stainless steel
2. Hardware: Type 18-8 stainless steel
3. Inlet and Outlet fittings: 304 stainless steel
4. Piping & pipe fittings: schedule 80 PVC
5. Tubing and tube fittings: polyethylene, polypropylene, stainless steel and Viton
6. Water solenoid valve: brass
7. Pressure gauges: stainless steel, liquid filled
8. Pressure switches: NEMA 4, brass connection
9. Flow meter: acrylic, stainless steel, PVC and or polypropylene
10. Water control valve: stainless steel with stainless steel seat
11. Mixing chamber body / flanges: stainless steel
12. Mixing chamber cover / chamber: clear polycarbonate
13. Mixing Chamber Discharge: stainless steel
14. Impeller: 304 stainless steel
15. Impeller shaft seal: Viton, stainless steel, ceramic, or carbon
16. Mixing chamber pressure relief valve: stainless steel
17. Metering pump wetted parts: stainless steel & Viton
18. Metering Pump Shaft Seals: Viton, stainless steel ceramic, or carbon
19. Control enclosure: FRP

2.3 POLYMER ACTIVATION & BLENDING CHAMBER:

A. These specifications are based on a multi-stage, multi-zone, Hydro-Mechanical polymer activation & blending technology. Alternate technologies will only be considered if proven to provide an equal level of performance, versatility, reliability and quality, otherwise the following technology will be provided without exception.

B. In order to provide control and versatility to optimize the performance of the wide range of polymers available and to optimize system reliability, a multi-stage Hydro-Mechanical

polymer blending technology shall be provided with both a non-mechanical and mechanical mixing stage:

C. Non-Mechanical Stage: To optimize reliability, the device shall be capable of activating and blending polymer based on plant water pressure alone at 30 psid or greater. Polymer shall be injected directly into a water jet by means of an injection quill positioned such that the non-mechanical mixing energy is in no way diminished prior to polymer and water contact. The non-mechanical zone shall be designed such that the velocity of the mixing energy producing water jet is maintained or increases as flow decreases.

D. Hydro-Mechanical mixing Stage: In order to provide optimal polymer performance under all operating conditions and to provide total control over mixing energy, in addition to the non-mechanical mixing stage the device shall be capable of producing its mixing energy independent of plant water pressure through a variable intensity, controllable stainless steel hydro-mechanical mixer. The mixing impeller shall be fully controllable and capable of inducing ultra high, non-damaging mixing energy at all flow rates. This shall be accomplished by controlling mixing intensity and preventing over exposure to, or damaging recirculation through the impeller. The polymer mixing impeller shall be designed to produce both axial and radial flow to optimize mixing effectiveness and to effectively inducing high, non-damaging mixing energy over the systems full flow range.

E. Mixers that rely solely on plant water pressure and or flow for mixing energy will not be acceptable. Mixers where performance is affected by flow rate and therefore retention time resulting in under or over exposure to mixing energy, or which rely on constant speed impellers or that rely on close tolerances for blending shall not be acceptable.

F. In order to prevent polymer build-up, the mixing chamber shall maintain high velocity in the entire chamber - at no time shall there be low velocity within any portion of the mixing chamber.

G. The mixing impeller shall be controlled by an SCR motor controller and driven by a wash-down duty motor. The motor shall be mounted horizontally or above the mixing chamber. Motors mounted under the mixing chamber where seal failure or leaks can damage the motor shall not be acceptable.

H. The mixer drive shaft shall be sealed by a mechanical seal which shall have an integrally mounted and factory plumbed seal flush. A drain hole behind the seal shall be provided in the mixing chamber to drain the polymer solution in case of a seal failure. The seal shall be easily accessible for replacement. Systems without a seal flushing system shall not be considered. Systems with holes in the mixing impeller to “pull” polymer away from the seal shall not be acceptable or used, as this feature fails to prevent polymer from coating the shaft seal face. All bearings shall be external from the mixing chamber. Internal bearings shall not be acceptable.

I. Both mechanical and non-mechanical mixing zones shall be clear polycarbonate to view the mixing action and blending effectiveness. Acrylic chambers prone to becoming brittle over time and cracking, or opaque pipe shall not be acceptable to meet this requirement. The clear cover shall have a stainless steel reinforced gusseted flange with a stainless steel discharge connection in order to handle maximum operating pressures.

J. The mixing chamber shall have a maximum rated pressure of 100 psi. Provide a pressure relief on the mixing chamber factory set at 75 psi.

K. Provide a neat polymer check valve specifically designed to isolate neat polymer from dilution water. The valve shall be designed with an open, unobstructed path to the valve seat. To minimize check valve plugging due to normally occurring polymer agglomerations, the minimum open area up to and including the valve seat shall be 3/16" without exception. The valve body shall be constructed of Teflon with Viton seals. The valve poppet and spring shall be stainless steel. The spring shall be outside of the polymer flow path to prevent build-up and plugging. The locking pin used to hold the valve in place shall be attached to the mixing chamber with a lanyard. The valve shall be readily accessible for cleaning and shall not require tools for removal, cleaning or replacement. Conventional check valves, valves that rely on ball seals, and or check valves that are installed inside the mixing chamber, or which require mixing chamber disassembly for servicing will not be accepted.

2.4 DILUTION WATER ASSEMBLY:

A. The dilution water flow rate shall be monitored by a Rotameter flow meter having the range as specified under paragraph 1.02 above. Unions or flanges shall be provided on the flow meter to allow easy removal for cleaning.

B. The unit shall have an electric solenoid valve for on/off control of total dilution water flow.

C. A differential pressure type low water differential pressure alarm shall be provided. The switch shall be adjustable between 9 and 60 psid. Static working pressure, 500 psi. The pressure switch shall be as manufactured by Ashcroft.

D. Provide a 2-1/2" stainless steel liquid filled pressure gauge to monitor dilution water inlet pressure.

2.5 PROGRESSIVE CAVITY NEAT POLYMER METERING PUMP

A. The unit shall have one (1) neat polymer metering pump(s) integrally mounted on the systems skid. The metering pump(s) shall have a range as specified under paragraph 1.02 above. The pump shall be a positive displacement, progressive cavity type constructed of stainless steel and Viton. The shaft seal shall be an adjustable packing type. Mechanical seals shall not be used. A 90 VDC wash-down duty motor shall drive the pump. A gear reducer shall be provided to produce a maximum pump shaft speed of not more than 545 RPM. The motor shall be controlled by an SCR motor controller located in the system control panel.

B. Provide a calibration column with two full port PVC ball valves having Viton o-rings. The column shall be calibrated for a one minute draw-down at maximum pump rate and read in GPH and milliliters. The calibration column shall be rigidly mounted to the systems frame with a minimum of two heavy duty brackets. Mounting the calibration to the neat polymer inlet piping shall not be acceptable. Provide a breather plug in the top of the calibration column designed to allow adequate displacement of air during calibration while preventing water or other foreign material from entering the calibration column.

2.6 SOLUTION DISCHARGE ASSEMBLY:

A. Provide a 2-1/2” stainless steel liquid filled pressure gauge to monitor system discharge pressure.

2.7 CONTROLS:

A. A control panel integral to the systems frame shall be provided. The enclosure shall be rated NEMA 4X and constructed of FRP. The control panel shall consist of all controllers, digital displays, potentiometers, switches, lights, relays, and other control devices required for a complete operable system. The control panel and all components shall be industrial duty. All skid mounted electrical components interconnected to the control panel shall terminate at numbered and labeled terminal blocks. The terminal blocks shall be sized for 14 ga. wire. Wires shall be neatly run through wire race-way and numbered with shrink tubing type labels. Adhesive labels shall not be used. The control panel shall be positioned such that there are no obstructions in front of the control panel per related NFPA requirements. Control.

B. Power: 120 VAC, 1Ph, 60 Hz.

C. A circuit breaker on the main control circuit and on each motor shall be provided as manufactured by Allen Bradley or equal. Fuses shall not be used for circuit protection.

D. Operator Interface – Discrete Selector Switch:

1. System ON / OFF(reset) / Remote

2. One-Turn Potentiometer – Mixer Speed

E. Status / Alarm Indicators:

1. Main Power ON

2. Display of Metering Pump Rate

F. Inputs (signals by others):

1. Remote Start / Stop (discrete dry contact)

2. Pacing Signal Based on Process Flow (4-20mA)

G. Outputs:

1. System Running (discrete dry contact)

2. Remote Mode (discrete dry contact)

3. Common Alarm (discrete dry contact)

2.8 SYSTEM SKID:

A. The system's frame shall be of rugged 304 stainless steel construction. No mild steel shall be used. All piping shall be rigidly supported.

B. Under no circumstance shall the pump suction exceed 5” from the bottom of the skid for progressive cavity pumps.

C. The skid shall have an integral stainless steel drip pan located under the neat polymer metering pump. Provide one dozen absorbent pads designed for oil and sized to fit within the drip pan.

D. The overall system footprint shall not exceed 34”W x 30”D.

2.9 SPARE PARTS

A. All polymer mix/feed pumps shall be furnished with the following spare parts:

1. One (1) progressive cavity pump stator.

2. One (1) progressive cavity pump shaft seal.

3. One (1) banding clamp tool for replacement of the progressive cavity metering pump pin joint banding clamps.

4. One (1) neat polymer check valve, complete.

2.10 MANUFACTURERS, OR EQUAL:

A. Velodyne

B. Engineer Approved Equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. The polymer mix/feed pumps shall be installed in accordance with approved procedures submitted with the shop drawings and per Screw Press Manufacturer’s written instructions, unless otherwise approved.

3.2 SERVICES OF MANUFACTURER

A. Inspection, Startup, and Field Adjustment: An authorized service representative of the Screw Press and/or Polymer Mix Manufacturer shall visit the site for one day to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation:

1. Installation of the equipment

2. Inspection, checking, and adjusting the equipment

3. Startup and field-testing for proper operation

4. Performing field adjustments to ensure that the equipment installation and operation comply with the specified requirements.

B. Instruction of the Owner's Personnel: An authorized training representative of the Manufacturer shall visit the site for one day to instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.

1. The representative shall have at least two year's experience in training.

2. Training shall be scheduled a minimum of three weeks in advance of the first session.

3. Proposed training material and a detailed outline of each lesson shall be submitted for review. Comments shall be incorporated into the material.

4. The training materials shall remain with the trainees.

5. The Installation Contractor shall videotape the training and provide one copy of the training on a DVD to the Owner.

C. For the purposes of this paragraph, a workday is defined as an eight-hour period, excluding travel time.

END OF SECTION 46 33 33

SECTION 46 53 36 – INTEGRATED FIXED FILM ACTIVATED SLUDGE SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Vendor shall furnish the process design, equipment, and process performance guarantee for an Integrated Fixed Film Activated Sludge (IFAS) system as specified herein. The system shall consist of two trains, each with an IFAS zone with media, and a polishing zone. In addition to the equipment shown below, technology licenses and patent infringement indemnification shall be included in the Vendor's scope. A single Vendor shall supply the process equipment for IFAS system in order to establish system performance responsibility. The equipment shall be installed by the Installation Contractor. Note that new 3 mm headworks screening will be provided upstream of the IFAS system.

B. Scope of Work: Equipment to be furnished by the Vendor under this section includes the following. Reference attached drawings for additional information.

1. Fixed film media

2. Screen assemblies with air sparging system, including valves

3. Medium bubble aeration system

4. Blowers (to be installed in a nearby building)

5. Instrumentation, including DO sensors, float switches, level probes, and air mass flowmeters

6. Control system, including PLC and HMI (to be installed in a nearby building)

C. The concrete tanks are existing and shall be modified by the Installation Contractor as required by the Vendor. The Installation Contractor shall provide the piping and equipment not specified in the Vendor's scope of supply.

D. The Installation Contractor shall provide a coagulant system for phosphorous removal. The Installation Contractor shall be responsible to provide controls for multiple locations for dosing coagulant in the clarifiers and before the filters.

E. All the equipment specified under this Section shall be furnished by a single reputable Vendor who meets the experience requirement, as specified in paragraph 1.4.A, and is qualified in the manufacture of said equipment, as specified in paragraph 2.1.A.

F. All of the equipment must comply with the requirements of IDAPA 58.01.16.

G. The process basins shall be considered Class 1 Division 2 per NFPA 820. All electrical equipment to be installed in this environment shall be designed to meet applicable codes.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 30 00 –Vendor Submittals.

B. The Vendor shall submit a copy of this equipment specification section with all addenda and all referenced specification sections. Each paragraph shall be check-marked to indicate specification compliance or marked to indicate deviations from the specification requirements. Check marks shall indicate complete compliance with the paragraph requirements. Deviations from the specification shall be indicated by underlining the deviation and marking the paragraph or line with a number or letter. The remainder of the paragraph not marked as a deviation shall indicate compliance with the requirements of the paragraph. The manufacturer shall prepare a detailed justification for each deviation. Failure to include the required specification sections and justification for deviations will indicate non-compliance and shall be rejected without further consideration.

C. The submittals shall also include the following information:

1. Listing of and data submittals for all major equipment components and appurtenances to be supplied. Data submittals must clearly show the size, model, type, mounting, electrical wiring diagrams, structural, etc., necessary to easily evaluate the equipment. Standard charts, graphs, table, etc., may be used but must be highlighted to show the specific unit being proposed. Include blower curves. In addition to the major equipment components, Vendor must also provide details as to what parts, pieces, bolts fasteners, flanges, etc. will be included as part of the proposal. Included spare parts shall also be listed. If the equipment proposed will require additional or special physical, structural, or electrical provisions, the Vendor shall submit drawings which illustrate the special requirements.

2. Certified general arrangement drawings showing the layout, all important details and materials of construction, dimensions, loads on supporting structures and anchorage locations.

3. Schematic control diagram.

4. Treatment calculations for maximum monthly loadings, tank volumes required, aeration required and provided, and expected effluent quality. The submitted calculations must show the entire range of operation, (from average to peak hour design flows). Hydraulic calculations must include operation with one unit out of service. Treatment calculations should demonstrate that the system meets redundancy requirements (treatment of maximum month flows and loads through both trains with one blower offline).

5. Industry-accepted process model results to substantiate the design calculations. These should use all default parameters (kinetic, stoichiometric, switching functions) unless technical justification is provided.

6. Performance warranty to meet effluent requirements.

7. Copy of the manufacturer’s mechanical warranty.

8. Descriptive literature, brochures, and/or catalogs of the equipment.

9. Overall dimensions (including anchor bolt layout), materials, size, weight, lifting points, and performance data.

10. Motor characteristics and performance information.

11. Gear reducer data including service factor, efficiency, torque rating, and materials.

12. Electrical drawings including panel layouts, schematics, interconnecting wiring diagram and control descriptions. The control description will include electrical component description, process flow description, set points and alarms, screen shots, process flow charts, and SCADA interfaces. Electrical submittal package shall clearly illustrate interface with electrical control devices operating in conjunction with the provided equipment. A control philosophy shall be provided.

13. Manufacturer's installation drawings including the location of equipment inlet/outlet connections.

14. Recommendations for short and long term storage.

15. Parts list including a list of recommended spare parts.

16. The Vendor shall provide anchor bolt calculations made and signed by a civil or structural engineer currently registered in the State of Idaho.

D. Operation and Maintenance Manuals: The Vendor shall submit an Owner's Manual in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.3 PROCESS DESIGN CRITERIA

A. The extended aeration secondary treatment process shall conform to the following process influent and secondary treatment effluent requirements:

1. Maximum Month (Design) Flow, MGD: 0.50

2. Average Day Flow, MGD: 0.36

3. Peak Day Flow, MGD: 0.67

4. Peak Hour Flow, MGD: 1.73

5. Biological Oxygen Demand (BOD_5)

a. Design Influent Load (including return flows): 1,499 lbs./day

b. Design Effluent Concentration (Avg. Monthly): 30 mg/L

c. Design Effluent Concentration (Avg. Weekly): 45 mg/L

6. Total Suspended Solids (TSS)*

   a. Design Influent Load (including return flows): 2,004 lbs./day

   b. Design Effluent Concentration (Avg. Monthly): 30 mg/L

   c. Design Effluent Concentration (Avg. Weekly): 45 mg/L

   d. *Note that the effluent TSS limits are not the responsibility of the IFAS vendor. However, the IFAS vendor is responsible to provide a design mixed liquor concentration that would allow a typical secondary clarifier to achieve the effluent TSS limits.

7. Ammonia as nitrogen (N)

   a. Design Influent Load (including return flows): 166 lbs./day

8. Ammonia as nitrogen (N)

   a. Design Effluent Concentration (Avg. Monthly): <1 mg/L

   b. Design Effluent Concentration (Max Day): <2.6 mg/L

9. Total Phosphorus (as phosphorus (P))

   a. Design Influent Load (including return flows): 40 lbs./day

10. Temperature

    a. Design Influent Temperature: 7.0 – 19°C

B. The expected phosphorus concentration following treatment in the IFAS basins and existing clarifiers is 2.0 mg/L (not required to be included in the vendor's Process Performance Guarantee). To aid in achieving this phosphorus concentration, a coagulant (such as alum) dosing point will be added by the Installation Contractor to the outlet to the IFAS basins. The chemical dosing pumps, piping, filtration system, and appurtenances shall be provided by others.

1.4 QUALITY ASSURANCE

A. The proposed Vendor shall have a minimum of 15 years' experience in the design, application, and supply of IFAS treatment systems in wastewater treatment plants and shall submit a list of no less than 15 operating installations in North America where the average design flow rate is at least 0.5 MGD.

B. The Vendor shall submit a Process Performance Guarantee. Said guarantee shall be valid for a period of 12 months from the date of plant start-up. A single Vendor shall supply and be responsible for the performance of the IFAS Treatment Process.

C. All equipment furnished under this specification shall be new and unused, unless otherwise noted.

D. The installations shall conform to all applicable codes that are typical and reasonable for the type of installation. Requirements of the following organizations shall be considered minimum:

1. OSHA - Occupational Safety and Health Act
2. ANSI - American National Standards Institute
3. ASTM - American Society for Testing and Materials
4. AISI - American Iron and Steel Institute
5. AIWC - American Institute of Steel Construction
6. AWS - American Welding Society
7. AGMA -American Gear Manufacturers Association
8. NEMA- National Electrical Manufacturers Association
9. NEC -National Electric Code

1.5 PATENTS

A. The Vendor shall assume all costs of patent fees or licenses for equipment or processes it supplies under this agreement supplied by Manufacturer under this agreement, and shall safeguard and save harmless the GENERAL CONTRACTOR, OWNER and ENGINEER and their agents from damages, judgments, claims and expenses arising from license fees or claimed infringements or any letters of patent or patent right, or because of royalty or fee for the use of any equipment or process; and the price stipulated for all such patent fees, licenses, or other costs pertaining thereto.

1.6 WARRANTY

A. Warranty: A written Vendor's warranty shall be provided for the equipment specified in this Section. The warranty shall be for a minimum period of one (1) year from the date of Substantial Completion. The Vendor shall repair or replace all defects of materials or workmanship in the equipment at no additional cost to Owner. Warranty shall cover site visits, shipping, labor, repair or replacement of equipment, and physical removal and reinstallation of equipment at the site.

1.7 PROCESS PERFORMANCE REQUIREMENTS

A. The effluent quality performance of the Treatment Process will be demonstrated via one (1) thirty-day process performance test period during the first twelve (12) months of operation, following stabilization of the process. The process performance test will demonstrate and document the effluent quality for purposes of determining whether the effluent process performance guarantees have been satisfied.

B. Guaranteed Process Performance is based upon a process designed in accordance with the influent and effluent wastewater criteria from Section 1.3. Additionally, the following

conditions shall be met:

1. The pH entering the secondary treatment shall be in the range of 6.5 - 8.0 to maintain biological activity.

2. The wastewater shall be biodegradable with no inhibitory concentrations of toxic compounds present. Testing of the influent for toxic chemicals, if necessary, shall be provided by the Vendor.

C. Process Performance Testing

1. The Owner shall be responsible for carrying out the process performance testing, for collecting all samples, for carrying out all laboratory tests and for keeping such detailed records as may be necessary for determining whether the process performance guarantees have been met. The said records shall be retained until the process performance guarantee has been satisfied or until expiration of the period during which the process performance test is to be performed whichever occurs earlier, and such records shall include all daily log sheets, operator notes, sample inspections, and instrument charts produced in operation of the plant. The Owner shall provide one copy of such records to the Vendor free of charge. The Owner shall make copies of such records available to the Vendor for inspection or copying at the Vendor's expense.

2. The process performance test shall be subject to the following general conditions:

   a. All analyses, data reduction or tests not otherwise specified shall be carried out by procedures furnished or approved by Standard Methods for the Examination of Water and Wastewater, most recent edition; unless a different source is agreed upon by Owner and the Vendor.

   b. The Owner shall furnish all materials, utilities, services and personnel as required to operate the plant during the process performance tests.

   c. The performance test shall commence within 30 days after Supplier's written notice to Purchaser that system stability has been reached.

3. The following are specific responsibilities of the Vendor and Owner with respect to the process performance test and guarantees:

   a. Owner will carry out the thirty (30) day process performance test at such conditions and at such time as the Vendor and Owner mutually agree for purposes of determining whether the process performance guarantees are met. The time within which the process performance test is to be carried out may be extended by the length of any period of down time required for correcting any failure or deficient performance.

   b. The Owner shall provide the labor required to obtain samples and measurements and shall pay for all laboratory analyses of the samples.

c. If during the process performance test it appears that the process guarantees are not being met, the Vendor shall have the right to have the plant operated at such reasonable conditions as it may deem necessary or advisable for the purpose of determining the nature or cause of the failure of the plant to meet such guarantee, provided such operating conditions are in accordance with good engineering practice and Owner's operating rules enforced at the plant site. Thereafter, the Vendor shall have the right to make or have made such adjustments in order to meet such guarantee and the right to make or have made such alterations or modifications to the plant necessary to correct deficiencies in the process design basis as it deems necessary or advisable. Such alterations or modifications shall be subject to review and approval by an appropriate State Agency and the Owner.

d. The following recordings and samples shall be taken and analyzed. The samples shall be taken at the Treatment Process influent and effluent, unless noted otherwise. The following are the minimum samples and recording points:

1) Plant Flow: Influent/Effluent (MGD)

2) BOD_5: Influent/Effluent (mg/L)

3) TSS: Influent/Effluent (mg/L)

4) TKN: Influent (mg/L as N)

5) Total Ammonia: Influent/Effluent (mg/L as N)

6) Total Phosphorus: Influent/Effluent (mg/L as P)

7) pH: Influent/Effluent (S.U.)

8) Temperature: Influent/Effluent (°C)

9) Dissolved Oxygen (DO): Secondary Biological Tanks (mg/L)

10) Alkalinity: Secondary Biological Tanks (mg/L) (samples shall be taken during first week of testing only.)

e. The Vendor and Owner will jointly review performance of the process system to determine compliance with performance guarantees. Performance shall be based on 24-hour composite sample results. Review will include, but not be limited to, a comparison of influent and process design basis with the actual performance results. The effluent quality shall meet the requirements specified for 30 consecutive days based on 24-hour composite sample results.

f. The Owner will promptly notify the Vendor of the failure to meet any process guarantee and specify the respect in which such guarantee has not been met.

g. If the Vendor disputes any claimed failure, notice of such dispute shall be furnished promptly to Owner.

D. Performance Standards and Exclusive Remedy

1. In the event that the Treatment Process does not achieve the required level of process performance (as set forth in Section 1.3) during the test periods attributable to the Vendor, the Vendor shall be permitted to conduct a maximum of two (2) additional 30-day tests to meet the specified process guarantee criteria at Vendor's expense. Prior to either of these additional tests the Vendor may undertake modifications, (at Vendor's expense), to improve effluent quality. Where process does not achieve the level of performance required due to events outside of the responsibility of the Vendor, the performance testing will be completed once events have been corrected and testing will be at the Owner's expense.

2. Upon successful completion of the specified testing requirements, the Vendor's total liability, with the exception of equipment warranties, under this Agreement shall be discharged.

3. If the IFAS Treatment Process fails to achieve the required effluent quality during the process performance test period and fails the additional test(s), the Vendor shall have failed the process performance test.

PART 2 - PRODUCTS

2.1 GENERAL DESIGN

A. Description: The work shall generally comprise the supply of an IFAS system complete with process design, media, aeration system, screens, blowers, instrumentation, controls and all other related appurtenances required for a complete system.

B. Fabrication: All welded connections shall develop the full strength of the connected elements and all joined or lapped surfaces shall be completely seal welded with a minimum 3/16-inch fillet weld. Intermittent welding shall not be allowed.

C. Edge Grinding: Sharp projections of cut or sheared edges of ferrous metals shall be ground to a radius by multiple passes of a power grinder as required to ensure satisfactory coating adherence.

D. Structural Design: All structural members and connections shall be designed so that the unit stresses will not exceed AISC allowable stresses by more than one-third when subject to either the toque load under startup or the dynamic loading of the equipment operating under full load. All steel design shall be in accordance with the AISC Manual of Steel Construction, latest edition, and the Uniform Building Code (UBC), latest edition.

E. Materials of construction shall be as follows unless otherwise specified herein:

1. All continuously wetted metal shall be minimum Type 304L stainless steel.

2. All air piping equipment supplied by the Vendor shall be rated for the maximum blower discharge temperature at its point of use. Deficiencies in air piping equipment due to temperature shall be replaced by the Vendor at no charge.

2.2 AERATION BLOWERS

A. Complete mixing and aeration of each basin shall be provided by the Vendor.

B. The Vendor shall provide the aeration blowers necessary for the treatment process. Blowers shall be located indoors and provide sufficient air to the diffuser system. The blowers shall conform to either Section 43 11 33 – Rotary Lobe Blowers or Section 43 11 31 – Rotary Helical Screw Blowers. In addition to the blower units required to supply the air volume required for peak loading, one (1) additional blower unit, the same size as the largest blower, shall be supplied for backup.

C. Each blower shall be controlled by a variable frequency drive (VFD), provided by the Installation Contractor.

2.3 MEDIA

A. GENERAL

1. The Vendor shall provide media that meets the design quantity, media dimension, and specific gravity, specified for the design conditions stated herein.

2. Media shall be contained in bags. The media in each bag shall be of known volumetric quantity such as to facilitate accurate inventory control during final placement of the media. Each bag shall have handles on the topside to assist in moving the bags from the storage location to above the basins for final placement of the media.

3. The INSTALLATION CONTRACTOR shall install the media into the reactors and maintain an accurate inventory of the number of bags installed in each reactor. These records shall be made available to the ENGINEER or VENDOR upon request.

B. BIOFILM CARRIER MEDIA

1. The Vendor shall provide a minimum protected surface area as noted in the design criteria for each IFAS reactor.

2. The total media percent fill shall not exceed 40% for current design conditions. This allows room to add media for future expansion or unforeseen increases in load. Vendors unable to meet this criteria will be required to change the geometries of the IFAS reactors to increase the total working volume.

3. Material shall be an extruded, white, virgin high-density polyethylene. Recycled materials will not be accepted.

4. Media model to be used in this project shall have been used in a minimum of fifteen (15) municipal IFAS systems in the US and shall have at least ten (10) years of experience to prove media quality in full scale installations.

2.4 AERATION SYSTEM

A. GENERAL: The INSTALLATION CONTRACTOR shall install the aeration grids in the basins. The Vendor shall furnish the items listed below:

1. Drop Pipes

2. Aeration Grids

3. Supports

4. Air Flow Control Valves (manual and modulating)

B. EQUIPMENT

1. Drop Pipe: 304/304L stainless steel drop pipes shall be provided for the aeration grids to a point approximately 3’ above the SWD. The drop pipe shall be schedule 10 pipe and connect to the INSTALLATION CONTRACTOR supplied out-of-basin pipe. Manufacturer scope ends at the Straub coupling at the top of the drop pipe.

2. Aeration Grids: A 304/304L stainless steel aeration grids shall be provided for the basins. The aeration grids shall be comprised of an aeration grid manifold of schedule 10 pipe with Ø1” or Ø1-1/4”laterals of schedule 5 pipe. The laterals shall be uniformly spaced along the length of the aeration grid manifold. Each lateral will have a series of 4mm (5/32”) holes uniformly spaced along the bottom. The lateral pipe shall include a crimped drop pipe at the end, to provide for easy drainage, and to prevent entry of media. Each aeration grid shall be supplied with all necessary gaskets and hardware.

3. Supports

a. Drop Pipe Supports: Drop pipe supports to be fabricated from 304/304L stainless steel. Each support shall consist of a minimum 2” bearing contact between the pipe and support. The support shall be secured by two (2) 18-8 stainless steel threaded rods with a minimum diameter of 5/8”. Each rod will be anchored to the concrete by chemical anchors. The drop pipes shall be secured to the support by a U-bolt. Supports shall have a maximum spacing of 9’-0”. All interconnecting hardware required to secure the support to the drop pipe shall be provided. No field welding shall be required.

b. Aeration Grid and In-Basin Manifold Supports: Aeration grid and in-basin manifold supports to be fabricated from 304/304L stainless steel. Each support shall consist of a minimum 2” bearing contact between the pipe and support. The support shall be secured by two (2) 18-8 stainless steel threaded rods with a minimum diameter of 5/8”. Each rod will be

anchored to the concrete by chemical anchors. The aeration grid and in-basin manifolds shall be secured to the support by a U-bolt to prevent lateral movement. Supports shall be designed to allow for on-site height adjustment. Supports shall have a maximum spacing of 9'-0". All interconnecting hardware required to secure the support to the aeration grid shall be provided. No field welding shall be required.

4. Construction

   a. Welding: All welding shall conform to Manufacturer Welding Fabrication Procedures. All factory welding shall undergo pickling/passivation to prevent rust and corrosion.

   b. Bolting: Where nothing to the contrary is indicated, bolts, screws, nuts, and washers shall be 18-8 stainless steel.

   c. Installation: The installation of the aeration equipment shall be such that upon completion of installation, all diffusers in the system are level to ±1/8" of a common horizontal plane.

      1) Checkout: INSTALLATION CONTRACTOR to provide an embedded benchmark location in each reactor along with its elevation as a means for comparing air grid elevations from one reactor to the next.

5. Design

   a. The system shall be designed to be submerged within the tank basin without deforming any component.

   b. All welded parts and assemblies shall be shop fabricated from 304L stainless steel with a 2D finish. Unless otherwise specified, all non-welded parts and pieces shall be shop fabricated from type 304 stainless steel with a 2D finish.

   c. All flanged joints shall have 45 to 55 durometer, Shore A, neoprene gaskets. EPDM gaskets are also acceptable.

   d. All aeration grid and in-basin manifold supports shall be designed to compensate for a maximum floor elevation difference of ±3".

   e. All supports shall be designed to resist the load of the media in the event the tank is drained.

   f. Diffusers such as fine bubble diffusers that require maintenance and replacement shall not be allowed.

6. Airflow Control Valves

   a. Valves shall meet the requirements of Sections 40 05 64 – Butterfly Valves and 40 05 63 – Ball Valves.

2.5 SCREENS

A. GENERAL: The INSTALLATION CONTRACTOR shall install cylindrical screens for media retention in the basins. The Vendor shall furnish the items listed below:

1. Media Retention Screens

2. Flat screens

3. Air Sparge System

4. Supports

B. EQUIPMENT

1. Media Retention Screen

a. Cylindrical Screens shall be constructed of 304/304L stainless steel and shall be provided for the basins.

b. Design and supply of screens and supports shall be provided by the Vendor.

c. Cylindrical Screen (Perforated Plate): 304/304L stainless steel cylindrical screens shall be provided for the basins. The cylindrical screens shall be constructed of a minimum 14 gauge sheet and have a perforation pattern of a 5/8" dia. with 13/16" centers on a staggered spacing. Each screen will have a minimum 1/4" thick plate mounting flange with two sets of anchor holes for wall mounting.

d. Screens that require manual maintenance shall not be allowed.

2. Wedge wire type screens shall not be allowed due to high potential for clogging.

3. Sparger Air Scour Piping

a. 2-inch diameter 304/304L stainless steel air scour piping will be provided for each cylindrical screen. The air scour piping shall be tapped from the main air line inclusive of manual isolation valves.

b. Sparger piping shall be rated for continuous operation.

4. Manual Ball Valves

a. Vendor shall provide manual ball valves for each IFAS basin screen sparge system. Valves shall meet the requirements of Section 40 05 63 – Ball Valves

5. Air shut off solenoid

a. Vendor shall provide shut off solenoids for each IFAS basin screen sparge system. Valves shall meet the requirements of Section 40 05 82 – Solenoid

Valves

6. Construction

a. Welding: All welding shall conform to Manufacturer Welding Fabrication Procedures. All factory welding shall undergo pickling/passivation to prevent rust and corrosion.

b. Bolting: Where nothing to the contrary is indicated, bolts, screws, nuts, and washers shall be 18-8 stainless steel.

c. Installation: Each cylindrical screen shall be mounted directly to the concrete wall with (8) 18-8 stainless steel threaded rods with a minimum diameter of 3/8". Where cylindrical screens have spargers, screens shall be installed so that all air scour piping within the system is level to ±1/8" of a common horizontal plane. Where cylindrical screens do not have spargers, screens shall be installed so that they are level to ±1/4" of a horizontal plane.

7. Design

a. The system shall be designed to be submerged within the tank basin without deforming any component.

b. All welded parts and assemblies shall be shop fabricated from 304L stainless steel with a 2D finish. Unless otherwise specified, all non-welded parts and pieces shall be shop fabricated from type 304 stainless steel with a 2D finish.

c. The cylindrical screens shall be designed to handle the combined peak hour flow and RAS flow.

d. Screen design loading rate shall not be more than 23 gpm/sf of screen surface area.

e. Screens shall have a minimum of 50% open space.

f. Maximum headloss through the cylindrical screens shall not exceed 3" in each basin at peak hydraulic flows.

2.6 INSTRUMENTATION

A. All required instrumentation for control of the process treatment, including pressure gauges and transmitters, level sensors, temperature sensors, dissolved oxygen probes, etc. shall be included. Instrumentation shall meet the requirements of the applicable Sections:

1. Section 40 71 76 – Insertion Type Air Flow Meter

2. Section 40 72 00 – Level Measuring System

3. Section 40 73 00 – Pressure Measuring and Detection Systems

4. Section 40 74 00 – Temperature Measuring Systems

5. Section 40 75 43 – Dissolved Oxygen Measuring Systems

B. The following instruments shall be provided at a minimum per aeration train:

1. One (1) DO probe

2. One (1) level transducer

3. One (1) float switch

4. One (1) thermal mass flowmeter for process air

5. One (1) pressure gauge for process air

2.7 SPARE PARTS

A. The Vendor shall provide the recommended spare parts for the first five (5) years of maintenance.

2.8 CONTROL PANEL

A. The entire system shall be monitored and controlled by a remote-mounted Allen-Bradley CompactLogix 5069 Series Programmable Logic Controller (PLC) or approved equal and Allen-Bradley touch screen HMI (minimum 10'' color) or equal mounted within an enclosure. The entire control panel enclosure shall be UL-certified. The PLC shall control the speed of the aeration blowers and turn the units on and off to maintain the dissolved oxygen content in the aeration tanks within predetermined operator adjustable limits when aerating. The PLC shall perform all timer sequences for the process operation of the system. The PLC shall provide alarm outputs for extended low D.O. levels and other system alarms. D.O. probes shall be used to monitor dissolved oxygen levels in the aeration basins and provide the information for primary control of the aeration blowers. The PLC shall be programmed to interface with a SCADA system for the entire WWTP. The touch screen HMI shall include VNC capability. The PLC control panel shall include a VPN for secure remote access.

B. Remote connection and interface to control panel via Ethernet/IP to SCADA and hardwired signals for equipment interlocks inter interconnections as required. Control panel to include ethernet switch and numbered I/O terminal blocks.

C. The control panel shall be housed in NEMA 12 enclosure and will be installed in a climate controlled building, near the blowers and associated motor starters. The control panels shall be UL-listed, and shall include the following:

1. Power: 120 VAC, 1Ph, 60 Hz.

2. Transient voltage surge suppressor, 120 volt.

3. The panel shall include pilot lights with protected LEDs. Green pilot lights shall signal when the equipment is operating. Red pilot lights shall signal an overload condition.

2.9 SYSTEM CONTROL

A. A primary objective of the Process Control System is to adjust aeration to match the extended aeration secondary biological treatment oxygen demand using Dissolved Oxygen (DO) concentration as the primary control parameter. The Process Control System will use the DO signals to pace the blower VFDs in "auto mode" while the operator will manually control the VFD speed using the Process Control System's operator interface module in the "manual mode." The entire system shall be designed to restart after power outage if there are no alarm conditions that would normally shut the unit down. Status and alarm lights with an audible alarm shall be included.

B. At minimum, the Process Control System will include the following data:

INPUT	OUTPUTS TO SCADA
Motor Temperatures	Motor High Temp Alarms
D.O. Signals (4-20mA)	D.O. Analog Signals
	High D.O. Alarms
	Low D.O. Alarms
Run Signal from VFDs	Speed (4-20mA) to VFD
	Run to VFD
	System On to VFD
	Auto Speed Select to VFD
	Basin Level Analog Signal
	High Level Switch
	Temperature Analog Signals

C. The Process Control System shall be designed to provide high reliability and factory programmed with logic functions to match the process and mechanical operational requirements. The controller will allow the system to operate the equipment without excessive speed changes or excessive switching. The Vendor shall assume single source responsibility for the system and shall provide the Allen Bradley CompactLogix PLC with all necessary I/O cards, Ethernet card, Ethernet switch, power supply, UPS and touch screen all in a single NEMA 12 Hoffman enclosure, rated for 120 volt, 60 Hz power, complete with a fused terminal block for disconnecting power. The panel shall be located as shown on the plans. The Process Control System operator interface module shall also be capable of controlling the VFD speed.

D. VFDs shall conform to Specification 26 29 23 – Variable-Frequency Motor Controllers.

2.10 ANCHORAGE AND FASTENERS

A. GENERAL

1. The Installation Contractor shall furnish all anchoring hardware for the supplied equipment.

2. The Installation Contractor shall furnish all epoxy and dispensing equipment for chemical anchoring.

3. The Vendor shall provide anchor bolt calculations made and signed by a civil or structural engineer currently registered in the State of Idaho.

2.11 MANUFACTURERS OR PREAPPROVED EQUAL

A. Veolia

B. World Water Works

C. Or Approved Equal

PART 3 - EXECUTION

3.1 ONSITE SERVICES

A. The manufacturer shall provide the services of a qualified factory representative for four (4) trips including a total of eight (8) workdays to advise the Installation Contractor on proper installation, setting, piping, wiring procedures, and provide operator training on the extended aeration secondary treatment. The Installation Contractor shall videotape all training sessions and provide a copy on DVD to use such DVD for continuing operator training.

B. Six (6) months after Substantial Completion the Vendor shall provide the services of a qualified factory representative for one (1) trip including a total of four (4) workdays to advise the Owner on process improvement and provide continued operator training.

3.2 SITE STORAGE AND HANDLING OF EQUIPMENT

A. The Vendor shall provide instruction to Installation Contractor on how to unload, handle and store the equipment.

3.3 INSTALLATION

A. The Vendor shall provide complete installation instructions to the Installation Contractor and the Installation Contractor shall be required to follow Vendor’s installation instructions.

3.4 START-UP

A. Before the equipment is started, the manufacturer shall make a thorough inspection of the installation to make sure equipment has been installed properly. Equipment shall not be energized without the qualified factory representative present.

B. Perform Level 2 Testing in accordance with Section 43 05 60 – Process Equipment Testing except vibration testing.

END OF SECTION 46 53 36

SECTION 46 61 27 – UPFLOW MOVING BED FILTER

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Vendor shall furnish and place into satisfactory operating condition a complete filtration system as specified herein. Filters shall be provided with all required equipment, and filtration media. Filters shall be modular and will be installed in concrete basins. The Installation Contractor shall install all structures including any required wall thimbles and external piping.

B. The Vendor shall size the filter equipment to meet the performance specifications below. The filter systems shall be designed so that the peak flow can be treated with one unit offline.

C. Air compressor: Vendor shall provide a compressed air system sized to deliver sufficient air to each airlift for backwashing, as well as any ancillary air requirements for the system, including pneumatic actuation of valves. The compressed air system shall include a dual air compressor with reservoir, air dryer, compressed air control panel, air panels for the control of air to the air lifts, and valves. The Installation Contractor shall install the air system and provide and install the interconnecting piping.

D. Vendor can provide more than one proposal (for different configurations or materials) at the time of bid.

E. The Installation Contractor shall provide two chemical dosing systems with associated mixing and flocculation – an alum system for phosphorus coagulation, and a caustic soda system for pH adjustment (downstream of the filters). Where necessary, a polymer dosing system shall also be provided by the contractor. The chemical, mixing and flocculation systems shall meet the Filter Vendor's requirements subject to the Engineer's approval.

1.2 DESIGN REQUIREMENTS

A. Influent Design Criteria: Clarified secondary effluent will be provided to the sand filter system with the following flow and water quality:

1.	Average Daily Flow:	0.36 MGD
2.	Max Month Flow:	0.50 MGD
3.	Peak Day Flow:	0.67 MGD
4.	Peak Hour Flow:	1.73 MGD
5.	Max Total Suspended Solids (from clarifier effluent):	30 mg/L
6.	Total Phosphorus:	2 mg/L*

*Note that chemical dosing upstream of the clarifiers will be provided to meet the influent concentration noted above to the sand filters.

B. Effluent Design Criteria: The sand filter vendor shall meet the following effluent water quality:

1.	Total Suspended Solids:	5 mg/L
2.	Total Phosphorus:	0.29 mg/L

C. The maximum allowable hydraulic loading shall not exceed 5 gpm/ft^2 at the peak hour flow with one unit offline.

D. The headloss through the filter shall not exceed 48" (as measured from the influent to the filter module to the crest of the effluent weir).

1.3 SUBMITTALS

A. See Section 01 30 00 – Vendor Submittals, for submittal procedures.

B. The Vendor shall submit a copy of the equipment specification section with all addenda and all referenced specification sections. Each paragraph shall be check-marked to indicate specification compliance or marked to indicate deviations from the specification requirements. Check marks shall indicate complete compliance with the paragraph requirements. Deviations from the specification shall be indicated by underlining the deviation and marking the paragraph or line with a number or letter. The remainder of the paragraph not marked as a deviation shall indicate compliance with the requirements of the paragraph. The manufacturer shall prepare a detailed justification for each deviation. Failure to include the required specification sections and justification for deviations will indicate non-compliance and shall be rejected without further consideration.

C. Submit to the Engineer for review, filtration calculation, headloss calculations, air flow requirements, complete drawings showing installation details, materials of construction, arrangement details, loadings, elevations, and all items furnished under this Section.

D. Complete instructions on installation of the equipment, air compressor, air lift system, controls, and filter media.

E. Design calculation for anchor bolts. Design calculations shall include dead, live, and dynamic loadings for normal and seismic conditions (see Drawings for seismic design standards). Design calculations shall be stamped by a professional engineer registered in the State of Idaho.

F. Start-up instructions.

G. Operation and Maintenance Data: Submit operation and maintenance data and equipment parts list in manual in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

A. To ensure that all the equipment required for the installation of the filter modules and air supply is properly coordinated and will function as a unit in accordance with the intent of these Specifications, the Vendor shall provide all the equipment specified under this Section.

B. Qualification of Filter Manufacturer: The filter Manufacturer shall have a minimum of 10 years' experience in the manufacture of this type of filter equipment and shall have completed at least 10 successful installations of the same type proposed.

1.5 WARRANTY AND GUARANTEE

A. A written manufacturer warranty shall be provided. The warranty shall be for a minimum period of one (1) year from the date of Substantial Completion. Manufacturer shall repair or replace all defects of materials or workmanship in the equipment during the warranty period. Corrections shall be completed within five (5) days after notification.

B. Written Guarantee: The Vendor shall guarantee that the filter system shall meet the required effluent limits. The coagulant dosing system will be supplied by the Installation Contractor. If, during the one-year guarantee period, the filter system fails or does not meet any of the specified requirements or test criteria herein, the Vendor shall correct such deficiencies as may be necessary to meet these requirements and criteria at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Parkson

B. Nexom

C. WesTech

D. Or approved equal

2.2 GENERAL

A. All structural steel shall conform to "Standard Specifications for Structural Steel of the A.S.T.M."

B. An effluent weir shall be provided to control the water level over the media.

C. All equipment shall be designed for continuous, twenty-four hour operation, and all parts of the mechanism shall be amply proportioned for all stresses, which may occur during fabrication, erection, and operation.

D. All anchor bolts shall be Type 316 stainless steel and shall be sized by the Vendor. The Installation Contractor shall provide and install the anchor bolts in accordance with the Vendor instructions.

E. All filter wetted parts shall be 304 or 316 stainless steel, FRP, or PVC. No carbon steel shall be allowed in the filters. All stainless steel shall be passivated.

2.3 UPFLOW MOVING BED FILTER

A. Materials of Construction

1.	Basin	Concrete, FRP, or 304 SS
2.	Filtrate trough (if applicable)	FRP or 304 SS
3.	Bottom hopper cones	FRP or 304 SS
4.	Feed distribution radials	FRP or 304 SS
5.	Reject compartment	FRP or Injection Molded Plastic
6.	Washer rings	PVC or Injection Molded Plastic
7.	Reject weirs	FRP or Injection Molded Plastic
8.	Distribution cones	FRP of 304 SS
9.	Airlift pipes	HDPE or PVC
10.	Airlift housing	FRP or 304 SS
11.	Airlift panel	304 SS
12.	Nuts, bolts, fasteners	304 SS
13.	Anchor bolts	304 SS

B. FILTER TANK

1. Each filter shall be self-contained in an open-top concrete tank sized by Vendor. Vendor shall produce dimensioned layout drawings of the filters with all sections needed to estimate concrete volumes, if applicable.

C. AIRLIFT

1. The sand cleaning system shall be capable of continuous or intermittent backwashing and internally redistributing the granular media to the top of the sand bed an average of 4-8 times per 24 hours. The airlift shall be supplied with an external air feed line to supply the pressurized air to the injection point. The feed line shall be protected from the abrasive movement of the media both inside the airlift and outside within the filter bed.

D. COUNTER-CURRENT WASHBOX

1. The filter system shall be furnished with a washbox assembly of fiberglass or injection molded plastic construction with an adjustable weir. The cross-sectional area of the counter-current washbox shall be sized to assure sufficient velocity of up-flowing water to transport separated solids into the wash chamber and over the reject weir and ultimately out through the reject line. The washbox geometry shall be optimized for separation of solids rejected from the filter media.

E. FILTER MEDIA

1. The filter media shall be furnished by the Filter Manufacturer and shall be of high quality silica sand in accordance with the American Water Works Association Standard for Filter Materials AWWA/ANSI B-100 (latest edition). The Filter manufacturer shall deliver the sand to the Site, and the Installation Contractor shall install the filter media per the Filter Manufacturer's instructions.

F. FEED CHAMBER

1. Each filter shall be furnished with a central feed chamber designed to distribute the influent water directly into the media. The feed chamber shall have capacity to distribute the influent at least 60" below the top of the media. The feed chamber shall have a central protector tube to house, support and protect the airlift feed pump and compressed air feed line from damage due to abrasion. This central protector tube shall extend from the top of the filter bed down through the feed chamber to the recessed chamber in the lower cone. The feed chamber shall also incorporate support devices to the side wall, if applicable. The feed chamber shall be permanently attached and centered on the lower end to ensure that the system remains properly located at all times. The feed chamber shall be constructed of fiberglass or 304 SS.

G. HEAD LOSS INSTRUMENTATION

1. The Head Loss Indicator Gauge shall be coupled directly to the influent feed channel of the filter and extend above the top of the filter cell. The Head Loss Indicator Gauge shall be marked with an easily readable clear rule indicating the differential pressure (ΔP).

2. Head Loss shall also be monitored with a pressure transmitter directly to the influent feed of the filter system. Transmitter signal shall land in the Air Control Panel and the signal made available to the plant PLC (by Installation Contractor).

H. AIR CONTROL PANEL WITH AIR BURST SYSTEM

1. The filter system shall be furnished with a NEMA 4X operators control panel equipped with manufacturer's standard equipment, including airflow regulation, flow monitoring/control valves, normal operation and adjustable duration airbursting (where applicable) solenoids and all other controls necessary for operation of the filter's airlift. A signal from the plant SCADA system shall be received to operate the system.

2. All analog and digital signals from flow or level instrumentation in the Air Control Panel shall be available to the plant PLC via terminal contacts.

3. Where filter cells are intended to be operated in a lead/lag type configuration, the Vendor shall provide a control narrative for system integration through the plant PLC. Solenoid valves shall be included in the Vendor's scope, as well as sufficient instrument air in the air compressor system, to operate Installation Contractor-supplied pneumatic control valves to each filter cell.

I. AIR SYSTEM

1. The Filter Manufacturer shall furnish an air compressor unit to pressurize the pneumatic system. The duplex air compressor unit shall be provided with two each, two-stage compressor pumps. The air tank shall be an ASME Code receiver rated at a minimum of 200 psig. The system shall be complete with two (2), 460 V/3P/60 Hz powered, 2-stage compressor pumps; air cooled aftercooler; loadless starting; low oil shutdown switch; pressure gauge; safety valve; intake air filter; pressure switch; manual and automatic receiver blowdown and shut off valves; vibration pads for mounting; and complete startup kits. The Vendor shall size the air compressor.

2. A refrigerated-type air dryer shall be provided and sized by Vendor. Power shall be 115V/1P/60 Hz. The air dryer shall be provided with a pre-filter.

3. The Vendor shall provide a duplex alternating control panel. The panel shall include motor starter for the two compressor motors and thermal overloads. Circuit protection and disconnects shall be by others.

J. SPARE PARTS

1. Filter Equipment: The Filter Manufacturer shall provide the following spare parts for the airlift pumps and control panel (one each):

a. Spare airlift

b. Regulator - air control panel.

c. Air flow indicator and control valve - air control panel.

d. Air filter element – air control panel.

e. One intake air filter and one oil change for the air compressor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: The Installation Contractor shall install structures, filter equipment, filter media, piping and valves in conformance with the Manufacturer's recommendations.

B. The Installation Contractor shall provide and install the chemical feed system including pumps, valves, piping, and controls.

3.2 TESTING AND CORRECTION OF DEFICIENCIES

A. General

1. All testing shall be performed under the supervision of the Filter Manufacturer's representative as specified. The Installation Contractor shall conduct all specified tests and shall furnish all power, material, instrumentation, equipment, personnel, etc., for conducting tests as specified herein.

2. The Vendor shall submit three copies of full and complete test reports for all tests, describing the units tested; the type of test; test set-ups, and procedures and instrumentation; and test flow rates, pressures, levels and all other data and results as required to demonstrate that all items tested meet specified requirements.

B. Start-Up

1. Equipment Testing

a. The Filter Manufacturer's representative shall check and verify that installation of the filter modules is in accordance with Drawings, Specifications, and Filter Manufacturer's installation instructions.

b. The Filter Manufacturer's representative shall adjust all reject weir plates and air rates to each airlift.

c. The Filter Manufacturer's representative shall instruct plant personnel on operation and maintenance of the filter system.

d. The Filter Manufacturer shall include two (2) trips to the site, each one (1) day to advise the Installation Contractor on the installation of the filter equipment and to inspect and approve the installation.

e. The Filter manufacturer shall include two (2) trips to the site for four (4) days to start-up the filter system and to train the operators.

C. Testing

1. Process System Testing

a. The Installation Contractor and Filter Manufacturer shall test the blower/air compressor system for correct operation and certify that the backwash system is operating in conformance with these Specifications.

2. 7-Day Test

a. The Owner shall collect inlet and outlet samples (composite) on seven consecutive days and analyze them for total suspended solids (TSS) and total phosphorus (TP) at the Owner’s expense. If the outlet concentration averages are less than or equal to the performance requirements, then the filter system shall have passed the initial seven-day test. The Installation

Contractor and Filter Manufacturer shall make the necessary adjustments to the filter system and conduct additional seven-day tests at no cost to the Owner until the system passes.

3.3 OPERATOR TRAINING

A. A trained factory representative shall provide a minimum of 4 hours of operation and maintenance training to the Owner's personnel. The Installation Contractor shall video the training session and provide a copy on DVD to the Owner.

END OF SECTION 46 61 27

SECTION 46 76 27 – SLUDGE DEWATERING SCREW PRESS

PART 1 - GENERAL

1.1 SCOPE

A. One sludge dewatering screw press shall be installed in a new Dewatering Building. Roll-top access doors will be planned for as part of the design to provide for equipment installation by the Installation Contractor. **Vendor shall clearly note the dimensions of their equipment in their submittal and indicate if the screw press can be shipped in smaller sections for field assembly.**

B. A future screw press #2 (not part of this contract) will be planned for installation adjacent to the screw press #1 (part of this contract).

C. Vendor shall furnish a complete dewatering system including one (1) screw press, one (1) polymer mix system, flocculation system, one (1) main common control panel, drive motors, gear reducers, support legs, controls, air compressors, VFDs and motor starters, and associated panels if required, and all accessories and appurtenances required for successful operation of the dewatering process as specified herein for installation by an Installation Contractor. Vendor shall also include the startup and additional services specified within Part 3 of this Section. **Polymer activation and mix systems shall meet the minimum requirements in Paragraph 2.4 and Section 46 33 33 – Polymer Mix Units.**

D. The dewatering unit shall be manufactured from AISI 304 stainless steel shapes. Fabrication and assembly shall be in conformance with these specifications and drawings. Vendor shall also include the startup and additional services specified herein.

E. Installation Contractor shall install the equipment according to instructions and recommendations of the Vendor. The Vendor shall coordinate all details of the equipment with other related parts of the Work and verify that all structures, piping, wiring, and equipment are compatible.

F. Power supply for main control panel is 460 Volts, 60 Hz, 3-phase. The power supply for the air compressor if required shall be 120 Volts, 60 HZ, 1-phase.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM) Publications:

1. Section A322: Carbon and Alloy Steel Bar Specifications.

2. Section A507-10: Standard Specification for Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold Rolled.

B. Anti-Friction Bearing Manufacturers Association (AFBMA):

1. Standard 9-90: Load Ratings and Fatigue Life for Ball Bearings.

2. Standard 11-90: Load Ratings and Fatigue Life for Roller Bearings.

C. American Institute of Steel Construction (AISC) Publications

D. American Welding Society (AWS) Publications

E. American Structures Painting Council (ASPC) Publications

1.3 INFORMATION TABLE

A. The following table shall be completed and submitted as part of the bid package.

INFORMATION SHEET		
General Design Information		
Solids Capacity		lbs/hr
Hydraulic Capacity		gpm
Motor Size(s)		HP
Washwater Requirement		gpm
		psig
Frequency of Washing		minutes/day
Duration of Washing		minutes/cycle
Required Feed Pressure (including polymer mixing)		psig
Polymer Required		lbs/dry ton
Minimum Cake Solids		%
Estimated Power Draw @ Design Conditions		kWhr/day
Required Overhead Crane Lifting Capacity		tons
Compressed Air Requirements		scfm
		psig

1.4 SUBMITTALS

A. Submit in accordance with Section 01 30 00 – Vendor Submittals. Submittals shall include the following:

1. Product Data including:

a. Descriptive literature, brochures, catalogs, cut sheets and other detailed descriptive material of the equipment.

b. Motor characteristics and performance information.

c. Gear reducer data including service factor, efficiency, torque rating, and materials.

d. Parts list including a list of recommended spare parts.

e. Air Compressor, if required.

f. Polymer Mix System as described in Section 46 33 33 – Polymer Mix Units.

g. Flocculation System (If integrated as part of the screw press inlet feed piping then only system sizing shall be provided)

h. Instantaneous spray water flow and water pressure requirements, appurtenant utility connections, and average spray water consumption.

2. Shop Drawings including:

a. Manufacturer’s installation drawings.

b. Wiring and schematic diagrams.

c. The Vendor shall submit an I/O list, panel drawings, etc. for all equipment and instrumentation to be used

d. Provide functional description of equipment controls.

3. Provide bearing life calculations sealed by a Professional Engineer in the State of Idaho.

4. Anchoring calculations in accordance with Section 43 05 50 - Equipment Mounting and sealed by a Professional Engineer in the State of Idaho.

5. Operation and Maintenance Manuals: Per Section 01 78 23 - Operation and Maintenance Data.

6. Detailed installation instructions, with clear step-by-step points on the correct mechanical and electrical installation procedures.

7. Equipment weights and lifting points.

8. Recommendations for short and long-term storage.

9. A copy of the manufacturer's warranty.

1.5 QUALITY ASSURANCE

A. To ensure quality, conformance, and reliability with regard to the manufacturing and production of the machinery described in this section, the equipment manufacturer shall meet the requirements listed in this section.

B. Manufacturer shall have a minimum of fifteen (15) installations of screw presses for sludge dewatering of the same type and similar size that have been in successful operation for a minimum of five (5) years in the United States.

C. All stainless steel components and structures shall be submersed in a chemical bath of nitric acid and hydrofluoric acid (pickling bath) to remove any residues that may be present on the material as a result of forming, manufacture, or handling. After removal from the pickling bath, the equipment must be washed with a high-pressure wash of cold water to remove any remaining surface debris and promote the formation of an oxidized passive layer which is critical to the long life of the stainless steel. No stainless steel components may be fabricated or assembled in a factory where carbon steel products are also fabricated, in order to prevent contamination by rust.

D. Screw Press shall be manufacturer's standard product and only be modified as necessary to comply with the drawings, specifications, and specified service conditions.

E. All welding is performed in accordance with American Welding Society (AWS) D1.1 Structural Welding Code, or equivalent.

F. All electrical equipment, controls, and instrumentation shall bear the label of Underwriters' Laboratories, Inc. (UL) or an independent testing laboratory acceptable to the local code enforcement agency having jurisdiction.

G. Manufacturer shall provide services by a factory-trained service technician, specifically trained on the type of equipment specified. Service technician requirements include, but are not limited to the following:

1. Service technician shall be present during initial energizing of equipment to determine directional testing (Installation).

2. Service technician shall inspect and verify location of anchor bolts, placement, leveling, alignment and field erection of equipment, as well as control panel operation and electrical connections.

3. Service technician shall provide classroom and/or field training on the Operation and Maintenance of the equipment to operator personnel.

4. In the event that the field service time required by this Section should not be sufficient to properly place the equipment into operation, additional time shall be provided by Vendor to correct deficiencies in installation, equipment, or material without additional cost to Owner.

H. Vendor shall guarantee all equipment against faulty or inadequate design, improper assembly, defective workmanship or materials, and breakage or other failure. Materials shall be suitable for service conditions.

I. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable Engineering and shop practice. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service prior to delivery, except as required by testing.

J. Each major component of equipment shall have the manufacturer's name, address and product identification on a nameplate securely affixed to the equipment.

1.6 WARRANTY

A. The manufacturer will warrant against any defects in material or workmanship to the screw press and framework. This warranty will commence upon Substantial Completion for the construction project and will expire a minimum of one (1) year from that date.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Huber Sludge Dewatering System Model Q-Press, Huber Technology, Inc.

B. Or Approved Equal

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Sludge to be dewatered shall be well-mixed and well-blended having the following characteristics:

1. Sludge Characteristics:

a. Sludge type: Aerobically digested waste activated sludge (no enhanced Bio-P removal)

b. Solids concentration: 1.0% - 3.0% TS (Typical)

c. Volatile solids ratio: < 70%

d. The Owner may elect to dewater directly from the waste activated sludge feed (bypassing the aerobic digesters). Where this is the case, the solids concentration is expected to be 0.8%. Performance testing, as specified in Part 3.5, shall be based on the aerobically digested sludge as described above.

B. Screw Press Performance Requirements:

1. Capture Rate ≥ 95%

2. Cake Solids: ≥ 16%

3. Design Solids Load, per Press: 210 lbs. dry solids per hr. @ 1.5% TS

4. Design Sludge Feed Rate, per Press: 28 gpm @ 1.5% TS

5. Maximum Polymer Dosage per Dry Ton of Solids: ≤32 lbs. of active polymer

C. Equipment Requirements:

1. Instantaneous Air Requirement: As per Manufacturer's standard equipment

2. Average Washwater Requirement: As per Manufacturer's standard equipment

D. The sludge dewatering system consists of the following major parts:

1. One (1) Screw Press including support legs (provided by Screw Press Manufacturer)

2. One (1) Polymer dosing system (provided by Screw Press Manufacturer)

3. One (1) Flocculation systems (provided by Screw Press Manufacturer if standalone system, or by Installation Contractor if integrated as part of the screw press inlet feed piping)

4. One (1) Air Compressor and associated panel if required for Screw Press (provided by Screw Press Manufacturer)

5. One (1) Screw Press Control Panel (provided by Screw Press Manufacturer)

6. One (1) Sludge Feed Pump with VFD's mounted in an MCC along with manual control valves, feed flow meters, and pressure transmitters (provided by Installation Contractor)

7. Sludge Holding Tank level transducer (by Installation Contractor)

8. Water Booster Pumps and associated local controls (by Installation Contractor)

9. One (1) Dewatered Cake Shaftless Screw Conveyor, associated instrumentation, and standalone control panel (provided by Installation Contractor)

E. All parts of the dewatering press shall be designed and appropriate for the service specified as indicated and for continuous operation.

F. Provide equipment footprints and indicate minimum clearances required for operation and maintenance.

G. All parts shall be designed and manufactured to handle the forces that may be exerted on the screw press during fabrication, shipping, erection, and proper operation according to the O&M manual.

H. All components shall be so balanced that jamming at any point will not result in structural failure but will cause the drive motor to stall. All components, including the gear reducer, shall be designed to withstand, without damage or permanent distortion, the full stalling torque of the drive motor.

2.3 DESIGN SPECIFICATIONS

A. Materials

1. Sludge dewatering press shall be manufactured from AISI 304L stainless steel shapes (rods, angles, and channels), pipes, and sheets. In particular, flocculation reactor, wedge wire or slotted screen basket, screw, shaft, support legs, discharge chute, fasteners and anchor bolts shall be made of this material.

2. Press access covers shall be either stainless steel, a composite of acrylonitrile butadiene styrene (ABS) and poly (methyl methacrylate) (PMMA), or fiberglass-reinforced plastic (FRP). Materials other than stainless steel shall be acceptable if the material meets the following requirements:

a. Is not a structural load-bearing component.

b. Is equal to or exceeds stainless steel's resistance to wastewater environment chemicals.

c. Is resistant to heat degradation up to 185°F (85°C).

d. Is equal to or exceeds stainless steel's resistance to UV degradation.

e. Is resilient to impact

f. FRP shall be manufactured in conformance with NBS standards PS15-69.

3. Wipers for helical screw flights shall be of wear resistant polyurethane (PU) material. Wipers must have a basket contact width of at least .315 in (8 mm). The wiper is held in place by stainless steel clamps and set screws which can be easily removed. The wiper shall have a self-contained dampening mechanism to maintain constant contact with the basket while limiting wear. Wiper self-contained dampening mechanism shall compensate for up to 4mm of radial wiper wear.

B. Design

1. The screw press shall be installed inclined. Dewatering of the sludge shall take place in wedge wire baskets or a screw press basket with slotted screen.

2. The screw press support legs shall be capable of field adjustment for ease of installation.

3. Each section of the basket shall be split in half along the length of the basket to allow for easy separation of the basket into halves for servicing of the wiper. The basket shall be fastened together using bolt fasteners made of stainless steel. The screw press shall be provided with alignment pins for ease of basket alignment during reassembly. The bottom half of the basket shall remain inside of the machine during servicing of the wiper for ease of maintenance.

4. The screw press shall be completely enclosed to prevent odor emission. The whole dewatering section and basket area shall be easily accessible through inspection panels, which are mounted via hinges on the sides and quick release latches on the top of the machine. Foul air ports shall be included.

5. A screw shall be installed inside of the screen basket. The screw transports the sludge from the inlet to the discharge area at the end of the pressure zone. Its shaft diameter shall be conical towards the discharge section of the machine. The flights of the helical screw shall be provided with brushes or wipers to clean the wedge wire screen from the inside.

6. The screw shall be shafted and shall be made of stainless steel. A bearing shall support the discharge end of the screw shaft.

7. A screw drive shall be provided at the discharge side of the press. The motor speed shall be controlled with a VFD housed in the common control panel. The drive unit shall be directly coupled to the screw shaft through a planetary gearbox.

8. A pressure transmitter shall be installed at the inlet housing of the screw press. The pressure sensor provides a signal which is used to control the speed of the auger. The pressure in the inlet box shall automatically adjust the speed of the screw via the control system and the range for the pressure shall be adjustable at the HMI.

9. The cleaning of the wedge wire screen from the outside shall be performed by two rotating spray bar washing systems utilizing a single drive (drive: 0.1 HP, 460 V, 3 phase) made of stainless-steel piping and PVDF spray nozzles. The spray wash system shall be split into two systems, upper and lower, to cover the entire area of the basket by rotating around the circumference of the basket. Its spraying shall cover the entire area of the screen and also cover the interior of the screw press housing. In total, four solenoid valves control the flow to each section of the spray bar washing system. The upper and lower spray bar washing systems shall have the ability to operate independently.

10. The duration and frequency of spray washes shall be adjustable by the operator. The timer and frequency shall be adjustable at the HMI.

11. If required by the manufacturer, a pneumatically actuated cone that serves for adjusting the pressure in the pressure zone shall be provided at the discharge end of the screening basket. If required by the manufacturer, the Screw Press Supplier shall provide one new air compressor which satisfies the combined instantaneous air requirements of the press supplied.

12. The pneumatically actuated cone is controlled by a 5-2-way solenoid valve. The solenoid directs the pressurized air to the ports which engage or disengage the cone at the discharge of the screw press. The control valve shall be installed in a local control station which also houses the pressure control valve and the pressure switch. The switch monitors the availability of pressurized air. If the supply of pressurized air is interrupted, the switch shall send a signal to the PLC and an alarm message will be generated.

13. Sludge cake shall be automatically discharged through a rectangular sludge discharge opening. The discharge height shall be minimum 37 inches above floor level and shall be identified by the screw press supplier in submittal. The screw press supplier shall provide a flanged flexible connector to facilitate interconnection of the screw press discharge to a conveyor system by the Installation Contractor.

2.4 POLYMER FEED ACCESSORIES

A. The polymer feed system shall be provided by the Screw Press Manufacturer and shall be located in the Dewatering Building. The polymer mix system shall meet the requirements of 46 33 33 – Polymer Mix Units.

B. Polymer dosing ring and polymer mixing valves shall be provided by the screw press manufacturer. One (1) variable weight mixing valve shall be supplied for each dewatering line. The valve body shall be grey cast iron, with ASTM 420 stainless steel wetted parts. Additionally, each line shall be equipped with an injection ring for injection polymer into the sludge line. The injection and mixing devices shall be located upstream of the flocculator.

C. The Screw Press Manufacturer shall size and design stainless steel flocculation reactors to ensure adequate floc formation prior to dewatering.

1. Flocculator reactor, as designed by the screw press manufacturer, shall be supplied by the Vendor (or Installation Contractor if integrated as part of the inlet feed piping) and shall provide a minimum retention time of 45 seconds at design flow for the polymer and sludge mixture. Pipe flocculator shall be constructed of passivated Type 304L stainless steel piping with eccentric reducers to 4” flanged ends to prevent air entrapment and shall allow for operator sampling at the reactor outlet.

D. The size of the piping or tank needs to consider: maximum capacity, loading rate, minimum velocity in piping to avoid sedimentation and conditions which do not negatively impact the flocculation process.

2.5 DRIVES

A. Screw Press:

1. The press screw shall be driven by a shaft mounted planetary gearbox and motor assembly. The planetary gearbox shall be bolted to a machined flange welded to the upper end of the press.

2. The gear reducer shall be driven by a 1,680 rpm, 3-phase, 60 Hertz, 460 volt, continuous-duty permanent magnet motor with a conduit box suitable for outdoor operation. The motor power shall be a maximum of 3.0 HP. Motor efficiency shall exceed 75% over the complete operational range of the screw press.

3. The gearbox shall have the following outputs:

   a. 30,000 Nm output torque

   b. 1.1 rpm output speed

4. Spray wash system shall be driven by a gearbox connected to a 0.1 HP, 460 V, 3 phase motor.

2.6 BEARINGS

A. The shafts shall be equipped with heavy-duty greaseable type, self-aligning ball or roller bearings in sealed, splash proof housings. The housing shall be sealed to provide adequate protection from moisture and grime.

B. All bearings shall have a minimum B-10 bearing life of 500,000 hours based on ANSI-B13.6-1972. The B-10 bearing life of 500,000 hours shall be based on the maximum summation of all forces applied to the bearing.

2.7 DRAINAGE PANS

A. Drainage pans shall be supplied as necessary to contain all filtrate and wash water within the unit and to reduce rewetting of downstream cake. Filtrate and wash water pans shall be constructed of minimum 14-gauge Type 304 stainless steel. All drainage piping shall be furnished adequately sized for the intended service and rigidly attached to the press frame.

2.8 VALVES

A. Solenoid, ball, and/or other valves provided by the Screw Press Manufacturer shall meet or exceed the requirements of Division 40.

1. Valves shall be of a size, type, material, and class suitable for their intended application. Provide stainless steel solenoid valves.

2. Where two or more valves of the same type and size are required, the valves shall be furnished by the same manufacturer.

3. Valve bodies shall be cast, forged, or welded of the materials indicated, with smooth interior passages. Wall thicknesses shall be uniform in agreement with the applicable standards for each type of valve, without casting defects, pinholes, or other defects that could weaken the body. Welds on welded bodies shall be done by certified welders and shall be ground smooth. Valve ends shall be rated for the maximum temperature and pressure to which the valve will be subjected. Valve bonnets shall be clamped, screwed, or flanged to the body and shall be of the same material, temperature, and pressure rating as the body. The bonnets shall have provision for the stem seal with the necessary glands, packing nuts, or yokes.

2.9 ELECTRIC MOTORS

A. Electric motors shall comply with provisions of Division 26.

B. The gearbox shall be driven by a motor with the following characteristics:

1. 3.0 hp or as sized by Screw Press Manufacturer
2. 3-phase, 60 Hz, 460 V
3. Continuous Duty
4. Permanent magnet motor
5. 40°C environmental temperature
6. Insulation Class F
7. Motor efficiency class IE4

C. Electric motors shall be rated for continuous duty at 40 °C ambient and insulated with a minimum of Class F insulation with Class B temperature rise. All motors shall be TEFC or non-ventilated. All motors supplied shall be rated at 150% nameplate horsepower of the required horsepower maximum service condition.

2.10 CONTROLS AND INSTRUMENTATION

A. The entire control system shall be provided by the Screw Press Manufacturer. The controls for the screw press should be provided by one control panel.

B. The Installation Contractor shall provide wiring between all system components as required.

C. The Installation Contractor shall provide separate power supplies as required for the Vendor equipment.

D. The dewatering system shall be full-automatic and shall include the ability to provide control logic for the following components:

1. Single primary control panel for dewatering system
2. Automatic control for the pneumatic pressure cone (if required by manufacturer)
3. Sludge feed pumps and sludge flow meters (provided by Installation Contractor)
4. Air compressor
5. Polymer feed equipment
6. Sludge conveyor (provided by Installation Contractor)

E. The feed pump shall be of the positive displacement type. The pumps shall be controlled through a variable frequency controller (VFD in an MCC – by Installation Contractor) which accepts a speed control signal from the screw press control panel supplied by the Screw Press Manufacturer.

F. Sludge feed flow meters shall be provided and installed by the Installation Contractor and can be used for balance calculations and equipment pacing when press is in operation and to control the polymer feed system.

G. The screw press manufacturer shall program the controls to automatically control the equipment, the system sequencing, and interlock functions. Programming shall include time delay settings to provide a smooth start-up and shutdown of equipment. Programming shall also include coordination signals with systems outside of the scope of supply for the Screw Press Manufacturer to allow for coordination with upstream equipment, downstream equipment and supporting systems. If loss of run status occurs for one press, all equipment related to that press shall be shut down. When an automatic/stop command is sent, the dewatering equipment shall shut down in reverse order to allow for clearing of material prior to equipment stoppage. Timers used in sequencing the shutdown for each piece of equipment shall be operator adjustable.

1. Local Controls: Local controls for the screw press equipment shall be comprised of the screw press main control panel. Local controls for the dewatered sludge conveyor system will be in the conveyor local control panel. Local controls for the polymer mix system shall be in the polymer mix system local control panel. Local controls for the dewatering feed pumps will be in the dewatering feed pump MCC.

    a. Vendor shall provide allowances for terminal blocks, programming, and Operator Interface configuration and related functions to interface with these system's Local Controls for alarm, control, and interlocking functions to provide a fully integrated system.

2. Local Manual Control Mode: The operator may control the polymer system manually at the polymer control panel. The operator may control the dewatered sludge conveyor at the conveyor local control panel. The operator may control the sludge feed pump at the pump VFD.

3. Local Automatic Control Mode: For the Screw Press there are three anticipated modes of operation: Timer, Level and Schedule. Prior to putting each screw press into AUTO, the Operator shall be given the choice to select timer mode, level mode, or schedule mode.

    a. Timer Mode. In the timer mode, the Operator selects the length of time for dewatering to occur and the flow rate for the dewatering feed pump. The screw press control panel (SPCP) shall control the polymer system, the screw press, and the dewatered sludge conveyor. The control panel shall then automatically turn on the conveyor, the polymer feed pump, and then turn on the dewatering feed pump and controls to the selected flow rate. The SPCP shall continue to operate the dewatering system until the selected time has expired or the low level in the sludge holding tank is reached and then turns all the components off in the programmed shut down sequence (determined by Manufacturer).

b. In the Level Mode, the operator selects a level in sludge holding tank in feet from the bottom (operator adjustable), which dewatering feed pump to run, and a flow rate for the dewatering feed pump. This adjustable level setpoint should be at the SPCP. The SPCP controls the polymer system, the screw press, the air panel, and the dewatered sludge conveyor. The SPCP shall then automatically turn on the conveyor, the polymer feed pumps, and then turn on the selected dewatering feed pump and controls to the selected flow rate. The PLC continues to operate the dewatering system until the selected level has been reached in the sludge holding tank and then turns all the components off in the programmed shut down sequence.

c. Schedule Mode. In the schedule mode, the Operator selects either Level or Flow Rate mode.

1) In the Level mode, the Operator selects the level in the sludge holding tank in feet, the flow rate for each pump, the days of the week, and the time of day to start dewatering. The SPCP PLC starts the dewatering on the days selected and at the time selected and operates the dewatering process as noted above for level control for the scheduled time interval set by the operator.

2) In the Flow Rate mode, the Operator selects the flow rate for each pump, the days of the week, the time of day to start, and the time of day to stop the dewatering feed pump. The SPCP PLC starts the dewatering system on the days selected and at the times selected and operates the dewatering process as noted for flow control for the scheduled time interval set by the operator.

4. SCADA Manual Control: None.

5. SCADA Automatic Control: None.

6. Interlocks: The sludge feed pump, polymer mix system, discharge conveyor, air compressor, and other dewatering system appurtenances shall be interlocked with the screw press so that all of the equipment is called to start and stop in sequence when the screw press is called to operate. The entire system shall shut down on failure of or alarms from the feed pump, polymer system, screw press, or solids loading conveyor.

a. The following interlocks shall be satisfied when the control mode selector switch is in automatic or manual position. Failure of any one signal during the start cycle or prior to completion of a cycle shall shut down all associated dewatering equipment.

1) Polymer system servicing the screw press shall be operating and confirmed to be above a minimum allowable operating volume.

2) Discharge conveyor servicing the screw press shall be operating and confirmed by speed reference.

3) Wash water booster pump must be on and have no faults.

4) Air pressure must be sensed at a specified level.

5) Control mode selector switch shall be in “automatic” position for all related support systems (polymer, conveyor, feed pump, etc.).

6) “Emergency Stop” pushbutton shall be in operating position.

7. Local Indicators: The press control panel shall, at a minimum, have a dedicated menu available in the Operator Interface Terminal (OIT) for:

a. Equipment run status.

b. HOA switch

c. Failure alarm(s).

8. SCADA Indicators: As a minimum, the following indicators shall be provided at the SCADA screen.

a. HOA or LOR selector status for dewatering feed pump, press, polymer mix system, and the dewatered sludge conveyor.

b. Run status for pump, polymer system, press and dewatered sludge conveyor – manufacturer standard.

c. Pump speed

d. Elapsed run time meter for dewatering feed pump, press, dewatered sludge conveyor motor, and polymer system in tenths of an hour.

e. Digested sludge flow in gpm for dewatering feed pump.

f. Totalized 24-hour digested sludge flow in gallons for previous day and the current day from midnight to midnight.

g. Level in sludge holding tank in feet.

h. Pressure in the dewatering feed pipe in psi.

i. Selected operating mode (flow, level, scheduled mode) and associated operator setpoints, timer presets, and scheduled operation parameters as set by operators.

9. SCADA Alarms: As a minimum, the following alarms shall be provided to the SCADA system:

a. Common warning alarm (i.e., an active alarm that does not shut down a system but indicates an issue requiring attentions) for each associated system, with an indication as to which system has the active alarm.

b. Common interlock alarm for each associated system, with an indication as to which system caused an interlock-based shutdown to occur

c. These alarms shall be provided for the following systems:

1) Dewatering Feed Pump

2) Polymer system

3) Screw press

4) Dewatered sludge conveyor

5) Process piping alarms (e.g., high discharge pressure)

6) Low spray down water pressure

H. A 480-volt main control panel shall be provided for the screw press. The panel shall be a NEMA 4X-rated, free standing, non-fused through door disconnect, double door, stainless steel enclosure. The enclosure shall be suitable for elevated platform floor mounting, shall have hinged covers which swing horizontally, shall be held closed with a 3-point latch and shall include the following:

1. The single control panel shall house the following major components along with other items required for a functional system:

a. VFD’s and Spray Drives for Screw Press

b. PLC and Slots as needed

c. All relays needed for the system

d. UPS

2. Main power disconnect switch (pad-lockable)

3. Control power transformer

4. Integral Air Conditioning as recommended by the manufacturer

5. Surge arrester, for 480 VAC & 120 VAC

6. Panel lights to include:

a. Control Power On

b. PLC Fault

c. Press 1 Dewatering Mode

d. Press 1 Disturbance

7. Push Buttons to include:

    a. Emergency Stop

    b. System Reset

    c. Alarm Silence

8. Panel switches to include:

    a. Press 1 HOA

    b. Press 1 Forward/Off/Reverse

    c. Spray Wash 1 HOA

    d. Spray Drive 1 HOA

9. Variable Frequency Controller (VFD) including over-current and high temperature protection for screw press main drive and all ancillary equipment requiring variable speed operation to be provided by Vendor. Provide Allen-Bradley PowerFlex 525 VFD (with Ethernet/IP protocol support for native communication with Rockwell Automation processors).

    a. Drives for equipment not supplied by Screw Press Manufacturer (conveyor, sludge feed pump, etc.) shall be Allen-Bradley and provided by the Installation Contractor.

10. The panel shall be designed for manual starting and stopping of all drives. A master manual/auto system switch shall be supplied to override the alarm system and allow operation of any drive through momentary contact pushbutton. The control panel shall contain within the operator interface (OIT/HMI) start/stop functions, run status, and alarm indications for the sludge feed pumps, polymer system, conveyor, and booster pumps.

11. Reversing motor starter including over-current and over-heat protection for the wash water spray drive.

12. Pressure sensor at the inlet of the screw press: 4-20 mA signal is sent to the PLC. The sensor shall also have a discrete relay output, freely adjustable at the sensor, indicating high pressure conditions at the screw press inlet.

13. Programmable logic controller (PLC) Allen Bradley CompactLogix (L33ER or equal) with on-board Ethernet.

14. Operator Interface Terminal (OIT), Allen Bradley PanelView Plus 7 Performance series w/12-inch, color touch screen and Ethernet communication compatible with Rockwell Automation Ethernet/IP Protocol.

15. UPS Battery Backup, Phoenix Quint, 120 VAC, 500 VA, DIN rail mounted. 15 minutes of backup power.

16. Ethernet switch (ESW), Rockwell Automation Stratix 5700 series, RJ45, managed type switch.

17. Control panel shall allow either manual or automatic control of the screw press equipment through the OIT. If manual mode is selected, all equipment shall be controlled with start/stop pushbuttons on the touchscreen. If automatic mode is selected, control of equipment is by the automatic/start and automatic/stop pushbuttons on the OIT and PLC-based sequences and logic.

18. The operator interface terminal shall be equipped with a start/stop switch, open/close switch, run light, off light for each piece of equipment listed in this Section. The screw drive, polymer system, and sludge pump drives as hereafter specified, shall also incorporate speed control and speed indication. The control panel shall include start/stop pushbuttons, run lights, speed control and 4 to 20 mA signal generators for the polymer solution and sludge pump controls.

19. The PLC shall allow for Ethernet connection to SCADA and SCADA historian will provide primary data logging ability. The PLC shall be capable of providing Manufacturer's standard data logging ability for Operator review of recent parameters of interest at the control panel. The data logger shall document all important process parameters including, but not limited to, the following:

    a. Operation mode: OFF, dewatering, back wash, shutdown

    b. Drive operation: forward, reverse

    c. Sludge flow, gpm

    d. Screw Speed

    e. Polymer pacing signal

    f. Pressure screw press inlet

    g. Press motor amperage draw

    h. Set points: feed solids, polymer consumption, hydraulic loading

    i. Timer Mode operation parameters and setting (for logging process parameters when the system was operating under Timer mode operation)

    j. Level Mode operation parameters and settings (for logging process parameters when the system was operating under Level Mode operation)

    k. Scheduled Mode Operation parameters and setting (for logging process parameters when the system was operating under Scheduled mode operation)

20. Running time meter for screw press, sludge feed pumps, and spray drive shall be available within the OIT/HMI.

21. Text messages displayed on touch screen:

    a. Over-current and high-temperature indications

    b. Spray washing system on

    c. Polymer dosing station status

    d. Running time meter for dewatering equipment, associated pumps, and spray drive

22. Operating and warning lights displayed on touch screen:

    a. Power on

    b. Dewatering system in operation

    c. Malfunction indication

    d. Low water pressure

    e. Low air pressure

    f. Reset button

    g. E-Stop button

23. Laminated plastic nametags shall be provided for the name of the control panel and all disconnects, switches, and indicator lights.

24. Spare terminals (control- and power voltage) shall be provided to accommodate for remote control operation and to interface with other equipment components. These following lists do not include standard terminals for the press. Terminal connections shall include, but not be limited to, the following:

    a. Remote polymer injection system

    b. Air supply panel

    c. Sludge feed pump

    d. Conveyor

    e. Sludge holding tank water level

    f. Inputs and Outputs to Dewatering Control Panel:

        1) Inputs to Dewater PLC

            a) Press 1 Air Supply Ok

            b) Poly System 1 Running

c) Poly System 1 Low Pressure

d) Poly System 1 In Remote

e) Poly System 1 Low Flow

f) Low Wash Water Pressure from Booster Pump

g) Conveyor 1 Run Forward

h) Conveyor 1 Run Reverse

i) Conveyor 1 Fault

j) Conveyor 1 Zero Motion

k) Sludge Pump 1 Running

l) Sludge Pump 1 Fault

m) Sludge Pump 1 In Remote

n) Sludge Pump 1 Low Pressure

o) Sludge Pump 1 High Pressure

p) 20% Spares

2) Analog Inputs to PLC

a) Poly system 1 speed feedback

b) Press 1 sludge feed flow (Magnetic Flow Meter)

c) 4-20 mA Sludge Holding Tank Level

d) Press 1 Inlet Pressure

e) Sludge pump 1 speed feedback

f) 20% Spares

3) Outputs from Dewatering Control Panel:

a) Pneumatic Cone 1 Engage

b) Conveyor 1 Call Reverse

c) Conveyor 1 Call Forward

d) Conveyor 1 Fault

e) Sludge Pump 1 Call

f) Poly System 1 Call

g) 20% Spares

4) PLC Analog Outputs:

a) Sludge Pump 1 Speed Cmd

b) Poly System 1 Pacing

c) 20% Spares

g. Hardwire Conveyor interlocks

h. Hardwire Sludge feed pump interlocks

i. SCADA status:

1) Ethernet port to tie into SCADA

2) Inputs to Dewatering Control Panel:

a) Ethernet IP:

- Remote Dewatering System Start Command

3) Outputs from Dewatering Control Panel:

a) Ethernet IP:

- Press Running
- Press Fault
- Dewatering Mode
- System Disturbance
- Sludge Feed Pump Required (SCADA to determine which pump is selected and will marshal signal from Dewatering Press panel to appropriate pump.)
- Sludge Feed Pump Pacing, 0-100% Speed (SCADA to determine what pump is selected and will marshal signal from Dewatering Press panel to appropriate pump.)

2.11 SPARE PARTS

A. The following Spare Parts shall be included and supplied together with the dewatering equipment:

1. One (1) full set of wipers with mounting hardware.

2. One (1) bearing assembly for shaft.

3. One (1) solenoid valve or one (1) motorized ball valve for spray wash system.

4. Ten (10) nozzles for spray washing system.

5. Two (2) relays of each type and size.

B. Spare parts shall be packaged with labels indicating the contents of each package and shall be delivered to Owner as directed.

PART 3 - EXECUTION

3.1 FACTORY TESTING OF CONTROL PANEL

A. Inspection and Approval: Panel fabricator shall conduct the following tests and submit a report of factory testing before shipment:

1. Alarm circuits rung out to determine their operability.

2. Electrical circuits checked for continuity and where applicable, operability.

3. Any other test required to place the panel in an operating condition.

3.2 DELIVERY, STORAGE, AND HANDLING OF EQUIPMENT

A. Equipment shall be shipped and delivered fully assembled, except where partial disassembly is required in order to conform to transportation regulations, for the protection of components, or for setting the equipment on the second floor of the building.

B. See Specification 01 65 00 – Product Delivery Requirements.

3.3 SLUDGE EVALUATION

A. A sludge evaluation shall be performed by the Screw Press Manufacturer before equipment startup.

1. Four weeks before startup, the Owner will send to the Manufacturer a representative sludge sample.

2. The Manufacturer shall perform optimization tests for the polymer. The polymer selected for performance testing shall be readily available for purchase by Owner, and acceptable to the Owner.

B. Manufacturer to optimize process including, but not limited to, polymer dosage, hydraulic loading rate, mixing energy intensity, and unit drive speed, as applicable and possible.

C. Sludge evaluation shall be completed three (3) weeks prior to start-up.

D. Installation Contractor shall provide properly sized polymer totes or tanks as identified by the screw press manufacturer, and as required for the successful completion of functional testing, performance testing, and the 30-day test period prior to substantial completion.

3.4 INSTALLATION, START-UP, AND OPERATOR TRAINING

A. Installation of the equipment shall be in strict accordance with the contract documents and the manufacturer's instructions and shop drawings. Installation Contractor shall supply and install the anchor bolts in accordance with the manufacturer's recommendations

B. After installation, touch-up paint shall be applied to all scratched, abraded, and damaged shop painted surfaces. Coating type and color shall match shop painting. Installation Contractor shall passivate all field welds.

C. Functional testing of the entire screw press dewatering system shall be conducted following inspection, installation, and cleaning of the equipment.

D. The Vendor shall furnish the services of a factory-trained service technician to inspect the installation, conduct start up, and provide operator training. Vendor shall verify all dimensions in the field to ensure compliance of equipment dimensions with the drawings. Vendor shall notify Engineer of significant deviations.

1. Perform performance testing as specified in Section 3.5.

E. Service technician shall be onsite for a minimum of **two workdays (1 day for startup, 1 day for performance testing and operator training as specified in Paragraph 3.5)** at startup to provide the following additional startup services.

1. Provide Operator training after successful startup of the equipment.

2. Installation Contractor shall videotape the manufacturer-led training session and provide to Owner. Allow for a minimum of one training session of a maximum of four (4) hours following a course outline acceptable to the Engineer. Training shall take place during regular work hours, Monday through Friday, excluding City holidays. Anticipated course outline could include the following subjects:

a. Startup procedures.

b. Shutdown procedures.

c. Troubleshooting.

d. Selection of proper polymer types and dosages.

e. Replacement of unit components.

f. Operating adjustments for performance optimization.

g. Preventive maintenance.

h. Maintenance procedures.

i. Emergency procedures.

j. Record keeping.

k. Mechanical unit function and description.

l. Variable frequency drives.

m. System controls.

3. Workday: A “workday” shall be defined as an eight (8) hour work period onsite, excluding all travel time to and from the site.

3.5 PERFORMANCE TEST

A. Immediately following equipment startup, the Owner, in conjunction with the Screw Press Manufacturer, shall conduct a performance test of the dewatering system to verify that the unit meets the minimum performance requirements specified.

B. Performance test shall be five (5) days in duration, six (6) hours of operation each day.

C. The Owner shall operate the equipment throughout the duration of the test, obtain the samples, and document the data needed to confirm the performance of the dewatering system. Manufacturer’s representative shall be onsite for the first day of equipment operation (Day 2 of Manufacturer’s startup services) and shall be available via phone or videoconference during the remainder of the testing period.

1. Owner will conduct the laboratory tests.

D. The Screw Press Manufacturer shall provide an acceptable written **Performance Test Procedure** that includes sampling frequency and required analyses for Owner review at least 30 days prior to startup. Manufacturer shall also provide the recommended polymer and dosage identified in Paragraph 3.3.

E. At a minimum, one sample of the following flow streams shall be obtained for every hour of operation during the performance testing. Parameters to be identified, at a minimum, include:

1. Feed sludge: TSS

2. Pressate: TSS, Capture Rate (Calculated)

a. Capture Rate will be calculated using the equation below where Q represents flow in gpm, S represents the combined washwater & polymer water flow in gpm, C represents discharge cake in % TS, F represents feed solids in % TS, and E is the filtrate solids in % TS.

1) $$Percent\ Capture = \frac{C}{F} * \frac{F-\left(E*\frac{Q+S}{Q}\right)}{C-\left(E*\frac{Q+S}{Q}\right)} * 100$$

3. Dewatered sludge: Percent Solids

F. The following process data shall be recorded and documented each ½ hour of the test:

1. Feed sludge flow rate.

a. If required, feed sludge flow rate to the screw press will be adjusted based on the inlet feed solids concentration to provide an equivalent loading rate to that identified in Paragraph 2.2.B of this specification.

2. Polymer dosage and feed rate.

3. Cumulative feed sludge flow each day of operation.

4. Alarm conditions.

5. Equipment problems.

6. Screw speed

G. Once the screw press operation has stabilized, the Owner may elect to reduce the number of samples to be analyzed each day. Owner may elect to collect additional information on the samples taken at Owner's discretion.

H. In the case of nonacceptable performance, the Screw Press Manufacturer shall then have 15 days in which to perform, at its sole expense, any supplemental testing, equipment adjustments, changes, or additions and request an additional re-test of the nonacceptable system.

1. If the modified equipment then does not meet the guaranteed performance requirements of this Section, all or part of the final payment of the total lump sum price shall be retained as damages, or

2. Owner may elect to have the manufacturer remove the unit and refund any monies paid.

I. Performance testing records will be maintained per Section 3.7.

3.6 30-DAY RELIABILITY TEST

A. Immediately following successful completion of the performance test, the Owner shall operate the equipment system and pass a 30-day reliability test prior to acceptance. All Vendor equipment must properly run for the 30-day test period. If any item malfunctions during the test, the item shall be repaired, and the test restarted at day zero with no credit given for the operating time before the aforementioned malfunction.

B. The Screw Press Manufacturer shall provide an acceptable written **30-Day Reliability Test Procedure** that includes sampling frequency and required analyses for Owner review at least 30 days prior to startup. Manufacturer shall modify the testing procedure based on the results of the performance testing as needed.

C. The Owner and/or Engineer shall provide the effective coordination of all parties necessary for successful 30-day test.

D. The Owner shall start the 30-day test by introducing process flow through the equipment.

E. All defects in material or workmanship which appear during the tests shall be immediately corrected by the Vendor or Installation Contractor as applicable.

F. The Installation Contractor shall lubricate and maintain the equipment in accordance with the manufacturer's recommendations.

G. During the 30-day test, the Vendor shall be available via telephone or videoconference communications to provide remote troubleshooting services and, if ultimately necessary due to equipment malfunction, shall provide the services of an authorized representative at no cost to the Owner to correct faulty equipment operation. Services of the authorized representative during the 30-day test shall be in addition to those services required under performance testing, and as necessary, at no cost to the Owner, to correct faulty equipment.

H. Reliability testing records will be maintained per Section 3.7.

I. After successful completion and acceptance of the 30-day test, the Installation Contractor shall complete closeout of the project.

3.7 RECORDS OF TESTING AND STARTUP

A. The Owner shall maintain the following records during the 5-Day Performance Test and 30-Day Reliability Testing and submit originals to the Engineer prior to acceptance of tests and before substantial completion will be considered:

1. Sample test results.

2. Lubrication and service records.

3. Hours of daily operation for each mechanical and electrical equipment item.

4. Testing and validation of status indications and alarms.

5. Log of problems encountered, and adjustments made.

6. Other records, logs, and checklists as included in the Screw Press Manufacturer's testing procedures.

END OF SECTION 46 76 27

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RFP/PRE-PURCHASE
NOT FOR
CONSTRUCTION

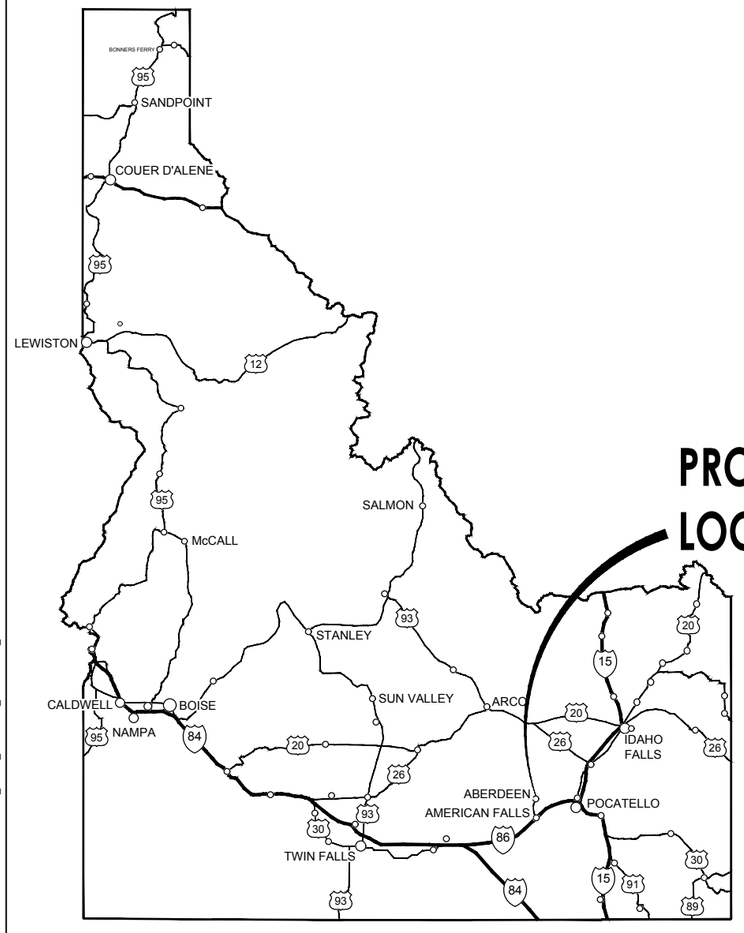
City of

ABERDEEN, IDAHO

WASTEWATER TREATMENT PLANT IMPROVEMENTS

FEBRUARY 2023

PRE-PURCHASE DRAWINGS



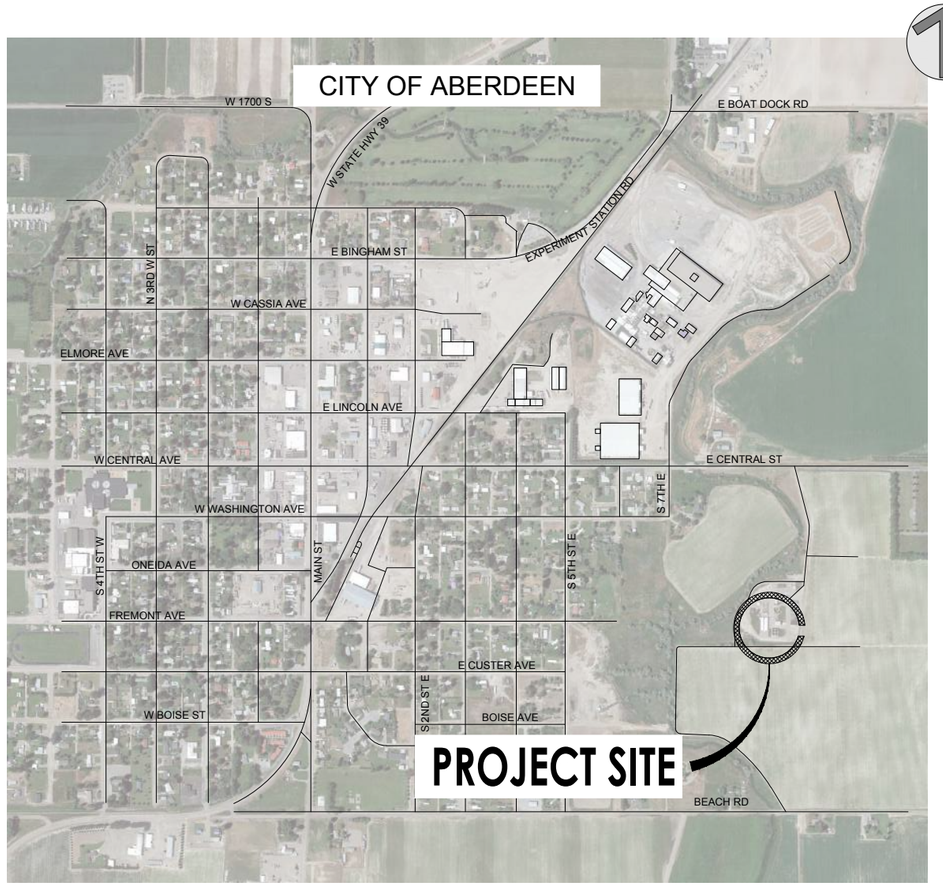
PROJECT LOCATION

OWNER
CITY OF ABERDEEN
PO BOX 190
ABERDEEN, ID 83210
CONTACT: LARRY BARRETT, MAYOR
PHONE: 208-397-416
EMAIL: mayor@aberdeenidaho.us

CIVIL ENGINEER
KELLER ASSOCIATES, INC.
305 N. 3RD AVENUE, SUITE A
POCATELLO, ID 83201
CONTACT: MATTEW HILL, P.E.
PHONE: (208) 238-2146
EMAIL: mhill@kellerassociates.com

811
Know what's **below.**
Call before you dig.
800.342.1585

A1 LOCATION MAP
N.T.S.



A2 VICINITY MAP
N.T.S.

KELLER ASSOCIATES
305 North 3rd Ave, Suite A
Pocatello, Idaho 83201
(208) 238-2146

30% Design Review
Not For Construction

NO.	REVISIONS	DATE

ABERDEEN WWTP IMPROVEMENTS

COVER SHEET

DRAWN: SMC | CHECK: HCJ

VERIFY SCALE: Scales based on 22"x34" prints.
1-1/2 Inches

PROJECT NO. 222032 | PAGE

SHEET NO. G-001

J:\222032 ABERDEEN WW IMPRIB_PREPURCHASE-EQUIPMENT_CAD\2_DESIGN\D_PLANS-101_GEN\G-001.DWG LAST SAVED: 2/24/2023 9:22 AM PRINTED: 2/24/2023 10:24 AM

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LIST OF DRAWINGS

GENERAL

DISCIPLINE DESIGNATORS

G	GENERAL DRAWINGS
V	SURVEY DRAWINGS
C	CIVIL DRAWINGS
A	ARCHITECTURAL DRAWINGS
S	STRUCTURAL DRAWINGS
MP	PLUMBING DRAWINGS
MH	HVAC DRAWINGS
M	MECHANICAL PROCESS DRAWINGS
E	ELECTRICAL DRAWINGS
EI	ELECTRICAL INSTRUMENTATION DRAWINGS

CIVIL SHEET TYPES

0XX	GENERAL (SYMBOLS LEGEND, NOTES, KEY MAPS, ETC.)
1XX	SITE (TOPOGRAPHY, DEMOLITION, SITE LAYOUTS, ETC.)
2XX	GRADING (GRADING, DRAINAGE, EXCAVATION, ETC.)
3XX	ROADWAY (ROADWAY DESIGN, PLAN & PROFILES, ETC.)
4XX	UTILITY (PLAN VIEW, PLAN & PROFILES, ETC.)
5XX	PROJECT DETAILS
55X	AGENCY DETAILS
6XX	MISCELLANEOUS

STRUCTURE SHEET TYPES

0XX	GENERAL (SYMBOLS LEGEND, NOTES, ETC.)
1XX	PLANS (HORIZONTAL VIEWS)
2XX	ELEVATIONS (VERTICAL VIEWS)
3XX	SECTIONS (SECTION VIEWS)
4XX	LARGE SCALE VIEWS (PLANS, ELEVATIONS OR SECTIONS)
5XX	PROJECT DETAILS
6XX	SCHEDULES AND DIAGRAMS
7XX	USER DEFINED (FOR TYPES WHICH DO NOT FALL IN OTHER CATEGORIES)

STRUCTURE DESIGNATORS

A - HEADWORKS (E)
B - IFAS (E)
B1 - IFAS SPLITTER BOX (N)
B2 - IFAS BLOWER BUILDING (N)
B3 - EBPR TREATMENT (FUTURE)
C - CLARIFIERS (E)
D - TERTIARY TREATMENT (N)
D1 - TERTIARY LIFT STATION (N)
E - CONTROL & DEWATERING BUILDING (N)
F - CONTROL BUILDING (E)
G - DIGESTERS (E)
G1 - DIGESTER BLOWER BUILDING (E)
G2 - DECANT LIFT STATION (E)
H - ELECTRICAL BUILDING (E)
I - SLUDGE DRYING BEDS (E)
J - MAINTENANCE BUILDING (E)
K - UV BUILDING (E)

SHEET NUMBERING KEY

DISCIPLINE DESIGNATOR → M - 101 - C ← STRUCTURE DESIGNATOR (OPTIONAL)
SHEET TYPE

DETAIL & SECTION CALLOUT KEY

(REFERENCE)
RE: A1/S-101-A ← (PROJECT DETAIL NO./SHEET NO.)
RE: S120 ← (STANDARD DETAIL NO.)

C2 ← (DETAIL NO.) → A1
S-301-B ← (SHEET NO.) → C-204

M303 ← (STANDARD DETAIL NO.)

(PROJECT DETAIL NO./GRID LOCATION)
A1 PROJECT DETAIL ← (DETAIL TITLE)
SCALE: 1"=1'

(STANDARD DETAIL NO.)
S120 TYP STANDARD DETAIL ← (DETAIL TITLE)
N.T.S.

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NO.	REVISIONS	DATE

City of Aberdeen

ABERDEEN WWTP IMPROVEMENTS

SHEET INDEX

DRAWN: DAC | CHECK: HCJ

VERIFY SCALE: Scales based on 22"x34" prints.
0 1 2
1-1/2 Inches

PROJECT NO. 222032 | PAGE

SHEET NO. G-002

J:\222032 ABERDEEN WW IMPR\B_PREPURCHASE-EQUIPMENT_CAD\2_DESIGN\D_PLANS-1101_GEN\G-002.DWG LAST SAVED: 2/23/2023 3:04 PM PRINTED: 2/24/2023 10:25 AM

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GENERAL ABBREVIATIONS

A

A	-AMPERE
AB	-ANCHOR BOLT
ABI	-ADDITIVE BID ITEM
AC	-ASPHALTIC CONCRETE
	-ACOUSTIC
A/C	-AIR CONDITIONING
ACC	-AREA CONTROL CENTER
ACOU	-ACOUSTIC
ACP	-ASBESTOS
ACT	-ACOUSTICAL CEILING TILE
AD	-ANAEROBIC DIGESTER
ADD	-ADDITION(AL)
ADF	-AVERAGE DESIGN FLOW (AVERAGE DAY, PEAK MONTH)
ADH	-ADHESIVE
ADJ	-ADJUSTABLE
ADPT	-ADAPTER
AF	-AIR FILTER
AFF	-ABOVE FINISHED FLOOR
AHU	-AIR HANDLING UNIT
AL	-ALUMINUM, ALUM
ALP	-AIR LOW PRESSURE
ALT	-ALTERNATE
A/O	-ANOXIC
	-OXIC
AP	-AIR PROCESS
APPX	-APPROXIMATE(LY)
AR	-AIR RETURN
ARV	-AIR RELEASE VALVE
ARCH	-ARCHITECTURAL
AS	-AIR SUPPLY
ASME	-AMERICAN SOCIETY OF MECHANICAL ENGINEERS
ASTM	-AMERICAN SOCIETY OF TESTING MATERIALS
ATM	-ATMOSPHERE
AUTO	-AUTOMATIC
AUX	-AUXILIARY
AV	-ANGLE VALVE
AVAR	-AIR VACUUM AND AIR RELEASE
AVE	-AVENUE

B

B	-BOTTOM
B/C	-BOTTOM OF CURB
BAC	-BACTERIOLOGICAL
BC	-BEGINNING OF CURVE
BCR	-BEGINNING OF CURVE CENTER
BD	-BOARD
BF	-BLIND FLANGE
BFP	-BACKFLOW PREVENTER
BFV	-BUTTERFLY VALVE
BHP	-BRAKE HORSEPOWER
BKR	-BREAKER
BLDG	-BUILDING
BLK	-BLOCK
BLVD	-BOULEVARD
BO	-BLOW OFF
BOD	-BIOCHEMICAL OXYGEN DEMAND
BOD5	-BIOCHEMICAL OXYGEN DEMAND, 5 DAY
BOP	-BOTTOM OF PIPE
	-BACK OF PIPE
BOT	-BOTTOM
BP	-POINT OF BEGINNING
BRG	-BEARING
BSN	-BAR SCREEN
BTD	-BIOTOWER DRAIN
BTI	-BIOTOWER INFLUENT
BTU	-BRITISH THERMAL UNIT
BV	-BALL VALVE
BVCE	-BEGIN VERTICAL CURVE ELEVATION
BVCS	-BEGIN VERTICAL CURVE STATION

C

C	-CELSIUS
	-CONDUIT
CAB	-DIRECT BURIAL CABLE
	-CABINET
CAF	-COMBUSTION AIR FAN
CATV	-CABLE TELEVISION
CB	-CATCH BASIN
CBOD5	-CARBONACEOUS BIOCHEMICAL OXYGEN DEMAND, 5 DAY
C/C	-CENTER TO CENTER
CCP	-CONCRETE CYLINDER PIPE
CCSP	-CONCRETE PINED AND COATED STEEL PIPE
CD	-CEILING DIFFUSER
CDF	-CONTROL DENSITY FILL
CDR	-CONDUCTOR
CDS	-CHEMICAL DOSING
CDU	-CONDENSING UNIT
CED	-CEILING EXHAUST DIFFUSER
CER	-CEILING EXHAUST REGISTER
CF	-CUBIC FOOT
CFM	-CUBIC FEET PER MINUTE
CFR	-CODE OF FEDERAL REGULATIONS
CFS	-CUBIC FEET PER SECOND
CH	-CHANNEL
CI	-CAST IRON
CIP	-CAST IRON PIPE
CJ	-CONSTRUCTION JOINT
	-CONTROL JOINT
CK	-CHECKER(ED)
CKPL	-CHECKER PLATE
CKT	-CIRCUIT
CL	-CHLORINE LIQUID
	-CHAIN LINK
	-CLEARANCE
	-CENTERLINE
CL2	-CHLORINE
CLG	-CEILING
CLO	-CHLORINE
CLR	-CLEAR
CLS	-CHLORINE SOLUTION
CMC	-CEMENT MORTAR COATED
CML	-CEMENT MORTAR LINED
CMP	-CORRUGATED METAL PIPE
CMU	-CONCRETE MASONRY UNIT
CND	-CONDUIT
CNTL	-CONTROL
CO	-CLEANOUT
COD	-CHEMICAL OXYGEN DEMAND
COL	-COLUMN
COM	-COMMINUTOR
CON	-CONVEYOR
CONC	-CONCRETE
COND	-CONDITION
CONN	-CONNECTION
CONST	-CONSTRUCTION
CONT	-CONTINUOUS
COTG	-CLEANOUT TO GRADE
CPLG	-COUPLING
CPVC	-CHLORINATED POLYVINYL CHLORIDE
CR	-CIRCLE
CSL	-COMBINED SLUDGE
CT	-CONTACT TIME
CTF	-CENTRIFUGE
CU	-CUBIC
CV	-CHECK VALVE
CV	-CONTROL VALVE
C/W	-COMPLETE WITH
CW	-CULINARY WATER (POTABLE)
CWR	-COOLING WATER RETURN
CWS	-COOLING WATER SUPPLY
CY	-CUBIC YARD

D

DAF/DAFT	-DISSOLVED AIR FLOTATION
DB	-DUCT BANK
	-DOWEL BAR
DBA	-DEFORMED BAR ANCHOR
DBL	-DOUBLE
DEMO	-DEMOLISH
DET	-DETAIL
DF	-DRINKING FOUNTAIN
DI	-DUCTILE IRON
DIA	-DIAMETER
DIAG	-DIAGRAM
DIFF	-DIFFERENTIAL
DIM	-DIMENSION
DIP	-DUCTILE IRON PIPE
DIR	-DIRECTION
DISCH	-DISCHARGE
DO	-DISSOLVED OXYGEN
DR	-DRAIN
DS	-DRUM SCREEN
DTL	-DETAIL
DWF	-DRY WEATHER FLOW
DWG	-DRAWING

E

(E)	-EXISTING
E	-EPOXY
	-EAST
EA	-EACH
	-EXHAUST AIR
ECC	-ECCENTRIC
EF	-EACH FACE
	-EXHAUST FAN
EFF	-EFFLUENT
EG	-EDGE OF GRAVEL
EJ	-EXPANSION JOINT
EL	-ELEVATION
ELEV	-ELEVATION
ELL	-ELBOW
EMBED	-EMBEDMENT
ENG	-ENGINEERED
EOP	-END OF PIPE
EP	-EDGE OF PAVEMENT
EPDM	-ETHYLENE PROPYLENE DIENE MONOMER
EQ	-EQUAL
EQUIP	-EQUIPMENT
EOR	-ENGINEER OF RECORD
EP	-EDGE OF PAVEMENT
EQ	-EQUAL
	-EQUATION
	-EQUALIZATION
EVCE	-END VERTICAL CURVE ELEVATION
EVCS	-END VERTICAL CURVE STATION
EW	-EACH WAY
EWEF	-EACH WAY EACH FACE
EWS	-EYE WASH STATION
EX	-EXISTING
EXIST	-EXISTING
EXT	-EXTERIOR

F

F	-FAHRENHEIT
FA	-FOUL AIR
FAB	-FABRICATE(D)
	-FABRICATION
FAI	-FRESH AIR INTAKE
FC	-FAIL CLOSED
FCA	-FLANGE COUPLING ADAPTER
FCO	-FLOOR CLEAN OUT
FCR	-FINE CRUSHED ROCK
FCV	-FLOW CONTROL VALVE
FD	-FLOOR DRAIN
	-FOUND
FE	-FIRE EXTINGUISHER
	-FLOW ELEMENT
	-FINAL EFFLUENT
FF	-FINISH FLOOR
	-FLAT FACE
FG	-FINISH GATE
FH	-FIRE HYDRANT
FIN	-FINISH
FIT	-FLOW INDICATOR TOTALIZER
FL	-FLANGE
	-FLOORING
	-FLOW LINE
FLC-	-FLOCCULATOR
FLEX	-FLEXIBLE
FLG	-FLANGE(D)
FLR	-FLOOR
FLT	-FILTER
FM	-FORCE MAIN
FMH	-FLEXIBLE METAL HOSE
FMX	-FLASH MIXER
FND	-FOUNDATION
FO	-FAIL OPEN
	-FIBER OPTICS
FPC	-FLEXIBLE PIPE COUPLING
FPS	-FEET PER SECOND
FRP	-FIBERGLASS REINFORCED PLASTIC
FS	-FAR SIDE
	-FLOW SWITCH
FT	-FEET
	-FOOT
FTG	-FOOTING
FUT	-FUTURE

G

GA	-GAGE
	-GAUGE
GAL	-GALLON
GALV	-GALVANIZED
GAS	-NATURAL GAS
GB	-GRADE BREAK
GBV	-GLOBE VALVE
GCO	-GROUND CLEAN OUT
GDR	-GRINDER
GEN	-GENERAL
GFD	-FLUX UNITS
GFI	-GROUND FAULT INTERRUPTER
GI	-GALVANIZED IRON
	-GRAVITY IRRIGATION
GL	-GLASS
	-GLASS LINED
GND	-GROUND
GPD	-GALLONS PER DAY
GPM	-GALLONS PER MINUTE
GRD	-GRADE
GRDR	-GRINDER
GRT	-GROUT
GRTG	-GRATING
GSKT	-GASKET
GSN	-GENERAL STRUCTURAL NOTES
GTS	-GRAVITY THICKENER SUPERNATANT
GV	-GATE VALVE
GYP	-GYPSUM

H

H	-HORIZONTAL
H/A	-HAND AUTO
H/B	-HOSE BIBB
HD	-HEAVY DUTY
HDPE	-HIGH DENSITY POLYETHYLENE
HDR	-HEADER
HEX	-HEXAGONAL
HG	-MERCURY
HH	-HANDHOLE
HM	-HOLLOW METAL
HOA	-HAND-OFF-AUTO
HOR	-HORIZONTAL
HP	-HORSEPOWER
	-HIGH PRESSURE
HR	-HOUR
HRT	-HYDRAULIC RETENTION TIME
HSA	-HEADED STUD ANCHOR
HSS	-HOLLOW STRUCTURAL SECTION
HT	-HEIGHT
HTR	-HEATER
H/V	-HEATING AND VENTILATING
HV	-HAND VALVE
HVAC	-HEATING AND AIR CONDITIONING
HWL	-HIGH WATER LEVEL
HWP	-HOT WATER PUMP
HWR	-HOT WATER RETURN
HWS	-HOT WATER SUPPLY
HYD	-HYDRAULIC
HYDT	-HYDRANT
HZ	-HERTZ (CYCLES PER SECOND)

I

I	-INFLUENT
IC	-INTERMEDIATE CLARIFIER(S)
ICE	-INTERMEDIATE CLARIFIER EFFLUENT
ICI	-INTERMEDIATE CLARIFIER INFLUENT
ICS	-INTERMEDIATE CLARIFIER SLUDGE
ID	-INSIDE DIAMETER
IE	-INVERT ELEVATION
IF	-INSIDE FACE
IN	-INCH
INFO	-INFORMATION
INT	-INTERIOR
	-INTERSECTION
INV	-INVERT
I/O	-INPUT/OUTPUT
IRR	-IRRIGATION
IS	-INERT SOLIDS
ISPWC	-IDAHO STANDARDS FOR PUBLIC WORKS CONSTRUCTION
IT	-INSTRUMENT TAP

J

JB	-JUNCTION BOX
JCT	-JUNCTION
JST	-JOIST
JT	-JOINT
	-JOINT UTILITY TRENCH

K

K	-KIP (1,000 POUNDS)
	-CURVE K VALUE
KV	-KILOVOLT
KVA	-KILOVOLT AMPERE
KW	-KILOWATT
KWH	-KILOWATT HOUR

L

LAM	-LAMINATED
LB	-POUND
LBS/DAY	-POUNDS PER DAY
LEV	-LEVEL
LF	-LINEAL FOOT
LG	-LONG
LH	-LEFT HAND
LIT	-LEVEL INDICATOR TRANSDUCER
LLH	-LONG LEG HORIZONTAL
LLV	-LONG LEG VERTICAL
LP	-LOW PRESSURE
LS	-LIMIT SWITCH
LSH	-LEVEL SWITCH HIGH
LSL	-LEVEL SWITCH LOW
LSLL	-LEVEL SWITCH LOW LOW
LV	-LOW VOLTAGE
LVC	-LENGTH VERTICAL CURVE
LVR	-LOUVER
LWL	-LOW WATER LEVEL
LWR	-LOWER
LLH	-LONG LEG HORIZONTAL
LLV	-LONG LEG VERTICAL

M

M	-METER
	-MALE (PIPE THREAD)
	-MOTOR
MA	-MILLIAMPERE
MAG	-MAGNETIC
MAN	-MANUAL
MAS	-MEMBRANE AIR SCOUR
MAT'L	-MATERIAL
MAX	-MAXIMUM
MBR	-MEMBRANE BIO-REACTOR
	-MEMBER
MCC	-MOTOR CONTROL CENTER
MCU	-MASTER CONTROL UNIT
MD	-MOTORIZED DAMPER
MDS	-MESOPHILIC DIGESTED SLUDGE
ME	-MISCELLANEOUS MECHANICAL EQUIPMENT
MECH	-MECHANICAL
MFR	-MANUFACTURER
MG	-MILLION GALLONS
MGD	-MILLION GALLONS PER DAY
MGL	-MILLIGRAM PER LITER
MGR	-MANAGER
MH	-MANHOLE
MHHW	-MEAN HIGH HIGH WATER
MID	-MIDDLE
MIN	-MINIMUM
	-MINUTE
MISC	-MISCELLANEOUS
MJ	-MECHANICAL JOINT
ML	-MIXED LIQUOR
	-MILLILITER
MLLW	-MEAN LOWER LOW WATER
MLW	-MEAN LOW WATER
MM	-MILLIMETER
MO	-MOTOR OPERATOR
MPH	-MILES PER HOUR
MTR	-MOTOR
MV	-MUD VALVE
	-MILLIVOLT
MX	-MIXER

N

(N)	-NEW
N	-NORTH
NC	-NORMALLY CLOSED
NAOH	-SODIUM HYDROXIDE
NE	-NORTHEAST
NEG	-NEGATIVE
NEMA	-NATIONAL ELECTRICAL MANUFACTURERS
NG	-NATURAL GAS
NIC	-NOT IN CONTRACT
NO	-NORMALLY OPEN
NOM	-NOMINAL
NPS	-NOMINAL PIPE SIZE
NPSH	-NET POSITIVE SUCTION HEAD
NPT	-NATIONAL PIPE THREAD
NTS	-NOT TO SCALE
NTU	-NEPHELOMETRIC TURBIDITY UNITS
NU	-NOT USED
NW	-NORTHWEST

O

OAI	-OUTSIDE AIR INTAKE
OC	-ON CENTER
OD	-OUTSIDE DIAMETER
	-OVERALL DIAMETER
OF	-OVERFLOW
	-OUTSIDE FACE
OFF	-OFFSET
OH	-OVERHEAD
OHP	-OVERHEAD POWER
OL	-OVERLOAD
O/O	-OUT TO OUT
OP	-OVERHEAD POWER
ORP	-OXIDATION REDUCTION POTENTIAL
OSC	-ODOR SCRUBBER

P

P	-PHOSPHOROUS
	-PUMP
PA	-PROCESS AIR
PAR	-PARALLEL
PC	-PIPE COUPLING
	-PRECAST
	-POINT OF CURVATURE
P/C	-PLAIN CONCRETE (NO REINFORCING STEEL)
PCC	-PLANT CONTROL CENTER
PD	-PLANT DRAIN
PDR	-POND DRAIN
PE	-PRIMARY EFFLUENT
	-PLAIN END
	-PLANT EFFLUENT
	-POLYELECTROLYTE
	-POLYMER
PEN	-PENETRATION
PG	-PRESSURE GAUGE
PH	-HYDROGEN ION CONCENTRATION
PI	-PLANT INFLUENT
	-POINT OF INTERSECTION
	-PRESSURE INDICATOR
	-PRESSURE IRRIGATION
PID	-PROPORTIONAL PLUS INTEGRAL PLUS DERIVATIVE CONTROL
PK	-PEAK
P/L	-PROPERTY LINE
PL	-PLATE
PLC	-PROGRAMMABLE LOGIC CONTROLLER
PLE	-PLANT EFFLUENT
PLY	-PLYWOOD
PO4	-PHOSPHATE
PP	-POWER POLE
	-UTILITY POLE
PPD	-POUNDS PER DAY
PPH	-POUNDS PER HOUR
PRE	-PRIMARY EFFLUENT
PRMT	-PERMEATE
PRV	-PRESSURE REGULATING
	-PRESSURE RELIEF
	-PRESSURE REDUCING VALVE
PS	-PRESSURE SWITCH
	-PRESSURE SEWER
PSH	-PRESSURE SENSORS
PSIA	-POUNDS PER SQUARE INCH ABSOLUTE
PSI	-POUNDS PER SQUARE INCH
PSIG	-POUNDS PER SQUARE INCH GAUGE
PT	-POINT OF TANGENCY
	-POINT
PV	-PLUG VALVE
	-PROCESS VARIABLE
PVC	-POLYVINYL CHLORIDE
PVI	-POINT OF VERTICAL INTERSECTION
PVT	-PAVEMENT

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ABERDEEN WWTP IMPROVEMENTS

ABBREVIATIONS

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VERIFY SCALE: Scales based on 22"x34" prints.

1-1/2 Inches

PROJECT NO. 222032 | PAGE

SHEET NO. G-006

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Xref ... \\h...MODELS\...STAMPS\STAMP...GENERAL.dwg

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GENERAL ABBREVIATIONS

Q

QCPL	-QUICK COUPLING
QTY	-QUANTITY

R

R	-RADIUS
	-RISER
RA	-RETURN AIR
RAS	-RETURN ACTIVATED SLUDGE
RB	-RUBBER WALL BASE
RCP	-REINFORCED CONCRETE PIPE
RCR	-RECORDER
RCY	-RECYCLE
RD	-ROOF DRAIN
	-ROAD
RE:	-REFERENCE
RECP	-RECEPTACLE
RED	-REDUCE(R)
	-REDUCING
REF	-REFERENCE
REG	-REGULATOR
REINF	-REINGORCEMENT(ING)
REL	-RELAY
REQ'D	-REQUIRED
RF	-RAISED FACE
RGS	-RIGID GALVANIZED STEEL
RH	-RIGHT HAND
RI	-RAPID INFILTRATION
RM	-ROOM
RO	-ROUGH OPENING
RPM	-REVOLUTIONS PER MINUTE
RR	-RAILROAD
RS	-RECIRCULATED SLUDGE
RT	-RIGHT
RV	-RELIEF VALVE
R/W	-RIGHT OF WAY
ROW	-RIGHT OF WAY

S

S	-SOUTH
	-SCUM
	-SINK
	-SECOND
	-SLOPE
SA	-SAMPLE
	-SUPPLY AIR
SB	-SCUM BAFFLE
SBR	-SEQUENCING BATCH REACTOR
SCFM	-STANDARD CUBIC FEET PER MINUTE
SCH	-SCHEDULE
SCM	-SCUM
SCR'D	-SCREWED
SD	-SMOKE DETECTOR
	-STORM DRAIN
SDMH	-STORM DRAIN MANHOLE
SDR	-STORM DRAIN
SE	-SECONDARY EFFLUENT
	-SOUTH EAST
SEC	-SECONDARY CLARIFIER EFFLUENT
SECT	-SECTION
SEP	-SEPARATOR
SF	-SQUARE FOOT
SG	-SUPPLY GRILLE
SHT	-SHEET
SHTH'G	-SHEATHING
SIM	-SIMILAR
SO2	-SULFUR DIOXIDE
SOR	-SURFACE OVERFLOW RATE
SPEC	-SPECIFICATION SECTION
SP	-SPACES
SPC'G	-SPACING
SPL	-SPLICE
SQ	-SQUARE
SRT	-SOLIDS RETENTION TIME
SS	-SANITARY SEWER
	-STAINLESS STEEL
	-SERVICE TANK
	-SUSPENDED SOLIDS
SSMH	-SANITARY SEWER MANHOLE
SST	-STAINLESS STEEL TUBING
ST	-START
	-STREET
STA	-STATION
STD	-STANDARD
STL	-STEEL
STOR	-STORAGE
STRUC	-STRUCTURAL
SV	-SOLENOID VALVE
SVI	-SLUDGE VOLUME INDEX
SW	-SOUTHWEST
	-SOCKETWELD
SYM	-SYMMETRICAL

T

T	-THERMOSTAT
	-TREAD OF STAIR
	-TANGENT
	-TOP
TB	-TERMINAL BOX
	-TOP AND BOTTOM
TC	-TOP OF CURB
T/D	-TELEPHONE/DATA COMMUNICATIONS
TD	-TIME DELAY RELAY
	-TANK DRAIN
TE	-TERTIARY EFFLUENT
	-TOTALLY ENCLOSED
TEL	-TELEPHONE
TEMP	-TEMPERATURE
	-TEMPORARY
TERM	-TERMINATE
THD'D	-THREADED
THRU	-THROUGH
T&G	-TONGUE AND GROOVE
TK	-TANK
TKN	-TOTAL KJELDAHL NITROGEN
TOC	-TOP OF CONCRETE
TOF	-TOP OF FOOTING
TOG	-TOP OF GROUT
TOP	-TOP OF PIPE
TOM	-TOP OF MASONRY
TOW	-TOP OF WALL
TP	-TOTAL PHOSPHORUS
TPD	-TONS PER DAY
TR	-TIMING RELAY
TRANS	-TRANSMITTANCE
	-TRANSFORMER
TRM	-TRANSMITTER
TRN	-TRANSDUCER
TS	-TEMPERATURE SWITCH
	-TUBE STEEL
TSS	-TOTAL SUSPENDED SOLIDS
TV	-TELEVISION
TYP	-TYPICAL

U

UG	-UNDERGROUND
UGP	-UNDERGROUND POWER
UH	-UNIT HEATER
UL	-UNDERWRITERS LABORATORIES
	-ULTIMATE LOAD
UN	-UNION
UNO	-UNLESS NOTED OTHERWISE
U/P	-UTILITY POLE
UPS	-UNINTERRUPTIBLE POWER SUPPLY
UV	-ULTRA VIOLET
UW	-UTILITY WATER (NONPOTABLE)

V

V	-VALVE
	-VENT
	-VOLTS
	-VAULT
VAC	-VACUUM
	-VOLTS ALTERNATING CURRENT
VAR	-VARIABLE
VB	-VALVE BOX
VCP	-VITRIFIED CLAY PIPE
VCT	-VINYL COMPOSITE TILE
VDC	-VOLTS DIRECT CURRENT
VERT	-VERTICAL
VOL	-VOLUME
VSS	-VOLATILE SUSPENDED SOLIDS
VTC	-VENT TO CEILING
VTR	-VENT THRU ROOF

W

W	-POTABLE WATER
	-WEST
W/	-WITH
WAS	-WASTE ACTIVATED SLUDGE
WC	-WATER COLUMN
WCO	-WALL CLEAN OUT
WEG	-WALL EXHAUST GRILLE
WER	-WALL EXHAUST REGISTER
WF	-WIDE FLANGE
WG	-WASTE GAS
W/O	-WITHOUT
WOG	-WATER/OIL/GAS WORKING PRESSURE
WPR	-WASHER COMPACTOR
WS	-WATER SURFACE
WSA	-WELDED STUD ANCHOR
WSP	-WELDED STEEL PIPE
WSTP	-WATERSTOP
WT	-WEIGHT
WWF	-WELDED WIRE FABRIC
WWP	-WATER WORKING PRESSURE

X

XFMR	-POWER TRANSFORMER
XLP	-CROSS LINKED POLYETHYLENE
XP	-EXPLOSION PROOF

Y

YCO	-YARD CLEANOUT
YD	-YARD
	-YARD DRAIN
YR	-YEAR

Z

ZS	-POSITION SWITCH

#	-NUMBER
	-POUNDS
&	-AND
@	-AT
Ø	-DIAMETER
	-PHASE
Δ	-ANGLE OF DEFLECTION

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PROJECT NO. 222032 | PAGE

SHEET NO. G-007

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Description	Units	Value	Comments
Design Flow			
Average Daily Flow	MGD	0.36	2042 AADF
Max Month Flow	MGD	0.50	2042 MMF
Peak Day Flow	MGD	0.67	2042 PDF
Peak Hour Flow	MGD	1.73	2042 PHF
Influent Characteristics			
BOD_5	MG/L	347	Maximum Month Average
BOD_5	PPD	1,446	Maximum Month Average
TSS	MG/L	404	Maximum Month Average
TSS	PPD	1,683	Maximum Month Average
TKN	MG/L	26	Maximum Month Average
TKN	PPD	107	Maximum Month Average
TP	MG/L	6	Maximum Month Average
TP	PPD	24	Maximum Month Average
Temperature (Minimum)	°C	7	
Temperature (Maximum)	°C	19	
Effluent Requirements			
BOD_5	MG/L	30	Average Monthly
BOD_5	PPD	205	Average Monthly
BOD_5	% REMOVAL	85	Average Monthly
BOD_5	MG/L	45	Average Weekly
BOD_5	PPD	308	Average Weekly
TSS	MG/L	30	Average Monthly
TSS	PPD	205	Average Monthly
TSS	% REMOVAL	85	Average Monthly
TSS	MG/L	45	Average Weekly
TSS	PPD	308	Average Weekly
Total Phosphorus as P	PPD	0.876	Annual Average
Total Phosphorus as P	PPD	1.36	Average Monthly
Total Phosphorus as P	PPD	2.38	Average Weekly
E. Coli	MPN/100 ML	126	Average Monthly Geometric Mean
E. Coli	MPN/100 ML	406	Instantaneous Maximum
pH	S.U.	6.5-9.0	
HEADWORKS			
Influent Flow Meter			Existing
Number	NO.	1	Open Channel Area/Velocity with Ultrasonic Level
Capacity	GPM	4,000	
Screens			
Number	NO.	2	1 New, 1 Existing
New Perforated Plate Screen			
Capacity/Screen	MGD	1.73	2042 PHF
Opening Size	mm	3	
Motor Size	HP	2	
Washer/Compactor			Incorporated into Screen
Existing Bar Screen			
Capacity/Screen	MGD	1.73	2042 PHF
Opening Size	IN	1/4	
Motor Size	HP	2	
Washer/Compactor			Incorporated into Screen
Grit Removal			Existing
No. of Chambers	NO.	1	Vortex Grit Chamber
Capacity/Chamber	MGD	2.80	Peak Hour Flow
Grit Chamber Drive Motor	HP	0.75	
No. of Grit Pumps	NO.	1	Existing
Grit Pump Capacity/Pump	GPM	225	
Grit Pump Motor	HP	10	
Grit Classifier			Existing
Number of Classifiers	NO.	1	Cyclone, Classifier and Washer
Capacity	GPM	225	
Motor Size	HP	0.5	
Headworks Pump Station			Exisiting
Wetwell Diameter	FT	12	Submersible Wetwell
Number of Pumps	NO.	3	3 Existing Submersible Pumps
Capacity/Pump	GPM	1,050	Each Pump; 1 Standby
TDH/Pump	FT	53	
Pump Motor Size	HP	25	
Drive			Variable Speed

Description	Units	Value	Comments
SECONDARY TREATMENT			
New Floating Media IFAS			Basins Existing, New IFAS Process
Number of Basins	NO.	2	Two Treatment Trains
Max. Basin Volume Combined	GAL	TBD	
Max. Side Water Depth	FT	14.0	
Design MLSS Concentration	MG/L	TBD	
Number of Blowers	NO.	3	2 Duty, 1 Standby
Total Ammonia IFAS Performance	MG/L	1.0	Average Monthly
Secondary Clarifiers			Existing
Number of Clarifiers	NO.	2	Rectangular
Dimensions (L x W x D)	FT	100 x 20 x 12	
Average Overflow Rate	GAL/DAY/FT2	178	1 Duty, 1 Standby
Max Month Overflow Rate	GAL/DAY/FT2	250	1 Duty, 1 Standby
RAS/WAS Pumps			Existing
RAS Pump Type			Submissible Non-clog
Number of RAS Pumps	NO.	4	2 Per Sump, Existing
RAS Pump Capacity/Pump	GPM	430	215-430
RAS Pump Motor Size	HP	5	VFD-Flow Paced
Scum			Existing
Scum Pipe	NO.	2	1 Per Clarifier
Type			Collector
Flow to Digester			Gravity
TERTIARY FILTRATION			
Tertiary Lift Station			New
Wetwell Diameter	FT	12	Submersible Wetwell
Number of Pumps	NO.	3	3 Submersible Pumps
Capacity/Pump	GPM	600	Each Pump; 1 Standby
TDH/Pump	FT	22	
Pump Motor Size	HP	7.5	Each Pump
Drive			Variable Speed
Coagulant Chemical Addition			New, 48% Aluminum Sulfate
Chemical Feed Pumps	NO.	3	2 Duty, 1 Standby
Number of Skids	NO.	1	3 Pumps on 1 Skid
Chemical Addition Locations	NO.	2	Leaving IFAS, Tertiary Filtration
Pump Capacity	GPH	30	
pH Adjustment Chemical Addition			New, 35% Sodium Hydroxide
Chemical Feed Pumps	NO.	2	1 Duty, 1 Standby
Number of Skids	NO.	1	2 Pumps on 1 Skid
Chemical Addition Locations	NO.	1	Tertriary Filtration
Pump Capacity	GPH	30	
Upflow Sand Filters			New
Number of Filter Modules	NO.	8	2 Per Cell
Number of Cells	NO.	4	3 Duty, 1 Standby
Filtration Area Per Cell	FT2	100	50 FT2 Per Filter Module
Peak Hour Hydraulic Loading	GPM/FT2	5.0	3 Duty, 1 Standby
Compressor Type			Rotary Screw
Number of Compressors	NO.	2	1 Duty, 1 Standby
Air Consumption at 100 psi	SCFM	12	All filters operating
Compressor Motor Size	HP	10	
TP Filter Performance	MG/L AS P	0.29	Average Monthly
Effluent Flow Meter			New
Number	NO.	1	Magnetic Flow Meter
Capacity	MGD	3.0	
Flow Meter Diameter	IN	18	
DISINFECTION			
UV Disinfection			Existing
UV Type			Closed Vessel
No. of Channels	NO.	2	1 Duty, 1 Standby
Capacity/Channel	MGD	3	
Dosage	MJ/CM2	35	
UV Transmittance	% TRANS.	55	
Lamp Aging Factor		0.85	
Lamp Fouling Factor		0.90	

Description	Units	Value	Comments
SOLIDS HANDLING			
Aerobic Digesters			Existing
No. of Aerobic Digester Basins	NO.	4	Diffused Aeration
Max. Basin Volume/Digester	GAL	255,822	
Type of Diffusers			Existing Fine Bubble
Number of Diffusers	NO.	39	Existing 9 in Cell 1; Existing 10 in Each Cell 2 to 4
No. of Blowers	NO.	2	Existing Rotary Lobe Blowers
Blower Air Flow	SCFM	1,060	@ 5.0 psig
Blower Motor Size	HP	25	
Polymer System			Existing
No. of Polymer Systems	NO.	1	
No. of Polymer Pump	NO.	1	Existing, Diaphragm
Polymer Pump	GPH	10	
Dilution Water	GPH	1,000	
Dewatering Pump			One Existing
No. of Dig. Sludge Pumps	NO.	1	Progressive Cavity
Dig. Sludge Pump Motor Size	HP	5	
Dig. Sludge Pump Capacity	GPM	36	30-60 GPM
Dewatering Pump			One New
No. of Dig. Sludge Pumps	NO.	1	Progressive Cavity
Dig. Sludge Pump Motor Size	HP	3	
Dig. Sludge Pump Capacity	GPM	36	
Sludge Drying Beds			Existing
No. of Sludge Drying Beds		6	
Size (L x W)	FT	60 x 30	
Sludge Dewatering Bags			Existing
No. of Sludge Dewatering Bags		5	
Size (L x W)	FT	60 x 30	
New Polymer System			New
No. of Polymer Systems	NO.	1	
No. of Polymer Pump	NO.	1	Progressive Cavity
New Screw Press			New
No. of Screw Presses	NO.	1	Keep Existing Sludge Dewatering Bags as the Redundancy
Hydraulic Capacity	GPM	28	At 1.5% Inlet Solids Concentration
Solids Capacity	LB/HR	210	8 Hours Per Day, 5 Days Per Week
Inlet Solids Concentration	%	1 - 3	
Minimum Cake Solids	%	18	
Solids Capture Rate	%	95	
Press Motor Size	HP	3	
Average Wash Water Requirement	GPH	62	@ 72.5 psig
MISCELLANEOUS			
Decant Drain Pump Station			Existing
Wetwell Diameter	FT	8	Submersible Wetwell
Number of Pumps	NO.	2	1 New, 1 Existing
Capacity/Pump	GPM	350	
TDH/Pump	FT	13	
Pump Motor Size	HP	3.0	
New Decant Drain Pump Station			New Pumps in Existing Wetwell
Wetwell Diameter	FT	8	Exisitng Submissible Wetwell
Number of Pumps	NO.	2	1 Duty, 1 Standby
Capacity/Pump	GPM	350	
TDH/Pump	FT	13	
Pump Motor Size	HP	2.0	
EMERGENCY POWER			
Existing Backup Generator	SC		Existing
Engine Type			Diesel
Number of Generators	NO.	1	
Engine Output	KW	400	Auto Transfer Switch Included
Storage Tank Capacity	Gallon	774	
New Backup Generator			New
Engine Type			Diesel
Number of Generators	NO.	1	
Engine Output	KW	750	Auto Transfer Switch Included
Storage Tank Capacity	Gallon	1,200	

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ABERDEEN WWTP IMPROVEMENTS

DESIGN CRITERIA

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1-1/2 Inches

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SHEET NO. G-008

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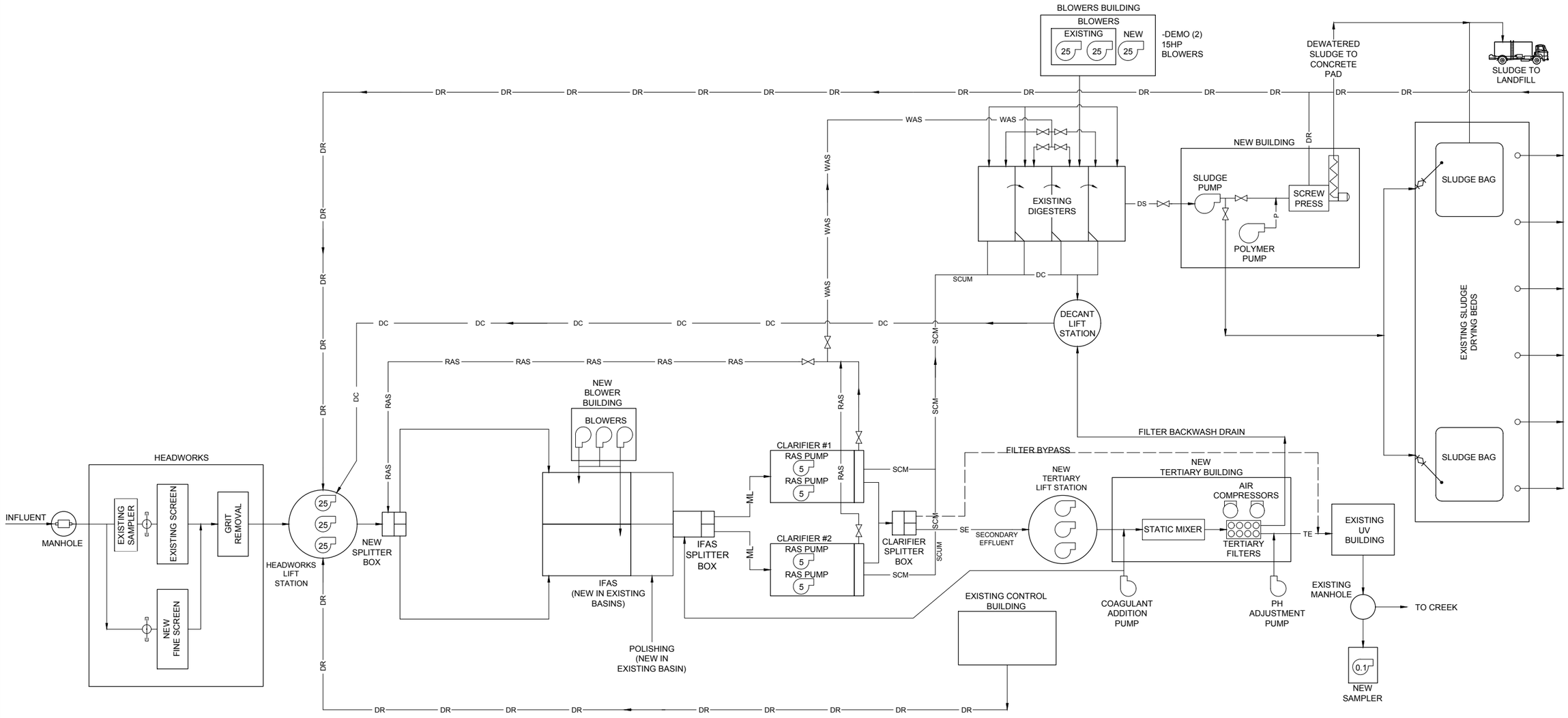

A1 PROCESS FLOW DIAGRAM
N.T.S.

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PROCESS FLOW DIAGRAM

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SHEET NO. G-010

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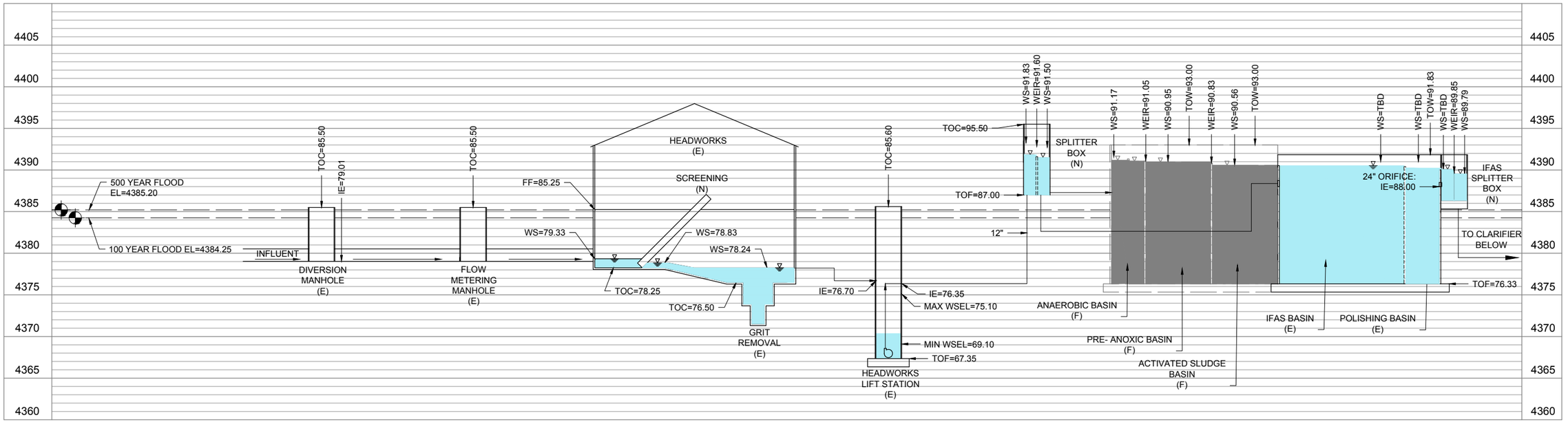
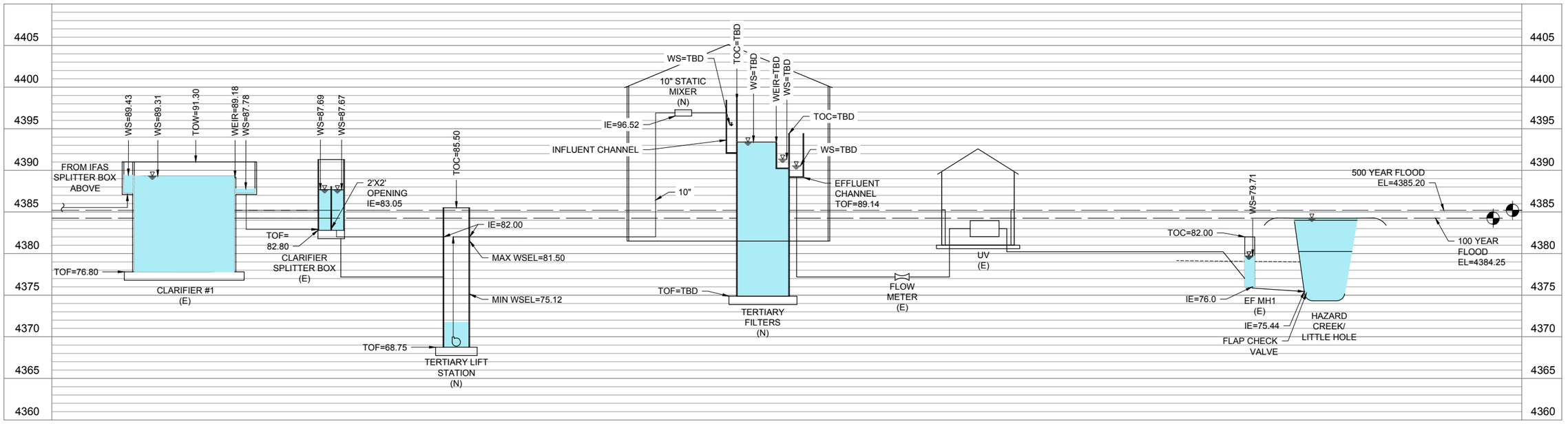


B1 HYDRAULIC PROFILE

N.T.S.



A1 HYDRAULIC PROFILE

N.T.S.

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HYDRAULIC PROFILE

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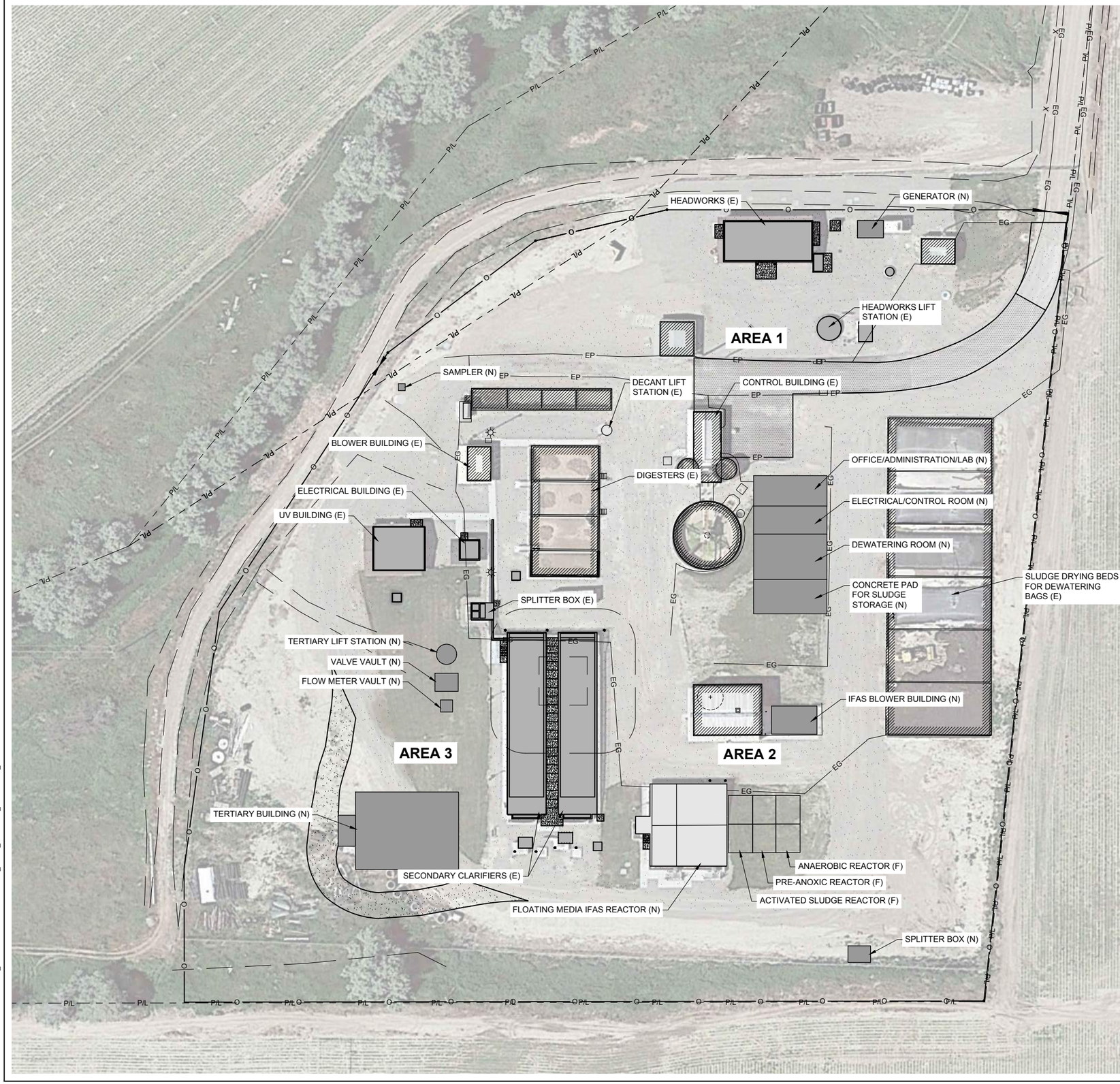

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LEGEND

PROPOSED STRUCTURE

EXISTING STRUCTURE

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PROJECT OVERVIEW

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PROJECT NO. 222032

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GENERAL INSTRUMENTATION NOTES

OR — SINGLE INSTRUMENT OR OTHER COMPONENT HAVING MULTIPLE FUNCTIONS.

NOTES:
1. DRAWINGS REFER ONLY TO CONNECTIONS FROM FIELD DEVICES TO THE PLANT PLC AND/OR SCADA SYSTEM. REFER TO THE SPECIFICATIONS FOR DETAILS ON ALL FIELD AND PACKAGED SYSTEMS.
2. ALL PANEL INSTRUMENTS SHALL BE FURNISHED UNDER THE SPECIFICATIONS.

INSTRUMENT LINE LEGEND

- INSTRUMENT CONNECTION TO PROCESS
- PNEUMATIC SYMBOL
- ELECTRIC SYMBOL
- HYDRAULIC SYMBOL
- CAPILLARY TUBE
- ETHERNET
- MAIN PROCESS
- SECONDARY PROCESS
- CONTROL WIRING
- POWER WIRING
- FIBER LINE (F)
- GAS LINE (G)
- RADIO LINE (R)
- SERIAL LINE (S)
- CONNECTING LINES
- NON-CONNECTING LINES

INPUT & OUTPUT SYMBOLS

- DIGITAL INPUT
- DIGITAL OUTPUT
- ANALOG INPUT
- ANALOG OUTPUT
- PULSED INPUT

CONTINUATION FROM/TO SHEET: EI-701-C (A) CONTINUATION LETTER
CONTINUATION ON DRAWING

INSTRUMENT TAG IDENTIFICATION LETTERS

	MEASURED VARIABLE / INSTRUMENT FUNCTION	ELEMENT	TRANSMITTER	INDICATING TRANSMITTER	CONVERTER TRANSDUCER RELAY, SPECIAL DEVICES	INDICATOR	RECORDER	CONTROLLER	INDICATING CONTROLLER	RECORDING CONTROLLER	SWITCH	SWITCH LOW LOW	SWITCH LOW	SWITCH HIGH	SWITCH HIGH HIGH	SWITCH COMBINATION HIGH LOW	ALARM LOW LOW	ALARM LOW	ALARM HIGH	ALARM HIGH HIGH	TOTALIZE INDICATOR TRANSMITTER	VALVE	GAUGE	LIGHT	SPEED SETTING	FAIL ALARM
A	ANALYSIS	AE	AT	AIT	AY	AI	AR	AC	AIC	ARC	AS	ASLL	ASL	ASH	ASHH	ASHL	AALL	AAL	AAH	AAHH				AL		
B	BURNER FLAME	BE	BT	BIT	BY	BI	BR	BC	BIC	BRC	BS	BSLL	BSL	BSH	BSHH		BALL	BAL	BAH	BAHH				BL		
C	CONDUCTIVITY	CE	CT	CIT	CY	CI	CR	CC	CIC	CRC	CS	CSLL	CSL	CSH	CSHH	CSHL	CALL	CAL	CAH	CAHH				CL		
D	DENSITY	DE	DT	DIT	DY	DI	DR	CD	DIC	DRC	DS	DSLL	DSL	DSH	DSHH	DSHL	DALL	DAL	DAH	DAHH				DL		
E	VOLTAGE	EE	ET	EIT	EY	EI	ER				ES	ESLL	ESL	ESH	ESHH		EALL	EAL	EAH	EAHH						
F	FLOW	FE	FT	FIT	FY	FI	FR	FC	FIC	FRC	FS	FSLL	FSL	FSH	FSHH	FSHL	FALL	FAL	FAH	FAHH	FQI	FV	FG	FL		
FF	FLOW RATIO				FFY	FFI	FFC	FFIC		FFS														FFL		
G	GAUGING (DIMENSION)																									
H	HAND (MANUAL)							HC			HS											HV		HL	HSS	
I	CURRENT		IT	IIT	IY	II	IR	IC	IIC	IRC	IS	ISLL	ISL	ISH	ISHH		IALL	IAL	IAH	IAHH				IL		
J	POWER																									
K	TIME				KY	KI	KR	KC	KIC	KRC	KS	KSLL	KSL	KSH	KSHH		KALL	KAL	KAH	KAHH		KV		KL		
L	LEVEL	LE		LIT	LY	LI	LR	LC	LIC	LRC	LS	LSLL	LSL	LSH	LSHH	LSHL	LALL	LAL	LAH	LAHH		LV	LG	LL		
M	MOISTURE OR HUMIDITY	ME	MT	MIT	MY	MI	MR	MC	MIC	MRC	MS	MSLL	MSL	MSH	MSHH		MALL	MAL	MAH	MAHH				ML		
N	EMERGENCY SHUTDOWN																									
O																										
P	PRESSURE OR VACUUM		PT	PIT	PY	PG	PR	PC	PIC	PRC	PS	PSLL	PSL	PSH	PSHH	PSHL	PALL	PAL	PAH	PAHH		PV		PL		
PD	DIFFERENTIAL PRESSURE		PDT	PDIT	PDY	PDI	PDR	PDC	PDIC	PDRC	PDS	PDSLL	PDSL	PDSH	PDSHH		PDALL	PDAL	PDAH	PDAHH		PDV		PDL		
Q	QUANTITY	QE	QT	QIT	QY	QI	QR				QS	QSLL	QSL	QSH	QSHH		QALL	QAL	QAH	QAHH						
R	RADIOACTIVITY																									
S	SPEED	SE	ST	SIT	SY	SI	SR	SC	SIC	SRC	SS	SSLL	SSL	SSH	SSHH		SALL	SAL	SAH	SAHH						
T	TEMPERATURE	TE	TT	TIT	TY	TI	TR	TC	TIC	TRC	TS	TSLL	TSL	TSH	TSHH	TSHL	TALL	TAL	TAH	TAHH		TV		TL		
TD	DIFFERENTIAL TEMPERATURE		TDT	TDIT	TDY	TDI	TDR	TDC	TDIC	TDRC	TDS	TDSLL	TDSL	TDSH	TDSHH		TDALL	TDAL	TDAH	TDAHH		TDV		TDL		
U	MULTIVARIABLE					UI	UR	UC	UIC	URC	US													UL		
V	VISCOSITY	VE	VT	VIT	VY	VI	VR	VC	VIC	VRC	VS	VSLL	VSL	VSH	VSHH		VALL	VAL	VAH	VAHH				VL		
W	WEIGHT	WE	WT	WIT	WY	WI	WR				WS	WSLL	WSL	WSH	WSHH		WALL	WAL	WAH	WAHH						
X	UNCLASSIFIED	XE	XT	XIT	XY	XI	XR	XC	XIC	XRC	XS	XSLL	XSL	XSH	XSHH		XALL	XAL	XAH	XAHH		XV	XG	XL		XA
XV	VIBRATION	XVE	XVT		XVY	XVI	XVR				XVS			XVSH	XVSHH				XVAH	XVAHH				XVL		
Y	EVENT / STATUS					YI		YC			YS													YL		YA
Z	POSITION	ZE	ZT	ZIT	ZY	ZI					ZS											ZV		ZL		

INSTRUMENT SYMBOLS

- LIT — INSTRUMENT OR OTHER COMPONENT TO BE MOUNTED IN THE FIELD
- TSL — INSTRUMENT OR OTHER COMPONENT TO BE MOUNTED INSIDE ON MCC, VFD, OR OTHER PANEL
- PIR PSH — SINGLE INSTRUMENT OR OTHER COMPONENT HAVING MULTIPLE FUNCTIONS
- INSTRUMENT OR OTHER COMPONENT TO BE FURNISHED AND INSTALLED BY OTHERS IN THE FUTURE
- TIC — INSTRUMENT OR OTHER COMPONENT TO BE MOUNTED ON FRONT OF LOCAL CONTROL PANEL (LCP) OR OTHER ELECTRICAL GEAR
- ZAH — INDICATING LIGHT MOUNTED IN THE FIELD; MAY BE MOUNTED ON A CONTROL STATION
- PAL — INDICATING LIGHT MOUNTED ON THE FRONT OF A LOCAL CONTROL PANEL (LCP) OR OTHER ELECTRICAL GEAR
- 1/2 — PLC BASED HMI
- 1/2 — POWER DEVICE
- 1/2 — SCADA SYSTEM
- 120 VAC — PRIMARY ELECTRICAL SUPPLY FOR INSTRUMENTATION (120V/60HZ) UNLESS OTHERWISE NOTED
- WATER SURFACE

INSTRUMENT SYMBOLS

- NOTE / # PROCESS # / NOTE — PROCESS TAG LEFT
- NOTE / # PROCESS # / NOTE — PROCESS TAG RIGHT
- STRUCTURE / X # SHEET # / STRUCTURE — SHEET REFERENCE LEFT
- STRUCTURE / # SHEET # X / STRUCTURE — SHEET REFERENCE RIGHT
- IB — INTRINSIC BARRIER
- (3) — INDICATES QUANTITY OF SIGNALS (THREE)
- (E) — EXISTING ITEM
- (N) — NEW ITEM
- (F) — FUTURE ITEM
- (D) — DEMOLITION ITEM
- (R) — RELOCATED/TO BE RELOCATED ITEM
- * — INDICATES VENDOR PACKAGE

MISCELLANEOUS ABBREVIATIONS

AM	AUTO/MANUAL
CB	CIRCUIT BREAKER
HA	HAND/AUTOMATIC
HOA	HAND/OFF/AUTOMATIC
HOR	HAND/OFF/REMOTE
ID	INCREASE/DECREASE
I/P	CURRENT TO PNEUMATIC
KO	TIMER/OFF
LCP	LOCAL CONTROL PANEL
LOR	LOCAL/OFF/REMOTE
LOS	LOCKOUT STOP
LR	LOCAL/REMOTE
MCC	MOTOR CONTROL CENTER
HIM	HUMAN INTERFACE MODULE
N.C.	NORMALLY CLOSED
N.O.	NORMALLY OPEN
OC	OPEN/CLOSE
OIT	OPERATOR INTERFACE TERMINAL
OL	OVERLOAD
OLH	OFF/LOW/HIGH
OSC	OPEN/STOP/CLOSE
PLC	PROGRAMMABLE LOGIC CONTROLLER
POT	POTENTIOMETER
RSL	RAISE/STOP/LOWER
RTU	REMOTE TERMINAL UNIT
SEL	SELECT
SP	SET POINT
SS	START/STOP
TSP	TWISTED SHIELD PAIR
VFD	VARIABLE FREQUENCY DRIVE

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P&ID NOTES & SYMBOLS

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SHEET NO. EI-001

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PUMPS, BLOWERS, & COMPRESSORS

- AERATOR
- CENTRIFUGAL WET PIT PUMP OR TURBINE PUMP
- CENTRIFUGAL OR TURBINE PUMP, FAN, OR BLOWER
- CHEMICAL FEED PUMP
- BLOWER OR COMPRESSOR
- COMPRESSOR (CENTRIFUGAL) OR TURBINE MOTOR
- DIAPHRAGM PUMP
- EJECTOR
- GEAR PUMP OR BLOWER
- METERING PUMP
- COMPRESSOR (PISTON)
- PISTON PUMP
- PROGRESSIVE CAVITY POSITIVE DISPLACEMENT PUMP
- PROGRESSIVE CAVITY PUMP
- SUBMERSIBLE PUMP
- SUBMERSIBLE SUMP PUMP
- VERTICAL TURBINE PUMP

P&ID GATES

- BUTTERFLY GATE
- FLAP GATE
- SHEAR GATE
- SLIDE GATE
- SLUCE GATE
- STOP GATE

P&ID VALVES

- THREE WAY VALVE
- AIR RELEASE VALVE
- ANGLE VALVE
- BALL VALVE
- BUTTERFLY VALVE
- CHECK VALVE
- DAMPER VALVE
- DIAPHRAGM VALVE
- DUPLEX HOSE VALVE
- FLOAT VALVE
- GATE VALVE
- GLOBE VALVE
- HOSE BIBB 1
- HOSE BIBB 2
- HOSE BIBB 3
- IRRIGATION CONTROL VALVE
- KNIFE GATE VALVE
- MUD VALVE
- NEEDLE VALVE
- NON-FREEZE HOSE BIBB

P&ID VALVES

- TELESCOPING VALVE
- PLUG VALVE
- LUBRICATED PLUG VALVE
- PRESSURE CONTROL VALVE
- PRESSURE RELIEF VALVE
- PRESSURE RELIEF (GLOBE) VALVE
- PRESSURE RELIEF VALVE WITH VENT
- VACUUM RELIEF VALVE
- VEE BALL VALVE
- BALANCED WEIGHT VALVE

P&ID VALVE ACTUATORS

- AIR ACTUATOR
- DIAPHRAGM ACTUATOR
- DIAPHRAGM WITH ELECTRO-PNEUMATIC CONVERTER
- DUEL CHAMBER HYDRAULIC OR PNEUMATIC CYLINDER ACTUATOR
- MANUAL ACTUATOR
- MOTOR ACTUATOR
- ROTARY MOTOR ACTUATOR
- SOLENOID ACTUATOR
- TEMPERATURE ACTUATOR

P&ID FLOW METERS

- FLOW TUBE FLOW METER
- INSERTION FLOW METER
- MAGNETIC FLOW METER

P&ID FLOW METERS CONTINUED

- MASS FLOW METER
- ORIFICE FLOW METER
- PARSHALL FLUME FLOW METER
- PITOT TUBE FLOW METER
- PROPELLER FLOW METER
- ROTAMETER TYPE 1 FLOW METER
- ROTAMETER TYPE 2 FLOW METER
- THERMAL DISPERSION FLOW METER
- ULTRASONIC FLOW METER
- ULTRASONIC (CLAMP ON) FLOW METER
- VARIABLE AREA FLOW METER
- VENTURI FLOW METER
- UV DISINFECTION WITH FM FLOW METER

P&ID GAUGES, SENSORS, & TRANSMITTERS

- ANNULAR DIAPHRAGM SEAL
- ANNULAR SEAL
- BUBBLER LEVEL CONTROL
- CALIBRATION COLUMN
- DIAPHRAGM SEAL
- FLOW SIGHT GAUGE
- HYDRAULIC WEIGHT TRANSMITTER
- INDUCTIVE RELAY LEVEL SWITCH
- INVERTED COLUMN SWITCH
- LIMIT SWITCH
- FLOW SWITCH

P&ID GAUGES, SENSORS, & TRANSMITTERS

- PRESSURE
- PRESSURE SWITCH
- PRESSURE SWITCH WITH DIAPHRAGM
- PRESSURE TRANSMITTER
- PRESSURE TRANSMITTER WITH DIAPHRAGM
- ROOM THERMOSTAT
- RUPTURE DISK
- SONIC LEVEL SENSOR
- SUBMERSIBLE PRESSURE LEVEL TRANSMITTER
- SUSPENSION CABLE LEVEL SWITCH
- TEMPERATURE ELEMENT WITH WELL
- TIPPING FLOAT LEVEL SWITCH

P&ID MISCELLANEOUS DEVICES & EQUIPMENT

- "Y" STRAINER
- ACCUMULATOR
- AIR FILTER
- AIR SET
- AREA DRAIN
- BASKET STRAINER
- CONDENSATE TRAP
- DEMISTER
- EJECTOR - EDUCTOR

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ABERDEEN WWTP IMPROVEMENTS

P&ID SYMBOLS LEGEND

DRAWN: DAC CHECK: ---

VERIFY SCALE: Scales based on 22"x34" prints.

1-1/2 Inches

PROJECT NO. 222032 PAGE

SHEET NO. EI-002

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P&ID MISCELLANEOUS DEVICES & EQUIPMENT

- ELECTRIC MOTOR
- EMERGENCY EYEWASH OR SHOWER
- EXPANSION CHAMBER WITH RUPTURE DISK
- EYE WASH
- FLOOR DRAIN
- FLOOR SINK
- GRINDER
- HEAT EXCHANGER
- HORN
- HOSE RACK
- IN-LINE STATIC MIXER
- IN-LINE MIXER
- MIXER
- MIXER AIR GAS
- PIPE ANCHOR
- PNEUMATIC CYLINDER
- PULSATION DAMPENER
- ROOF DRAIN
- SIGHT GLASS
- SURGE DAMPENER
- THERMOMETER
- TRENCH DRAIN
- WAFER TYPE STATIC MIXER
- TRANSFORMER IRON CORE

P&ID MISCELLANEOUS DEVICES & EQUIPMENT

- DOUBLE POLE
- SINGLE POLE
- PRESSURE SWITCH NORMALLY CLOSED
- PRESSURE SWITCH NORMALLY OPEN
- PUSH BUTTON NORMALLY CLOSED
- PUSH BUTTON NORMALLY OPEN
- ONE WAY SELECTOR (ON / OFF)
- TWO WAY SELECTOR
- THREE WAY SELECTOR
- HANDS OFF AUTO SELECTOR (OFF)
- STARTER (?A / ?P)
- MOTOR STARTER
- MOTOR STARTER DISCONNECT
- TEMPERATURE NORMALLY CLOSED
- TEMPERATURE NORMALLY OPEN
- TIME OPEN TIME CLOSED
- TIMING CLOSED NORMALLY CLOSED
- TIMING CLOSED NORMALLY OPEN
- TIMING OPEN NORMALLY CLOSED
- TIMING OPEN NORMALLY OPEN
- TORQUE SWITCH
- TRANSFER SWITCH
- TRANSFORMER
- TRANSFORMER DIAGRAM

PRIMARY ELEMENT SYMBOLS

- FE — VENTURI FLOWMETER WITH INSTRUMENT TAG
- FE — MAGNETIC FLOWMETER WITH INSTRUMENT TAG
- FE — PITOT TUBE WITH INSTRUMENT TAG
- FE — CLAMP-ON ULTRASONIC FLOWMETER WITH INSTRUMENT TAG
- FE — PARSHALL FLUME WITH INSTRUMENT TAG
- LE — SONIC LEVEL SENSOR WITH INSTRUMENT TAG
- LS — INVERTED COLUMN LEVEL SWITCH WITH INSTRUMENT TAG
- PIT — PRESSURE TRANSMITTER WITH DIAPHRAGM SEAL (ALSO APPLIES TO PRESSURE GAUGE AND SWITCH) WITH INSTRUMENT TAG
- LS — SUSPENSION CABLE LEVEL SWITCH WITH INSTRUMENT TAG
- FE — ORIFICE FLOWMETER WITH INSTRUMENT TAG
- FE — PROPELLER FLOWMETER WITH INSTRUMENT TAG
- FE — THERMAL DISPERSION FLOWMETER WITH INSTRUMENT TAG
- LS — TIPPING FLOAT LEVEL SWITCH WITH INSTRUMENT TAG
- TE — TEMPERATURE ELEMENT WITH WELL AND INSTRUMENT TAG
- PIT — PRESSURE TRANMITTER WITH ANNULAR SEAL (ALSO APPLIES TO PRESSURE GAUGE AND SWITCH) WITH INSTRUMENT TAG
- PIT — INDUCTIVE RELAY LEVEL SWITCH WITH INSTRUMENT TAG
- PIT (LE) — SUBMERSIBLE PRESSURE LEVEL TRANSMITTER WITH INSTRUMENT TAG

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P&ID SYMBOLS LEGEND

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SHEET NO. EI-003

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SCADA

PLC-100-E

FIELD

RUN HS — HS

INFLUENT FLOW FI — FIT

FAIL YA, LEVEL LI — YA, YA

RUN YL, FAIL YA, LEVEL LI — YL, YA, YA

FAIL YA 60-110A, E-STOP YA 60-110B — YA 60-110A, YA 60-110B

FAIL YA 60-110A, E-STOP YA 60-110B — YA 60-110A, YA 60-110B

LEL AAH 1001-1, H2S AAH 1001-2 — AAH 1001-1, AAH 1001-2

LCP-SCR-1

POWER ON YL SCR-1A — PLC

SCREEN RUNNING YL SCR-1B — PLC

HIGH LEVEL YL SCR-1C — PLC

OVERLOAD SHUTDOWN YL SCR-1D — HMI

ALARM SILENCE HS SCR-1A — HMI

E-STOP HS SCR-1B — HMI

RUNTIME METER 8888.88

LCP-SCR-2

POWER ON YL SCR-2 — PLC

SCREEN RUNNING YL SCR-2 — PLC

HIGH LEVEL YL SCR-2 — PLC

OVERLOAD SHUTDOWN YL SCR-2 — HMI

ALARM SILENCE HS SCR-2 — HMI

E-STOP HS SCR-2 — HMI

RUNTIME METER 8888.88

STR-GC-01

HS GC-01 HOA

PRIME FAILURE YL VG-1A

DRIVE UNIT ON YL VG-1B

PUMP ON YL VG-2A

PUMP FAILURE YL VG-2B

GRIT CHAMBER ON/OFF YS VG-1

GRIT PUMP HS VG-1 HOA

LCP-VG-1 GRIT CLASSIFIER

RUN TIME DRIVE 8888.88

RUN TIME PUMP 8888.88

DELAY TIMER 8888.88

RUN TIMER 8888.88

ASH 1001-1, ASH 1001-2, AIT 1001-1, AIT 1001-2 — GAS DETECTORS

120V — INF-1 INFLUENT SAMPLER

FIT 1020

18" FROM COLLECTION SYSTEM

FE

SG-1002

120V — LIT

SV-201B S

SV-201A S

SV-201C S — M

LE — LE

SCR-2

HV-201

LOCAL OPERATOR STATION-SCR-2
SCREEN MODE HS HOA
JOG SCREEN HS FOR
WASH MODE HS HOA
RESET / CYCLE START HS
E-STOP HS

SG-1005

SG-1007

SG-1004

SG-1006

DUMPSTER

SG-1009 N.C.

DRIVE MOTOR 0.75 HP 480V/3P/60HZ

TO HEADWORKS LIFT STATION

18" EI-005

P-1001 10 HP, 480V/ 3PH/60HZ

VG-1

SG-1008 N.O.

(D)

HV-1002

CLASSIFIER ON/OFF
RUN YL VG-1
FAILURE YL VG-2
HOA HS VG-1

HOSE

HOSE BIBB

M-1001 PORTABLE STEAM CLEANER 240V/3PH/60HZ

GC-1

SV-1004 NOTE 3

LIT 1001, LE 1001

SG-1003

SV-1001 S
SV-1002 S
SV-1003 S — M

SCR-1

LIT 1002, LE 1002

PS 1001

HV-1001

DUMPSTER

LOCAL OPERATOR STATION-SCR-1
SCREEN MODE HS SCR-1A HOA
JOG SCREEN HS SCR-1B FOR
WASH MODE HS SCR-1C HOA
RESET / CYCLE START HS SCR-1B
E-STOP HS SCR-1B
FWD-OFF-RWD M

FROM AIR GAP SYSTEM EI-017

EXISTING R.P. BACKFLOW VALVE

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HEADWORKS - FINE SCREEN P&ID

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1-1/2 Inches

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PAGE

SHEET NO. EI-004

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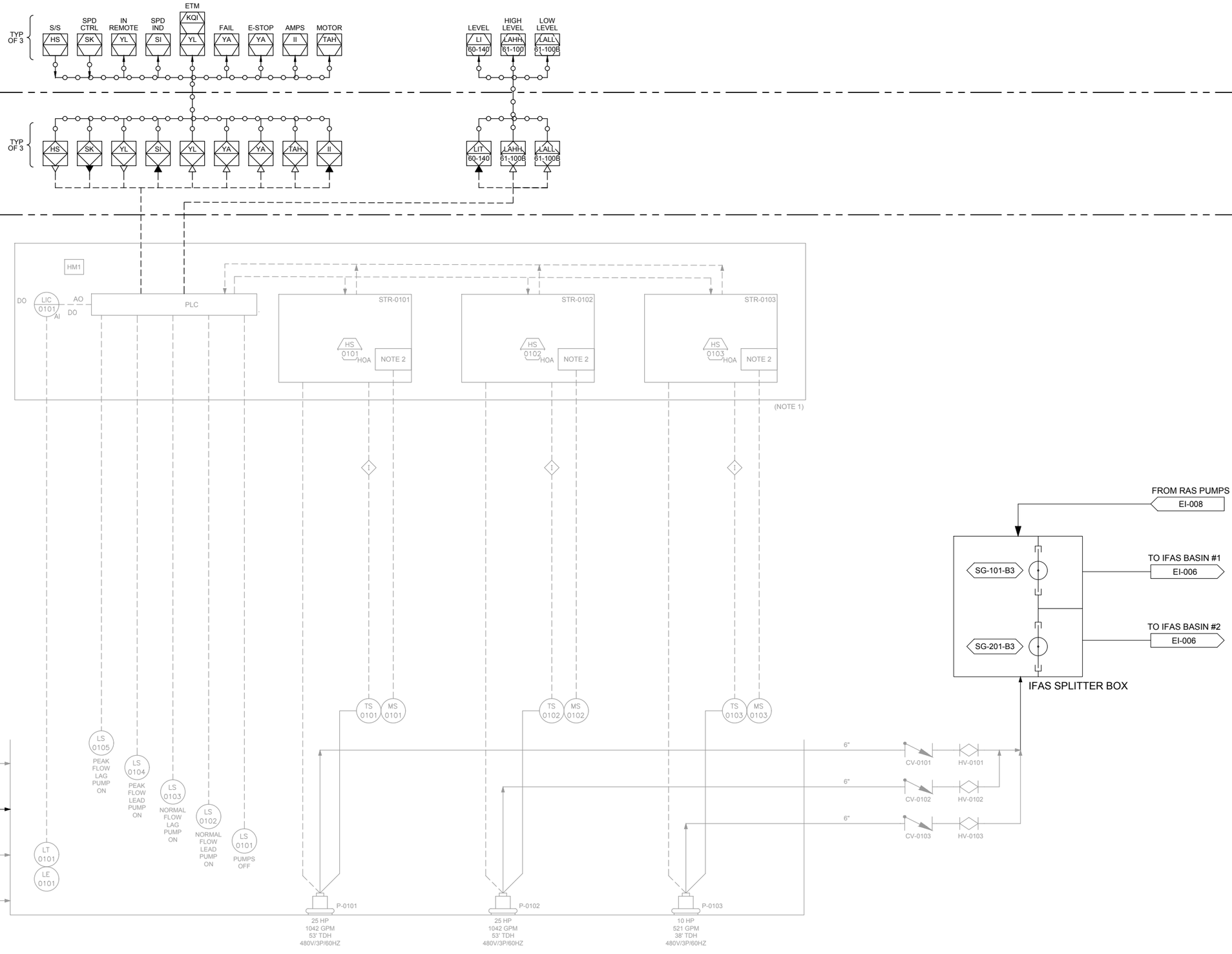

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HEADWORKS - P&ID

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1-1/2 Inches

PROJECT NO. 222032 PAGE

SHEET NO. EI-005

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KEYNOTES

01 ALL EQUIPMENT, INCLUDING PANELS, INSTRUMENTS, VALVING WITHIN THIS AREA, ARE TO BE PROVIDED BY THE IFAS VENDOR. INTERCONNECTING PIPING AND CABLING TO BE PROVIDED BY CONTRACTOR UNLESS OTHERWISE NOTED.

02 VALVE IS NOT IN VENDOR SCOPE

SCADA

IFAS BASIN TEMPERATURE TRAIN #1 — TI
IFAS BASIN DO CONCENTRATION TRAIN #1 — AI
IFAS BASIN HIGH WATER ALARM TRAIN #1 — LAH
IFAS BASIN TEMPERATURE TRAIN #2 — TI
IFAS BASIN DO CONCENTRATION TRAIN #2 — AI
IFAS BASIN HIGH WATER ALARM TRAIN #2 — LAH
IFAS BASIN LEVEL TRAIN #1 — LI
IFAS BASIN LEVEL TRAIN #2 — LI

FIELD

PLC-100-B2
HMI
01

AIT — 120 VAC
AIT — 120 VAC
AE
LSH
AE
LSH

FROM BLOWERS
EI-007

BFV-101-B
02
LT
LT
VENT
VENT
BV-101-B
SV-101-B
S

BFV-102-B

FROM NEW SPLITTER BOX
EI-005

IFAS BASIN #1

ME-101-B
ME-102-B
ME-103-B
ME-104-B
ME-105-B

FROM BLOWERS
EI-007

BV-201-B
SV-201-B
S
BFV-201-B

02
BFV-202-B

SPLITTER BOX 2
SG-101-B
SG-201-B

TO CLARIFIER #1
EI-008

TO CLARIFIER #2
EI-008

FROM NEW SPLITTER BOX
EI-005

IFAS BASIN #2

ME-201-B
ME-202-B
ME-203-B
ME-204-B
ME-205-B

FROM ALUM PUMPS
EI-011

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IFAS TREATMENT - P&ID

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1-1/2 Inches

PROJECT NO. 222032
PAGE
SHEET NO. EI-006

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SCADA

FIELD

IFAS BLOWERS
(TYPICAL FOR 3)

RUNNING — YL
FAILED — YA
HIGH DISCHARGE TEMPERATURE — YAL
IFAS BASIN #1 AIR FLOW — FI
IFAS BASIN #2 AIR FLOW — FI

PLC-100-B2
HMI
02

VFD-B10X, X=1,2,3
RUN — YL G
STOP — YL R
FAIL — YL A
HUMAN MACHINE INTERFACE
HMI

TO IFAS BASINS
EI-006

FIT
FE
120 VAC
PI
FE-101-B2

BFV-102-B2
BFV-202-B2
BFV-101-B2
BFV-201-B2
BFV-301-22

01

ME-101-B2
ME=201-B2
ME-301-B2

FIT
PI
FE
120 VAC
FE-301-B2

TO IFAS BASINS
EI-006

KEYNOTES

01 PACKAGED BLOWER SYSTEM SHALL BE PROVIDED AS PART OF THE IFAS EQUIPMENT PACKAGE.

02 IFAS PLC TO BE PROVIDED AS PART OF IFAS VENDOR PACKAGE

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ABERDEEN WWTP IMPROVEMENTS

IFAS BLOWERS BUILDING - P&ID

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1-1/2 Inches

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PAGE

SHEET NO. EI-007

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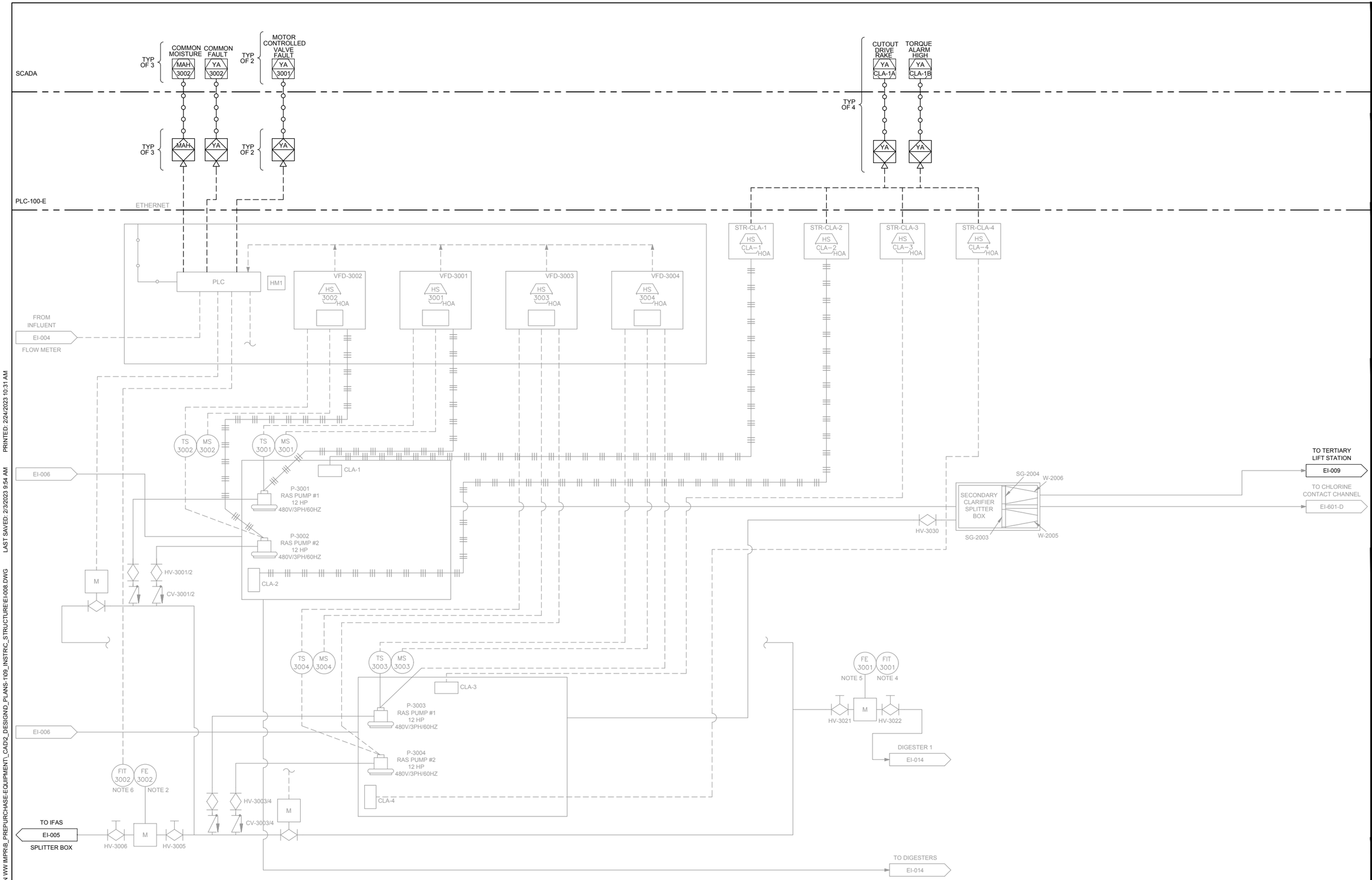

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CLARIFIERS - P&ID

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1-1/2 Inches

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SHEET NO. EI-008

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SCADA

TERTIARY LIFT STATION PUMP
(TYP FOR 3)

MOTOR AMPS (II) — AI
RUN CMD (HS) — DO
RESET CMD (HS) — DO
REMOTE (YI) — DO
RUNNING (YI) — DI
FAILED (YA) — DI
SPEED REFERENCE (SI) — AI
SPEED CMD (SK) — AO
HIGH TEMPERATURE (TAH) — DI
MOISTUE DETECTED (MAH) — DI

HIGH FLOAT (LAH) — DI — IB
LOW FLOAT (LAL) — DI — IB
LIT LEVEL (LI) — AI

PLC-100-E

VFD-X00-D1, X=1,2,3
RUN (YL G)
STP (YL R)
FAIL (YL A)

HUMAN MACHINE INTERFACE (HMI)
SEAL LEAK RELAY (SLR)

TYPICAL FOR EACH MOTOR X=1,2,3
IIT 1X1
120 VAC

LSH
LSL
LIT
VENT

PI — CV-101-D1 — PV-101-D1
PI — CV-201-D1 — PV-201-D1
PI — CV-301-D1 — PV-301-D1

TO FILTERS
EI-010

TERTIARY LIFT STATION
VALVE VAULT

FROM CLARIFIER
SPLITTER BOX
EI-008

ME
TE
M

P-101-D1
P201-D1
P-301-D1

TERTIARY LIFT STATION
WET WELL

FIELD

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TERTIARY LIFT STATION - P&ID

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1-1/2 Inches

PROJECT NO. 222032
PAGE

SHEET NO. EI-009

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KEYNOTES

01 FLOCCULATION AND MIXING SYSTEM TO BE DESIGNED BY ENGINEER OF RECORD. SAND FILTER SUPPLIER SHALL REVIEW DESIGN AND CONFIRM IT IS SUITABLE FOR VENDOR TO MEET PERFORMANCE REQUIREMENTS. REFER TO SPECIFICATIONS.

02 ALL EQUIPMENT, PANELS, INSTRUMENTS, AND VALVING SHOWN WITHIN THIS AREA ARE TO BE PROVIDED BY THE SAND FILTER VENDOR. INTERCONNECTING PIPING AND CABLING TO BE PROVIDED BY CONTRACTOR.

SCADA

(TYP OF 4)

FILTER INFLUENT FLOW — FI
HEADLOSS PRESSURE — AI
VALVE OPEN/ CLOSED CMD — YA
VALVE OPEN — ZLO
VALVE CLOSED — ZLC
LOW AIR PRESSURE — DI
VALVE OPENED (X12) — DI

PLC-100-E

FIELD

FIT
FE
120 VAC
FE-100-D
FROM TERTIARY LIFT STATION
EI-009
FROM ALUM ADDITION
EI-011
01
PIT
FLOCCULATION AND MIXING SYSTEM

BFV-101-D
BFV-201-D
BFV-301-D
BFV-401-D
ME-101-D
ME-201-D
ME-202-D
ME-301-D
ME-302-D
ME-401-D
ME-402-D

PI
YA
ZLO
ZLC
PAL
PSL

AIR CONTROL PANEL
FILTER 1 FILTER 2 FILTER 3 FILTER 4
LOR
AIRLIFT
AIRBURST
G
A

BV-504-D
PRV-501-D
ME-512-D
ME-511-D
BV-503-D
BV-502-D
BV-501-D
ME-501-D
ME-502-D
PI
MCP-500-D
480 VAC
120 VAC
DRAIN TO PLUMBING

02

BUILDING DRAIN

FROM CAUSTIC SODA ADDITION
EI-012

BACKWASH TO DECANT LIFT STATION
EI-015

TO UV TREATMENT
EI-013

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TERTIARY TREATMENT - P&ID

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1-1/2 Inches

PROJECT NO. 222032 | PAGE

SHEET NO. EI-010

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KEYNOTES

01 CHEMICAL PUMPING SYSTEM TO BE PROVIDED AS A PACKAGED SYSTEM BY THE INSTALLING CONTRACTOR.

SCADA

CHEM FEED PUMP
(TYP FOR 3)

ALUM TANK LEVEL

RUN CMD | RUNNING | FAULT | RUN SPEED | SPEED FEEDBACK

LI | HS | YI | YI | SK | SI

PLC-100-E

FIELD

ME-610-E

01

LCP-61X-D X=1,2,3

TYP. OF 3

VENT

LT

ALUM TANK

BV-601-D

2"

ME-601-D

TO DRAIN

BV-602-D

ME-602-D

BV-603-D

BV-604-D

P-611-D

P-612-D

P-613-D

120 VAC

TO PRE-FILTER STATIC MIXER

EI-010

TO SPLITTER BOX 2

EI-006

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ABERDEEN WWTP IMPROVEMENTS

TERTIARY TREATMENT - P&ID
CHEMICAL ADDITION - ALUM

DRAWN: TLL | CHECK: ALN

VERIFY SCALE: Scales based on 22"x34" prints.

1-1/2 Inches

PROJECT NO. 222032 | PAGE

SHEET NO. EI-011

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KEYNOTES

01 CHEMICAL PUMPING SYSTEM TO BE PROVIDED AS A PACKAGED SYSTEM BY THE INSTALLING CONTRACTOR.

SCADA

CAUSTIC TANK LEVEL

LI

LI

CHEM FEED PUMP
(TYP FOR 2)

RUN CMD | RUNNING | FAULT | RUN SPEED | SPEED FEEDBACK

HS | YI | YI | SK | SI

HS | YI | YI | SK | SI

PLC-100-E

FIELD

ME-710-E

01

LCP-71X-D X=1,2

TYP. OF 2

VENT

LT
D721

CAUSTIC SODA
TANK

BV-701-D

2"

ME-701-D

BV-702-D

BV-703-D

ME-702-D

P-711-D

120 VAC

P-712-D

120 VAC

TO FILTERS
OUTLET
EI-010

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ABERDEEN WWTP IMPROVEMENTS

TERTIARY TREATMENT - P&ID
CHEMICAL ADDITION - CAUSTIC

DRAWN: --- CHECK: ---

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1-1/2 Inches

PROJECT NO. 222032

PAGE

SHEET NO. EI-012

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SCADA

ACTUATOR FAIL YA 500
MINOR ALARM YA 500
INCOMPLETE SEQUENCE YA 500
MODULE FAIL YA 500
COMMUNICATION FAIL YA 500
OPEN CLOSE YA 6001
OPEN CLOSE YA 6003
MULT. LAMP FAIL YA 500
PLC FAIL YA 500
BANK FAIL YA 500
ADJ. LAMP FAIL YA 500
OPEN CLOSE YA 6002
OPEN CLOSE YA 6004
LOW U/V FAIL YA 500
LED LAG YC 500
OFF LINE YC 500
RUN YC 500
ON YI 500
AUTO YI 500
AUTO YI 500
LEVEL LI 500
EFF FLOW GPM YA 101
EFF FLOW TOTALIZED YA 101
EFF FLOW HS

FIELD

E.S. 120/1
U/V SYSTEM CONTROL CENTER PP-500
PLC
HS

E.S. 480/3
BANK 2 PDC
E.S. 480/3
BANK 1 PDC

AIT 305 UVI
AIT 306 LAMP
AIT 301 UVI
AIT 302 LAMP

FIT K-101 FLOW
AE 301
AE 302
ARV-6001

480V
480V
120V
480V
M
FCV-6001
UV-1
FCV-6002
HV-6003
120V
COOLING PUMP 1

AE 305
AE 306
ARV-6002

EI-010
HV-6001
FE K-101
HV-6002
480V
480V
120V
480V
M
FCV-6003
UV-2
FCV-6004
HV-6004
120V
COOLING PUMP 2

EFFLUENT FLOW METER

EFFLUENT SAMPLER
ME-100-H
ABERDEEN WASTEWAY
EF MH1

KELLER ASSOCIATES
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Pocatello, Idaho 83201
(208) 238-2146

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City of Aberdeen

ABERDEEN WWTP IMPROVEMENTS

UV BUILDING - P&ID

DRAWN: --- CHECK: ---

VERIFY SCALE: Scales based on 22"x34" prints.

1-1/2 Inches

PROJECT NO. 222032

PAGE

SHEET NO. EI-013

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HEADWORKS ALARM DIALER

(E) F-MCC-01

FIELD

FAULT YA 5001

FAULT YA 5002

FAULT YA 5003

STR 5001 HS 5001 HOA

STR 5002 HS 5002 HOA

TIMER

STR 5003 HS 5003 HOA

BFV-5001

CV-5001

CV-5002 HV-5013

CV-5003 HV-5012

6"

ME-5001

ME-5002

ME-5003

4" 4" 6" 6"

DW-5004 DW-5005 DW-5006

DW-5001 DW-5002 DW-5003

EI-008 SCUM

EI-008 WAS PUMPS

TO DECANT LIFT STATION EI-015

HV-5009 HV-5010

HV-5008 HV-5011

TO DEWATERING EI-016

6

HV-5007

HV-5006

5

4" D

4

HV-5005

HV-5004

3

(E) SLUDGE BAG 2

FROM DEWATERING EI-016

HV-5003

HV-5002

(E) SLUDGE BAG 1

EI-015 TO HEADWORKS LIFT STATION

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ABERDEEN WWTP IMPROVEMENTS

DIGESTERS - P&ID

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1-1/2 Inches

PROJECT NO. 222032

PAGE

SHEET NO. EI-014

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DECANT LIFT STATION PUMP
(TYP FOR 2)

SCADA

MOTOR AMPS — AI
RUN CMD — HS
RESET CMD — HS
REMOTE — YI
RUNNING — YI
FAILED — YA
HIGH TEMPERATURE — TAH
MOISTURE DETECTED — MAH
HIGH FLOAT — LAH
LOW FLOAT — LAL
LEVEL — LI

PLC-100-E

IB
IB

FIELD

MCC-X00-G2 X=1,2
RUN — YL G
STP — YL R
FAIL — YL A

HUMAN INTERFACE MODULE — HIM

SLR — SEAL LEAK RELAY

TYPICAL FOR EACH MOTOR X=1,2
IIT 1X1
120 VAC

LSH
LSL
LIT
VENT

CV-101-G2
PV-101-G2
CV-201-G2
PV201-G2

TERTIARY FILTERS
EI-010

DIGESTERS
EI-014

TO HEADWORKS LIFT STATION
EI-005

ME
TE
M

P-101-G2
P-201-G2

DECANT LIFT STATION
WET WELL

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ABERDEEN WWTP IMPROVEMENTS

DECANT LIFT STATION - P&ID

DRAWN: --- CHECK: ---

VERIFY SCALE: Scales based on 22"x34" prints.
1-1/2 Inches

PROJECT NO. 222032
PAGE

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KEYNOTES

01 SCREW PRESS SYSTEM, INCLUDING VALVES, INSTRUMENTS, PANELS, AND EQUIPMENT TO BE PROVIDED AS A PACKAGED SYSTEM AS SHOWN IN THIS AREA. INTERCONNECTING PIPING AND CABLING TO BE PROVIDED BY INSTALLING CONTRACTOR UNLESS NOTED OTHERWISE.

02 POLYMER MAKE UP SYSTEM. INCLUDING INSTRUMENTS, VALVES, PANEL AND EQUIPMENT SHOWN IN THIS AREA, TO BE PROVIDED AS A PACKAGED SYSTEM

03 FUTURE SCREW PRESS AND ASSOCIATED EQUIPMENT NOT SHOWN.

SCADA

FLOW FI | HIGH PRESSURE PAH | SPEED REF SI | E-STOP YI | RUN YI | AUTO YI | FAIL YA | MOTOR AMPS II

FIELD

ME-5550

01

LCP-5550
LOR HS
START HS
E-STOP HS
STOP HS
OIT

PLC-5500

VFD-5510
START HMS | STOP HMS | RUN YL | MOTOR TAH
SPD CTRL HMS | VFD RESET HMS | VFD AVAIL YL | E-STOP YA | GEN FAULT YA

VFD-5510
HOR HS | SPEED CONTROL SC | SPEED SI
E-STOP HS | STOP YA | RUN YA

FNVR-5530
HOR HS | HIGH TORQUE NAH
E-STOP HS | LOW SPEED SAL | RUN YA

OIT
HOR HS

POLYMER TOTE

P-5550

SV-5550 PDSL

02

ME-5551 M

FROM UTILITY WATER
EI-017
1.5" W3 (43.E)
S FE

SV-5520 S

LCP-5540

SV-5540 SOV S

PRV-5540 PI PSL

ME-5541 ME-5542

FROM SLUDGE DIGESTER
EI-007
2" SL (43.E)
BLIND FLANGE 03

PI

HV-5510

FIT FE

CV-5550

ME-5552

PIT ZSC ZSO

ME-5520

M

P-5510 M

CV-5510

HV-5511

PI

FE-5510

CV-5511

SSL NSH M

HS E-STOP PULL CORD

ME-5530

BV-401-E

TO SOLIDS LOADING AREA

TO HEADWORKS LIFT STATION
EI-004

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ABERDEEN WWTP IMPROVEMENTS

DEWATERING BUILDING - P&ID

DRAWN: --- CHECK: ---

VERIFY SCALE: Scales based on 22"x34" prints.

1-1/2 Inches

PROJECT NO. 222032 | PAGE

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SCADA

FIELD

PLC-100-E

(TYP OF 2)

FAIL

RUN

LOW TANK LEVEL

DISCHARGE PRESSURE

YA

YL

LAL

PI

YA

YL

LY

LAL

PIT

VCP-600-E

HOR

HS

SPEED CONTROL

SC

SPEED

SI

E-STOP

HS

STOP

YA

RUN

YA

HMI

PI

PIT

FROM AIR GAP PUMPS

EI-017

BFV-612-E

BFV-622-E

CV-611-E

CV-621-E

FROM W1 WATER

BFV-601-E

FV-601-E

TSH

TSH

M

M

P-611-E

P-621-E

PI

BFV-611-E

BFV-621-E

ME-601-E

LSL

BV-601-E

BFV-602-E

D

EI-004

ME-602-E

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ABERDEEN WWTP IMPROVEMENTS

AIR GAP SYSTEM

DRAWN: --- CHECK: ---

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1-1/2 Inches

PROJECT NO. 222032

PAGE

SHEET NO. EI-017

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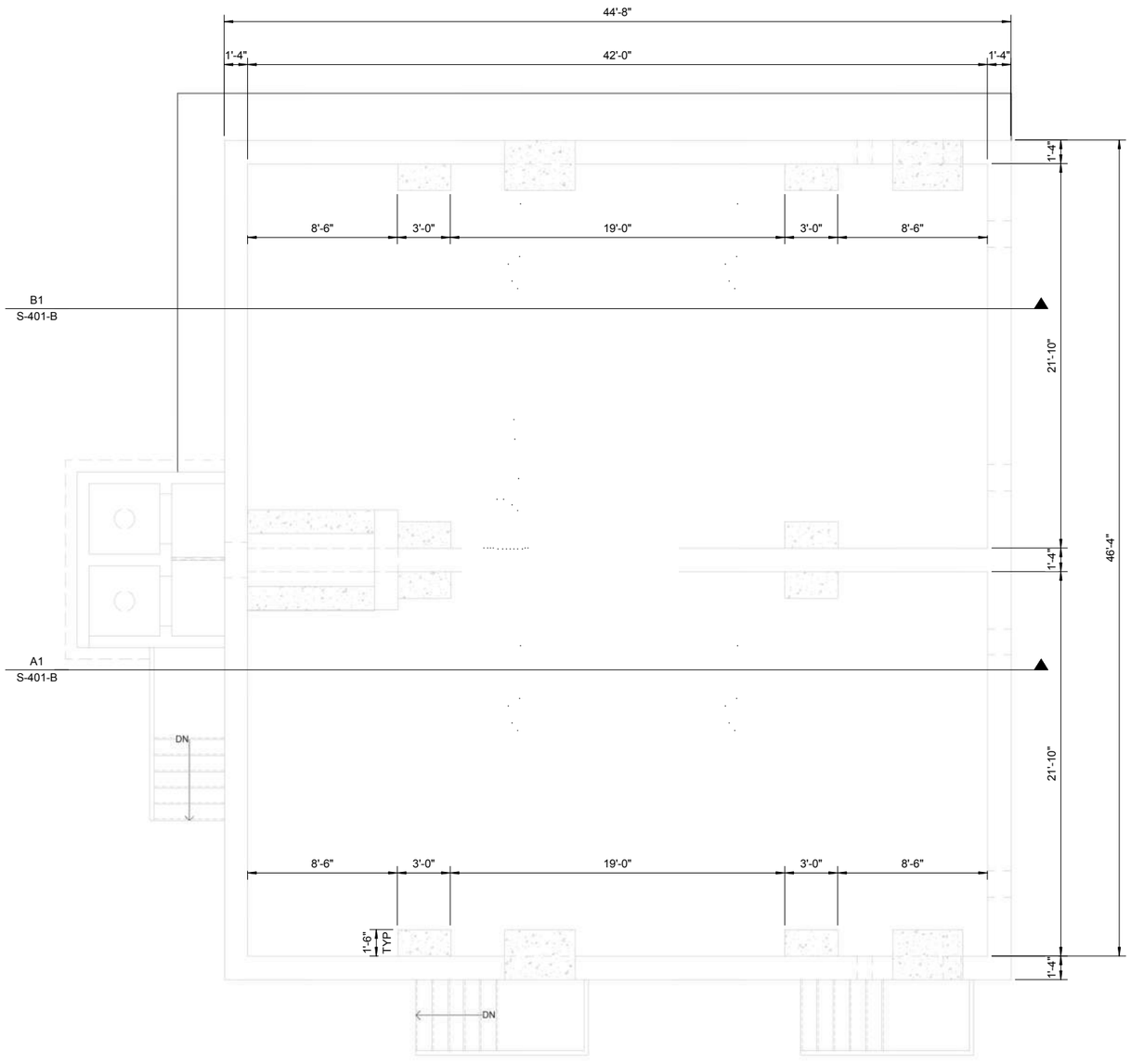

A1 EXISTING WALL PLAN

1/4" = 1'-0"

1/4" 0 2' 4' 8'

2/24/2023 10:51:00 AM - C:\Users\dcain\Documents\222032 - B-IFAS-Struc_dcain7086.rvt

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City of Aberdeen

WASTEWATER TREATMENT PLANT

IFAS - EXISTING PLAN FOR VENDOR

DRAWN: GAI CHECK:

VERIFY SCALE: Scales based on 22"x34" prints.

1-1/2 Inches

PROJECT NO. 222032 PAGE

SHEET NO. S-105-B

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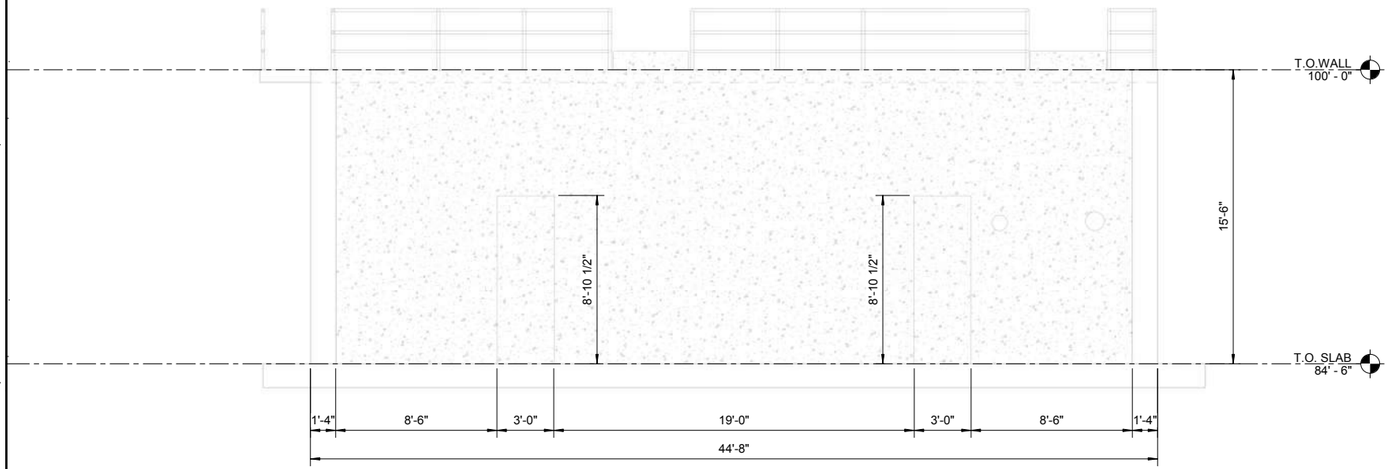
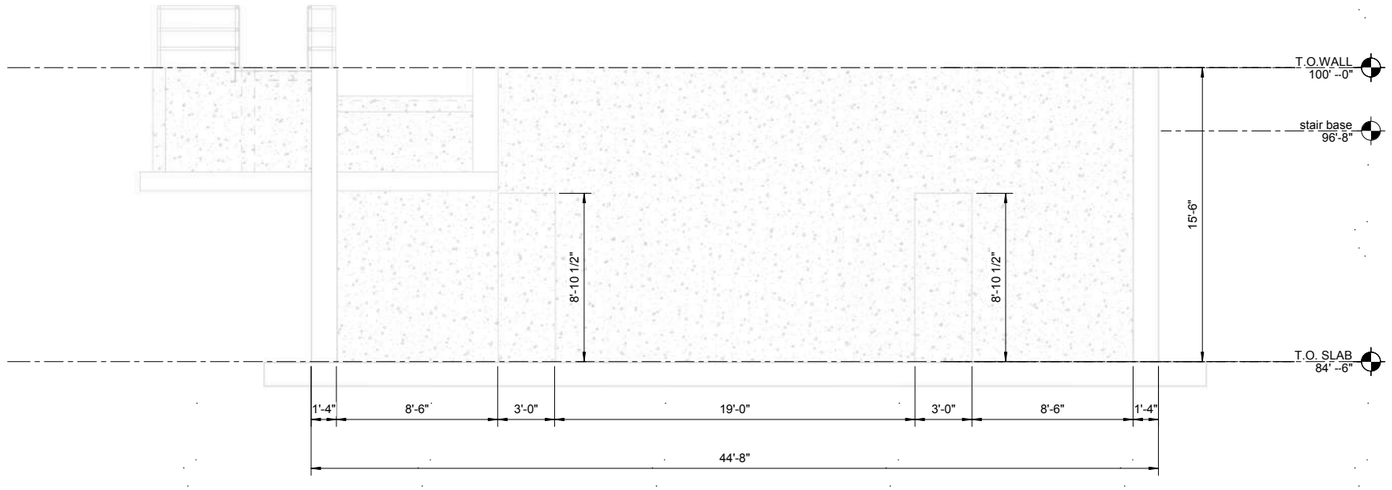


B1 Section 2

1/4" = 1'-0"

1/4" 0 2' 4' 8'



A1 Section 1

1/4" = 1'-0"

1/4" 0 2' 4' 8'

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WASTEWATER TREATMENT PLANT

IFAS - EXISTING SECTIONS FOR VENDOR

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PROJECT NO. 222032 PAGE

SHEET NO. S-401-B

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APPENDIX B.2

Prepurchase Documents April 2023

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Prepurchase Contract Documents & Specifications

CITY OF ABERDEEN
WWTP IMPROVEMENTS

Volume 1 of 2
Division 00 – Division 46

APRIL 2023

PROJECT NO. 222032-000

PREPARED BY:

KELLER ASSOCIATES

305 North 3rd Ave., Ste. A
Pocatello, ID 83201
(208) 238-2146

PREPARED FOR:

City of Aberdeen

33 N. Main St.
Aberdeen, ID 83210
(208) 397-4161

TABLE OF CONTENTS

BIDDING DOCUMENTS

NOTICE INVITING BIDS

Electronic sealed Bids for the **City of Aberdeen's Wastewater Treatment Plant Equipment Pre-Purchase** will be received, by the **City of Aberdeen and Keller Associates, Inc.** using QuestCDN Online Electronic Bid platform until 2:00 PM MST on May 11, 2023. Bids will be opened, evaluated, and an announcement will be made as defined in Section P-200 – Instructions to Bidders.

The Project consists of furnishing equipment for the Aberdeen Wastewater Treatment Plant, consisting of a sand filter system. Other associated work as described herein shall be included with the equipment system. The City will sign a purchase agreement with the selected vendor for the equipment package, which agreement will subsequently be assigned to the Installation Contractor. It is anticipated that the City will pay for submittals prior to the selection of the Installation Contractor and that the Contractor will then be responsible for the remainder of the purchase agreement. The Installation Contractor is expected to be selected in the first quarter of 2024. The vendor shall be responsible to coordinate all installation and startup activities with the selected Contractor.

Copies of the Contract Documents and Bid Document may be downloaded electronically at www.kellerassociates.com via QuestCDN for a non-refundable charge of $42.00. Click on 'Current Projects Bidding' which shows, in the left-hand column, all of the projects which we have bidding at this time. The '**City of Aberdeen – WWTP Equipment Pre-Purchase**' hyperlink will display information specific to the project. For assistance in viewing or downloading the digital project information, contact QuestCDN at (952) 233-1632 or info@questcdn.com.

Prospective Bidders will be required to register with the designated website as a plan holder. Bids will be submitted electronically at www.kellerassociates.com via QuestCDN. To submit your electronic Bid, your company will need to have an online signature with QuestCDN. Bids will only be accepted from registered official plan holders. The designated website will be updated periodically with addenda, lists of registered plan holders, reports, and other information relevant to submitting a Bid for the Project. All official notifications, addenda, and other Bidding Documents will be offered through the designated website. Neither Owner nor Engineer will be responsible for Bidding Documents, including addenda, if any, obtained from sources other than the designated website. Instructions for submitting an electronic Bid will be provided with the Bid Documents. Bidders who are unable to access or register with QuestCDN should contact Keller Associates at (208) 238-2146 to make separate arrangements.

A pre-bid conference will not be held. Questions shall be referred to the Project Manager: Dallin Stephens - Keller Associates, Inc. at (208) 238-2146 or via email at dstephens@kellerassociates.com.

The bidder shall be aware that this project will be funded by USDA-RD and DEQ ARPA grant funds and the bidder will need to comply with any funding agency requirements. This project will not need to meet Build America, Buy America requirements, however the project will need to comply with American Iron and Steel requirements.

Each Bid must be submitted on the prescribed forms and accompanied by Bid Security in the form of a cashier's check, or a bid bond executed on the prescribed form, payable to the City of Aberdeen, in an amount not less than five percent (5%) of the bid amount. The successful Bidder will be required to furnish Performance and Payment Bonds with the Purchase Order Agreement, each in the amount of not less than 100% of the contract price.

The City of Aberdeen, in accordance with Title VI of the Civil Rights Act of 1964, 78 Stat. 252, 42 US.C. 2000d to 2000d-4 and Title 49, Code of Federal Regulations, Department of Transportation, Subtitle A, Office of the Secretary, Part 21, Nondiscrimination in Federally-assisted programs of the Department of Transportation issued pursuant to such Act, hereby notifies all invited bidders that it will affirmatively ensure that in any contract entered into pursuant to this advertisement, disadvantaged business enterprises as defined at 49 CFR Part 23 will be afforded full opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, national origin, or sex in consideration for an award. In addition, the City of Aberdeen prohibits discrimination based on ancestry, religion, creed, age, marital or familial status, physical or mental stability, sexual orientation, and gender identity/expression.

The City of Aberdeen is committed to providing access and reasonable accommodation in its services, programs, and activities and encourages qualified persons with disabilities to participate. If you anticipate needing any type of accommodation or have questions about the bid opening, please contact Keller Associates, (208) 238-2146, at least forty-eight (48) hours in advance of the opening.

The City of Aberdeen reserves the right to reject any or all Bids and to waive any nonmaterial informalities in the Bids received.

Publication Dates: April 26, 2023

May 3, 2023

INSTRUCTIONS TO BIDDERS

ARTICLE 1 - GENERAL INFORMATION

1.01 The following instructions outline the procedure for preparing and submitting bids. Bidders must fulfill all requirements as specified in these Contract Documents.

ARTICLE 2 - DEFINED TERMS

2.01 Terms used in these Instructions to Bidders will have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below.

A. *Bidder* – Equipment vendors submitting a bid. Bidder shall be the manufacturer of the proposed equipment or be an authorized distributor of the manufacturer.

B. *Buyer or Owner* – City of Aberdeen, 33 N. Main St., Aberdeen, ID 83210, Telephone: (208) 595-4902.

C. *Engineer* – Keller Associates, Inc., 305 N. 3rd Street, Ste. A, Pocatello, ID 83201, Telephone: (208) 238-2146.

D. *Installation Contractor* – The individual, partnership, corporation, joint-venture, or other legal entity with whom the Owner shall execute a Contract for construction of the City of Aberdeen WWTP, including installation, start-up and testing of the WWTP equipment to be furnished by the selected Vendor(s).

E. *Issuing Office* – The office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered.

F. *Vendor* – Vendor shall have the same definition as *Seller* in the General Conditions.

ARTICLE 3 - BIDS RECEIVED

3.01 Refer to Notice Inviting Bids for information on receipt of Bids.

ARTICLE 4 - COPIES OF BIDDING DOCUMENTS

4.01 Complete sets of the Bidding Documents in the number and for the deposit sum, if any, may be obtained as described in the advertisement or invitation to bid.

4.02 Complete sets of the Bidding Documents shall be used in preparing Bids; neither Buyer nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

4.03 Buyer and Engineer have made copies of Bidding Documents available on the above terms only for the purpose of obtaining Bids for furnishing Goods and Special Services and do not authorize or confer a license for any other use.

ARTICLE 5 - QUALIFICATIONS OF BIDDERS

5.01 Bidder must comply with all bidding procedures and meet the specifications for the Goods and Special Services.

5.02 If Bidder is selected for award of the Contract, Bidder shall be required to obtain a City Business License if needed.

5.03 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

ARTICLE 6 - EXAMINATION OF BIDDING DOCUMENTS, OTHER RELATED DATA, AND POINT OF DESTINATION

6.01 It is the responsibility of each Bidder before submitting a Bid to:

A. examine and carefully study the Bidding Documents, including any Addenda, and the related data identified in the Bidding Documents;

B. become familiar with and satisfy itself as to all Laws and Regulations that may affect cost, progress, or the furnishing of the Goods and Special Services;

C. carefully study, consider, and correlate the information known to Bidder; information commonly known to sellers of similar goods doing business in the locality of the Point of Destination and the site where the Goods will be installed or where Special Services will be provided; and any reports and drawings identified in the Bidding Documents regarding the Point of Destination and the site where the Goods will be installed or where Special Services will be provided, with respect to the effect of such information, observations, and documents on the cost, progress, and performance of Seller's obligations under the Contract Documents;

D. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution (if any) thereof by Engineer is acceptable to Bidder; and

E. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for furnishing Goods and Special Services.

6.02 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 6, that without exception the Bid is premised upon furnishing Goods and Special Services required by the Bidding Documents, that Bidder has given Engineer written notice of all conflicts, errors, ambiguities and discrepancies that Bidder has discovered in the Bidding Documents and the written resolutions (if any) thereof by Engineer are acceptable to Bidder, and that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for furnishing Goods and Special Services.

ARTICLE 7 - INTERPRETATIONS AND ADDENDA

7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by Buyer as having received the Bidding Documents. Questions received less than seven business days prior to the date for opening of Bids will not be answered. Only answers in the Addenda will be binding. Oral statements, interpretations, and clarifications may not be relied upon and will not be binding or legally effective.

7.02 Addenda may be issued to clarify, correct, or change the Bidding Documents as deemed advisable by Buyer or Engineer.

ARTICLE 8 - BID SECURITY

8.01 A Bid must be accompanied by Bid security made payable to Buyer in an amount of at least 5% of Bidder's maximum Bid price and in the form of cash, a cashier's check, or a Bid Bond (on form attached) issued by a surety meeting the requirements of Paragraph 4.01.B of the General Conditions.

8.02 The Bid security of the Successful Bidder will be retained until such Bidder has executed the Contract Documents, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Buyer may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. The Bid security of other Bidders that Buyer believes to have a reasonable chance of receiving the award may be retained by Buyer until the earlier of 7 days after the Effective Date of the Agreement or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be returned. Bid Security in the form of a bid bond will only be returned upon request.

ARTICLE 9 - CONTRACT TIMES

9.01 The number of days within, or the dates by which the work is to be completed is set forth in Section C-400 – Bid Form, Paragraph 7.

9.02 The City of Aberdeen plans to bid the construction of the wastewater treatment plant improvements in the first quarter of 2024. It is expected that construction will begin in the spring or summer of that same year. Construction of the WWTP improvements is anticipated to be completed by the fourth quarter of 2025.

9.03 If the contract is to be awarded, the Owner will give the Successful Bidder a Notice of Award within 60 days after the day of the Bid opening.

9.04 It is anticipated that the Owner will purchase the submittals after an award is made. These submittals will be used by the Engineer to prepare construction drawings and bid the work of installation of the equipment to Contractors. The City will assign the remainder of the Vendor Purchase Agreement to the Installation Contractor after the bidding is finalized and the Contractor selected.

ARTICLE 10 - LIQUIDATED DAMAGES

10.01 Any provisions for liquidated damages are set forth in the Agreement.

ARTICLE 11 - PREPARATION OF BID

11.01 Bidder will complete the Bid Forms electronically at www.kellerassociates.com via QuestCDN according to Section 00 21 14 – Electronic Bid Instructions. Bid documents may be purchased and downloaded electronically at www.kellerassociates.com via Quest CDN for $42.00. Click on 'Current Projects Bidding' which shows, in the left-hand column, all of the projects which we have bidding at this time. The 'City of Aberdeen – WWTP Equipment Pre-Purchase' hyperlink will display information specific to the project.

11.02 Bidders who are unable to access or register with QuestCDN should contact Keller Associates at (208) 238-2146 to make separate arrangements.

11.03 The Bid Form is included with the Bidding Documents.

11.04 All blanks on the Bid Form shall be completed in ink and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each item listed therein. In the case of optional alternates, the words "No Bid," "No Change," or "Not Applicable" may be entered.

11.05 A Bid by a corporation shall be executed in the corporate name by the president or a vice-president or other corporate officer accompanied by evidence of authority to sign. The corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown.

11.06 A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership shall be shown.

11.07 A Bid by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown.

11.08 A Bid by an individual shall show the Bidder's name and official address.

11.09 A Bid by a joint venture shall be executed by each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown.

11.10 All names must be typed or printed in ink below the signature.

11.11 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.

11.12 Each Bidder shall list the postal address, e-mail address, and telephone number for communications regarding the Bid.

ARTICLE 12 - BASIS OF BID; COMPARISON OF BIDS

12.01 The bids will be evaluated and awarded under the selection process outlined in Article 18 of this Section. Although lump sum prices for equipment will be required, these criteria will be "weighted" as indicated in Article 18.03.

12.02 Lump sum prices for WWTP equipment shall be provided by each bidder for each item on the bid form for which they intend to provide a bid. Lump sum prices will include freight/shipping of all equipment to the project site located in Aberdeen, Idaho. Taxes will be paid by the Installation Contractor.

ARTICLE 13 - SUBMITTAL OF BID

13.01 A Bid shall be submitted no later than the date and time prescribed and at the place indicated in the Notice Inviting Bids. Bids may be submitted electronically according to Section 00 21 14 – Electronic Bid Instructions. See Article 11 – Preparation of Bid. If a Bid contains any "trade secrets", as defined by Idaho Code § 74-107(1), then Bidder must clearly identify such information and mark as "CONFIDENTIAL". Prices are not "trade secrets". The City of Aberdeen reserves the right to make its own independent determination as to whether information included in a Bid constitutes a "trade secret".

13.02 With each copy of the Bidding Documents, a Bidder is furnished one copy of the Bid Form, and, if required, the Bid Bond. The copy of the Bid Form is to be completed and submitted with the Bid security.

13.03 Bids received after the date and time prescribed for the Opening of Bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder.

13.04 Prospective Bidders will be required to register with the designated website as a plan holder. Bids will be submitted electronically at www.kellerassociates.com via Quest CDN. To submit your electronic Bid, your company will need to have an online signature with QuestCDN. Bids will only be accepted from registered official plan holders. Bidders who are unable to access or register with QuestCDN should contact Keller Associates at (208) 238-2146 to make separate arrangements.

13.05 The designated website will be updated periodically with addenda, lists of registered plan holders, reports, and other information relevant to submitting a Bid for the Project. All official notifications, addenda, and other Bidding Documents will be offered only through the designated website. Neither Owner or Engineer will be responsible for Bidding Documents, including addenda, if any, obtained from sources other than the designated website.

13.06 Instructions for submitting an electronic Bid will be provided with the Bid Documents as Section 00 21 14 Electronic Bid Instructions.

ARTICLE 14 - MODIFICATION OR WITHDRAWAL OF BID

14.01 A Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the Opening of Bids.

14.02 Any Bidder may modify its bid by telegraphic, fax, or written communication at any time prior to the scheduled closing time for receipt of bids, provided such communication is received by the Buyer prior to the closing time. Telegraphic, faxed, or written communication should not reveal the bid price; it should however, state the addition or subtraction or other modification so that the final prices or terms will not be known by the Buyer until the sealed bid is opened. It is the sole responsibility of the Bidder to see that any modification to its bis is received at the time and place stated in the Notice Inviting Bids.

14.03 It is the sole responsibility of the Bidder to see that any modification to its bid is received at the time and place stated in the Notice Inviting Bids.

ARTICLE 15 - OPENING OF BIDS

15.01 All bids will be evaluated based on the criteria provided and the Instructions to Bidders and information provided in the bid forms, Vendor Performance Questionnaire and the rest of the Vendor Proposal.

15.02 Bids will not be read aloud publicly.

ARTICLE 16 - BIDS TO REMAIN SUBJECT TO ACCEPTANCE

16.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Buyer may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 17 - SCOPE OF SUPPLY

17.01 The successful bidder shall enter into a Procurement Agreement (PA) with the Buyer to provide the following goods.

A. **Sand Filter System:** A sand filter system designed to remove phosphorus following a chemical addition and mixing system. The system shall include all major equipment components, such as internal piping and components, media bed, air compressors, instrumentation, motor controls and control panels as required in Section 46 61 27 – Upflow Moving Bed Filter and related sections.

17.02 The Procurement Agreement entered into with the Buyer shall also include the following services. These services are required to be included with the equipment system provided.

A. **Submittals:** The Vendor will provide design of the Goods, submittal of the shop drawings, general arrangement drawings of equipment, and a control strategy description; will participate in meetings and assist Engineer during the design; and will make changes to the equipment system as required to coordinate the design with the Engineer during the submittal review process. Submittals shall meet the requirements of Section 01 30 00 – Vendor Submittals.

B. **Supply and Shipping of Equipment:** The Vendor shall supply all equipment identified in the approved submittals and shall deliver equipment to site. During shipment, Vendor shall assume all responsibility for loss or damage.

C. **Start-Up Services and Training**: The Vendor shall provide the minimum number of days and trips identified in the equipment specifications and Section 01 75 16 – Startup Procedures.

D. **Anchoring Calculations**: Design of all equipment supports, and anchor bolt design shall be provided by the Vendor, certified by a licensed professional engineer in the state where the equipment is to be installed. Anchor bolts are to be provided by the Installation Contractor.

17.03 To better define the intended Scope of Supply for the equipment Vendor, it is anticipated that the Installation Contractor's scope of work under a separate general construction contract will include:

A. **Civil Work:** This includes all site work including earthwork, grading, excavation, landscaping, paving, sidewalks, curb and gutter, drainage, and all utility work including yard piping.

B. **Structural Work:** This work includes all superstructure-related work including building enclosure construction. This includes all cast-in-place concrete work, including foundations and floors, and all miscellaneous metal work including gratings, stairs and handrail (unless specified otherwise).

C. **Mechanical Work:** This work includes installation of equipment provided by the Vendor, as well as the supply and installation of all other mechanical equipment and piping not included in the Vendor's scope.

D. **Electrical, Instrumentation and Controls:** This work includes motor control centers, motor starters, main power entrance and switchgear, interconnecting electrical wiring and conduits, plant instrumentation and controls not included in the Vendor's scope, and main plant PLC and standby power.

E. **Protective Coatings:** This work includes coating of materials, equipment and piping not provided by the Vendor. This work also includes any on-site touch up of Vendor supplied equipment, as to be coordinated and approved by the Vendor.

ARTICLE 18 - EVALUATION OF BIDS AND AWARD OF CONTRACT

18.01 Buyer reserves the right to reject any and all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Buyer may also reject the Bid of any Bidder if Buyer believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not responsive or fails to meet any other pertinent standard or criteria established by Buyer. Buyer also reserves the right to waive all informalities not involving price, time, or changes in the Goods and Special Services. Discrepancies in the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

18.02 Selection of a Vendor, if made, will be based on the evaluation criteria discussed in Section

18.03, and will be made to a responsive, responsible, and qualified Vendor as determined by Owner in its sole discretion. Responsive means a Vendor who has submitted a bid that conforms in all material respects to the intent of the Documents. Responsible means a Vendor who as the capacity and capability in all respects to perform fully the Document requirements and who has the integrity and reliability to assure good faith performance.

18.03 The following evaluation shall be conducted by Engineer based on information provided by the Vendor and used to rank Vendors to assist Owner in selecting a Vendor. These criteria shall be weighted as indicated in evaluating proposals. The information submitted by each Vendor as required under Section 00 40 00 – Vendor Performance Questionnaire will be used by Owner to evaluate each bid proposal.

A. Capital Costs (60 Points): Points will be awarded based upon estimated capital costs: price quote for WWTP Equipment and Services as outlined in Scope of Work listed in Section C-400 – Bid Form and the estimated construction costs for the buildings, and other items associated with Vendor's proposal. The low bidder capital cost will receive full points. Accessory items will also be considered in evaluating total project capital costs. The other Bidders will receive points in proportion to the estimated capital cost associated with their equipment.

B. O&M Cost (20-Year) Present Value (35 Points): Points will be awarded based upon the present value of the O&M costs, including power consumption costs, scheduled maintenance, schedule part replacement, and other costs incurred over a 20-year cycle at a 3.5% discount rate. Bidders shall provide a table showing all operations and maintenance items in rows with columns for units, annual, 5 year, 10 year and 20 year costs. The flow rate for the O&M costs shall be based on the Average Annual Flow identified in Section 01 11 00 – Summary of Work. Bidders shall have units in dollars for parts, hours for labor to install parts or perform other operations and maintenance work. Power costs shall be a row item and must consider ALL equipment within each Vendor's scope of supply and shall be listed in kWh. The kWh cost shall be calculated at $0.10 per kWh. Labor shall be estimated at $75 per hour. Bidders shall provide any copies of any calculations used to develop operations and maintenance costs. The lowest life cycle cost will receive full points. Other bids will receive proportionally lower points.

C. Manufacturer's Experience and References (30 Points): The previous experience of each Vendor will be evaluated relative to facility location, capacity and length of operation as listed in the following table:

NO.	Category	Total Possible Points	Score
Company Experience			
1.	Number of operational North American installations where design (avg. annual) flow rate is at least 0.25 mgd.	One point per installation (up to 10 points max)	
2.	Identify the year of manufacturer's first full-scale installation at a municipal WWTP exceeding avg. design flow of 0.25 mgd, excluding pilot projects.	One point per two years prior to current year (up to 5 points max)	
Individual Experience			
3.	Individual Experience – Number of staff who have over 5 years of more	One point per qualifying individual (up to 5 points max)	

	experience in design and configuration of Vendor's WWTP Equipment.		
References			
4.	Positive Reference – Points will be awarded to the degree the Vendor has demonstrated full and timely support during final design, construction and start-up, training capability for Owner's staff, post commissioning for Owner and plant staff, and continued product support with timely delivery of spare parts.	Two points per positive reference (Up to 10 points max)	

D. Product Support (15 Points): Points will be awarded to Manufacturers who offer product support services such as start-up and operator training services, 24/7 telephone service, on-line facility monitoring, additional operator training beyond facility start-up, quarterly site visits, maintenance contract and operator conferences and/or discussion groups. In addition, the number of service/maintenance agreements, number of available maintenance personnel, and location of service centers will be considered.

E. System Configuration and Operation (30 Points): Points will be awarded based upon operation and maintenance requirements such as: (1) WWTP equipment system configuration and accessibility; (2) overall treatment process flexibility; (3) complexity of process controls; (4) level of operator attention; (5) cleaning requirements; and (6) equipment performance and longevity. Note that this evaluation is a subjective evaluation by the City operators and Engineer based on information provided in the submittal.

F. Extended Warranty (5 Points for one year of additional warranty): Points will be awarded based the additional years of warranty the Vendor offers to provide over the number of years of warranty listed in the individual WWTP equipment technical specifications.

G. Owner Preference (25 Points): Points will be awarded based upon Owner's preference of equipment and responsive submittal package.

ARTICLE 19 - CONTRACT SECURITY AND INSURANCE

19.01 Article 4 of the General Conditions and Article 4 of the Supplementary Conditions set forth Buyer's requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the executed Agreement to Buyer, it must be accompanied by such bonds. If the Bid Security was in the form of a Bid Bond, payment and performance bonds may be submitted after contract award.

ARTICLE 20 - SIGNING OF AGREEMENT

20.01 When Buyer issues a Notice of Intent to Award to the Successful Bidder, it shall be accompanied by the required number of unsigned counterparts of the Agreement with the other Contract Documents that are to be identified in the Agreement and attached thereto. Within 15 days thereafter, Successful Bidder shall sign and deliver the required number of counterparts of the Agreement and attached documents to Buyer.

ARTICLE 21 - SALES AND USE TAXES

21.01 Any applicable state sales and use taxes on materials and equipment to be incorporated in the Project shall be paid by the Installation Contractor. Said taxes shall not be included in the Bid.

ARTICLE 22 - CONTRACT TO BE ASSIGNED

22.01 Bidder's attention is directed to the provisions of Article 10.07 of the Section P-520 – Procurement Agreement which provide for the assignment of the Contractor for furnishing Goods and Special Services covered by these Bidding Documents to an Installation Contractor designated by the Owner to construct the facilities and install the Goods. The application of the terms and conditions of the Contract Documents after the Contract has been assigned to the Installation Contractor should be considered by Bidder. Timing of the assignment is set forth in the Agreement. Forms documenting the assignment of the Contract and for the agreement of the Vendor's surety to such assignment are included as attachments to the Agreement.

END OF SECTION P-200

BID FORM

PROJECT IDENTIFICATION:

City of Aberdeen - WWTP Equipment Pre-Purchase

ARTICLE 1 - BID RECIPIENT

1.01 This Bid is submitted to: **City of Aberdeen, ID**

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into a Contract with Buyer in the form included in the Bidding Documents to furnish the Goods and Special Services as specified or indicated in the Bidding Documents, for the prices and within the times indicated in this Bid, and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 - BIDDER'S ACKNOWLEDGMENTS

2.01 Bidder accepts all of the terms and conditions of the Notice Inviting Bids and Instructions to Bidders, including without limitation those dealing with the deposition of Bid security. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Buyer. Bidder will sign and submit the Agreement with the Bonds and other documents required within 15 days after the date of Owner's Notice of Award herein is received.

2.02 Bidder acknowledges that this Contract, if awarded, will be assigned by the Owner to the Installation Contractor, and hereby consents to the assignment under the terms and conditions of the Contract Documents. Bidder accepts that, until the assignment of contract is executed by all parties, the Owner is not obligated to any monetary commitment associated with the Contract beyond that which is associated with Special Engineering Services.

ARTICLE 3 - BIDDER'S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

A. Bidder has examined and carefully studied the Bidding Documents, the related data identified in the Bidding Documents, and the following Addenda, receipt of which is hereby acknowledged:

Date	Number	Initials

B. Bidder is familiar with and is satisfied as to all Laws and Regulations in effect as of the date of the Bid that may affect cost, progress, and the furnishing of Goods and Special Services.

C. Bidder has carefully studied, considered, and correlated the information known to Bidder; information commonly known to sellers of similar goods doing business in the locality of the Point of Destination and the site where the Goods will be installed or where Special Services will be provided; information and observations obtained from Bidder's visits, if any, to the Point of Destination and the site where the Goods will be installed or Special Services will be provided; and any reports and drawings identified in the Bidding Documents regarding the Point of Destination and the site where the Goods will be installed or where Special Services will be provided, with respect to the effect of such information, observations, and documents on the cost, progress, and performance of Seller's obligations under the Bidding Documents.

D. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution (if any) thereof by Engineer is acceptable to Bidder.

E. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for furnishing the Goods and Special Services for which this Bid is submitted.

ARTICLE 4 - BIDDER'S CERTIFICATIONS

4.01 Bidder certifies that:

A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;

B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;

C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and

D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Buyer, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Buyer of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Buyer, a purpose of which is to establish bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process.

ARTICLE 5 - BASIS OF BID

5.01 BID SCHEDULE 1 – BASE BID: WWTP EQUIPMENT. Bidder will furnish the Goods (specifically equipment by vendors listed below) and Special Services in accordance with the Contract Documents for the following price(s). Vendors may provide bids for one or more of the following base bid items. State of Idaho taxes shall not be included (Section P-800 – Supplementary Conditions 5.05.A).

Item No.	Description	Unit	Amount
1A	**SUBMITTALS AND SHOP DRAWINGS**: As defined in the Agreement, price **not to exceed 10%** of the Contract price for the work outlined in Item 1B.	LS	$
1B	**SAND FILTER SYSTEM** consisting of sand filters with all necessary appurtenances and services as described in Section 46 61 27 of the specifications.	LS	$
1A + 1B	**TOTAL ITEM PRICE** $_____ (In Words)	LS	$

ARTICLE 6 - PRICE ESCALATION

6.01 Any selected vendor or vendors will be required to honor their submitted proposal pricing for the Goods and Services for 60 consecutive calendar days from the proposal due date for this RFP.

6.02 Where a signed agreement between the City and the manufacturer is not signed within 60 calendar days from the proposal due date, price escalation shall be allowed as follows: Price adjustment will be based on the net change of the ENR Construction Cost Index occurring in the period from 60 consecutive calendar days from the proposal due date to the date when the agreement is signed with the City.

ARTICLE 7 - TIME OF COMPLETION

7.01 Bidder agrees that the furnishing of Goods and Special Services will conform to the schedule below. Startup services and training shall be coordinated with the Installation Contractor and Owner but shall not occur more than 21 days after the Vendor has certified the installation of the equipment.

Item	Required Time for Completion (Calendar days from Vendor Bid Award)
Signing of Agreement	30
	Required Time for Completion (Calendar days from completion of Signed Agreement)
Accepted Submittals, including drawings, calculations, and anchor bolt design	**75**
	Required Time for Completion (Calendar days from Installation Contractor Bid Award)
Assignment of Agreement to Installation Contractor	30
Delivery	212

ARTICLE 8 - ATTACHMENTS TO THIS BID

8.01 The following documents are attached to and made a condition of this Bid:

A. Information Required of Bidder;

B. Required Bid Security;

~~C. If Bid amount exceeds $10,000, signed Compliance Statement (RD 400-6). Refer to specific equal opportunity requirements set forth in paragraph 18.10 of the Supplemental Conditions to the agreement with the Contractor who will install the WWTP equipment and to who the City will assign the contract with the Vendor (attached);~~

~~D. If Bid amount exceeds $25,000, signed Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – Lower Tier Covered Transactions (AD-1048);~~

~~E. If Bid amount exceeds $100,000, signed RD Instruction 1940-Q, Exhibit A01, Certification for Contracts, Grants and Loans.~~

ARTICLE 9 - BID SUBMITTAL

9.01 This Bid submitted by:

If Bidder is:

An Individual

Name (typed or printed): _____

By: _____
(Individual's signature)

Doing business as: _____

Business address: _____

_____

Phone: _____ Facsimile: _____

E-mail address: _____

Partnership

Partnership Name: _____ (SEAL)

By: _____
(Signature of general partner - attach evidence of authority to sign)

Name (typed or printed): _____

Business address: _____

_____

Phone: _____ Facsimile: _____

E-mail address: _____

A Corporation

Corporation Name: _____

State of Incorporation: _____

Type (General Business, Professional, Service, other): _____

By: _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

(CORPORATE SEAL)

Attest _____
(Signature of Corporate Secretary)

Business address: _____

_____

Phone: _____ Facsimile: _____

E-mail address: _____

A Limited Liability Company (LLC)

LLC Name: _____

State in which organized: _____

By: _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

_____

Phone: _____ Facsimile: _____

E-mail address: _____

A Joint Venture

First Joint Venturer Name: _____(SEAL)

By: _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

_____

Phone: _____Facsimile: _____

E-mail address: _____

Second Joint Venturer Name: _____(SEAL)

By: _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

_____

Phone: _____Facsimile: _____

E-mail address: _____

Phone and Facsimile Number, and Address for receipt of official communications to Joint Venture:

_____

_____

(Each joint venturer must sign. The manner of signing for each individual, partnership, corporation, and limited liability company that is a party to the joint venture should be in the manner indicated above.)

BID BOND

Any singular reference to Bidder, Surety, Owner, or other party shall be considered plural where applicable.

BIDDER *(Name and Address)*:

SURETY *(Name, and Address of Principal Place of Business)*:

OWNER *(Name and Address)*:

BID

Bid Due Date:

Description *(Project Name— Include Location)*:

BOND

Bond Number:

Date:

Penal sum _____ $ _____

(Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER	**SURETY**
_____ (Seal)	_____ (Seal)
Bidder's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	By: _____
Signature	Signature (Attach Power of Attorney)
_____	_____
Print Name	Print Name
_____	_____
Title	Title
Attest: _____	Attest: _____
Signature	Signature
Title	Title

Note: Addresses are to be used for giving any required notice.
Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation shall be null and void if:

3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or

3.2 All Bids are rejected by Owner, or

3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after the Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

SECTION 00 40 00 – VENDOR PERFORMANCE QUESTIONNAIRE

1.1 GENERAL

A. This Section lists the submittal requirements for the Vendor Proposal. The purpose of the submitted information will be to provide Owner and Engineer with the necessary information to judge a Vendor's minimum qualifications and to assist in evaluating Vendors for basis of award as indicated in the Instructions to Bidders.

B. Vendor shall submit information and/or responses that address each item below on separate sheets to be attached to the Proposal. Each answer shall reference the item number to which the information pertains. If a question is not applicable to a Vendor's proposed equipment, then an answer of "Not Applicable" or "N/A" must be provided. Failure to provide the requested information may result in a Bid being judged as nonresponsive.

C. Vendor shall provide a separate complete list of all exceptions, or qualifications taken to the Contract Documents or Specifications in Vendors Qualification and Bid Proposal, including, any limitations on Vendor's liability.

D. The Vendor shall submit a copy of each applicable technical specification section with all addenda and all referenced specification sections. Each paragraph shall be check-marked to indicate specification compliance or marked to indicate deviations from the specification requirements. Check marks shall indicate complete compliance with the paragraph requirements. Deviations from the specification shall be indicated by underlining the deviation and marking the paragraph or line with a number or letter. The remainder of the paragraph not marked as a deviation shall indicate compliance with the requirements of the paragraph. The manufacturer shall prepare a detailed justification for each deviation. Failure to include the required specification sections and justification for deviations will indicate non-compliance and shall be rejected without further consideration.

1.2 SUBMITTAL REQUIREMENTS

A. Vendor to submit bound copies of questionnaire per instruction in Section P-030 – Notice Inviting Bids. Submitted information shall be considered the Qualifications Proposal.

B. Qualifications Proposal shall include the following:

1. Identification of Vendor, name of project, name of Owner, and date of submittal.

2. Responses to all questions listed in Parts below including: Product Support Services, Experience and References, Product Design, and pertinent licensing agreements.

3. Provide a complete description of proposed equipment including layout and installation details. Power requirements shall be provided. Description of motors, if any, shall be provided. For blowers, a blower curve shall be provided. For pumps, a pump curve shall be provided.

4. Provide a complete description of equipment operating and maintenance costs for power, materials, and labor hours. Provide a summary of annual maintenance, 5-year maintenance, 10-year maintenance, and 20-year maintenance activities and include estimated labor hours and materials cost for each item of maintenance to help Owner properly evaluate life cycle costs.

5. Indicate and list any and all advantages that Vendor's equipment might have over a competitor's equipment. Include information on any extended equipment or media warrantees offered beyond the specified warranty period.

6. Any other information deemed appropriate by Vendor to assist Owner and Engineer in determining Vendor qualifications including company brochures, product data sheets, etc.

7. Proposal to be organized with table of contents at the front and tabbed dividers between sections.

1.3 PRODUCT SUPPORT SERVICES

A. Provide examples or document past experience.

B. List of office locations of the WWTP Equipment Manufacturer in North America. Provide location where the equipment is manufactured.

C. List all service/maintenance locations in the United States for the WWTP equipment to be provided. Provide the following for each location:

1. Location

2. Type of support services provided

3. Description of Service Provided by Manufacturer or Subcontractor

4. Response Time for Technician to be in Aberdeen

D. Describe the system start-up and operator training capabilities of the Equipment Manufacturer. In addition, provide resume for installation supervision and start-up personnel.

E. Describe facilities, programs and methods, which the Equipment Manufacturer provides to Owners/operators for ongoing maintenance and troubleshooting.

F. Provide description of available 24/7 telephone support services, additional operator training after start-up including conferences, available support groups and quarterly site visits.

1.4 MANUFACTURER'S EXPERIENCE AND REFERENCES

A. Attach to this bid, a list of all municipal contracts completed (and private contracts if allowed) by the Bidder during the last 5 years involving applications for wastewater treatment and of comparable value in North America, please limit to 5 projects. The list shall include the following information as a minimum.

1. Names, address, and telephone number of Plant operator.

2. Name of project.

3. Location of project.

4. Brief description of the work involved.

B. Identify the year that the Equipment Manufacturer first began manufacturing WWTP Equipment for the treatment of municipal wastewater.

C. Furnish a list of North American Equipment installation for the treatment of municipal wastewater. The following information shall all be provided with each listing:

1. Location

2. Equipment rated capacity in mgd

3. Identify system by model or type

4. First year of operation (or identify as under construction)

D. Identify which of the North American installations utilize the manufacturer's same model/type anticipated for City of Aberdeen.

1.5 VENDOR LICENSING AGREEMENTS

A. Attach to this bid, a copy of the manufacturer's licensing agreement for the WWTP equipment technology, if existing, listing commencement and termination dates and all existing contractual arrangements related to the licensing agreement.

END OF SECTION 00 40 00

CONTRACT FORMS

PROCUREMENT AGREEMENT

THIS AGREEMENT is by and between City of Aberdeen, Idaho ("Buyer")

and _____("Seller").

Buyer and Seller hereby agree as follows:

ARTICLE 1 – GOODS AND SPECIAL SERVICES

1.01 Seller shall furnish the Goods and Special Services as specified or indicated in the Contract Documents.

1.02 Seller (Vendor) shall complete the Goods and Services as specified or indicated in the Buyer's Contract Documents and Specifications titled, "City of Aberdeen WWTP Equipment Pre-Purchase".

1.03 The Project, of which the Goods and Special Services may be the whole or only a part, is described as performing or providing all labor, services, engineering, manufacturing, testing, and documentation necessary for Installation Contractor to install and successfully start-up the WWTP Equipment.

1.04 The Goods are generally described as follows:

A. **Sand Filter System:** A sand filter system designed to remove phosphorus following a chemical addition and mixing system. The system shall include all major equipment components, such as internal piping and components, media bed, air compressors, instrumentation, motor controls and control panels as required in Section 46 61 27 – Upflow Moving Bed Filter and related sections.

1.05 The Services are generally described as follows:

B. **Submittals:** The Vendor will provide design of the Goods, submittal of the shop drawings, general arrangement drawings of equipment, and a control strategy description; will participate in meetings and assist Engineer during the design; and will make changes to the equipment system as required to coordinate the design with the Engineer during the submittal review process. Submittals shall meet the requirements of Section 01 30 00 – Vendor Submittals.

C. **Supply and Shipping of Equipment:** The Vendor shall supply all equipment identified in the approved submittals and shall deliver equipment to site. During shipment, Vendor shall assume all responsibility for loss or damage.

D. **Start-Up Services and Training:** The Vendor shall provide the minimum number of days and trips identified in the equipment specifications and Section 01 75 16 – Startup Procedures.

E. **Anchoring Calculations:** Design of equipment supports, and anchor bolt design shall be provided by the Vendor, certified by a licensed professional engineering in the state where the equipment is to be installed. Anchor bolts are to be provided by the Installation Contractor.

ARTICLE 2 – ENGINEER

2.01 The Contract Documents for the Goods and Special Services have been prepared by Keller Associates, Inc., 305 North 3rd Avenue, Ste. A, Pocatello, ID 83201 ("Engineer"), which is to act as Buyer's representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with Seller's furnishing of Goods and Special Services.

ARTICLE 3 – POINT OF DESTINATION

3.01 The point of destination is:

2683 W 1750 S
Aberdeen, ID 83210

ARTICLE 4 – CONTRACT TIMES

4.01 *Time of the Essence*

A. All time limits for Milestones, if any, including the submittal of Shop Drawings and Samples, the delivery of Goods, and the furnishing of Special Services as stated in the Contract Documents, are of the essence of the Contract.

4.02 *Milestones:*

A. *Days for Submittal of Shop Drawings and Samples:* Seller shall submit all Shop Drawings and Samples required by the Contract Documents to Buyer for Engineer's review and approval as noted in the Bid Forms. If more than one resubmittal is necessary for reasons not the fault and beyond the control of Seller, then Seller shall be entitled to seek appropriate relief under Paragraph 7.02.B of the General Conditions.

B. *Days to Achieve Delivery of Goods:* It is expected that the Seller shall deliver the Goods to the Point of Destination and ready for Buyer's receipt of delivery as noted in the Bid Forms. The delivery of the Goods shall be coordinated with the Installation Contractor and provided at the Installation Contractor's request within their construction contract time. Staged delivery of the equipment shall be acceptable at the Installation Contractor's request.

C. *Days for Furnishing Start-Up and Training Services:* The furnishing of start-up services, detailed installation and operation and maintenance manuals, testing services, and operator training shall be coordinated with the Installation Contractor and provided at the Installation Contractor's request within their construction contract time.

4.03 *Buyer's Final Inspection*

A. Days to Achieve Final Inspection: Buyer shall make its final inspection of the Goods pursuant to Paragraph 8.01.C of the General Conditions within 30 days after Buyer's acknowledgement of receipt of delivery of the Goods and Seller's completion of furnishing Start-Up and Training Services. The final inspection shall be requested by the Installation Contractor.

4.04 *Liquidated Damages*

A. Buyer and Seller recognize that Buyer will suffer financial loss if the Goods are not delivered at the Point of Destination and ready for receipt of delivery by Buyer within the times specified above, plus any extensions thereof allowed in accordance with Article 7 of the General Conditions. The parties also recognize that the timely performance of services by others involved in the Project is materially dependent upon Seller's specific compliance with the requirements of Paragraph 4.02. Further, they recognize the delays, expense, and difficulties involved in proving the actual loss suffered by Buyer if complete acceptable Goods are not delivered on time. Accordingly, instead of requiring such proof, Buyer and Seller agree that as liquidated damages for delay (but not as a penalty) Seller shall pay Buyer $1,000.00 for each day that expires after the time specified in Paragraph 7.01 of Section C-400 - Bid Form for delivery of acceptable Goods. Other services provided by the Seller, such as start-up services and training, shall be performed per requirements specified in Article 4 herein and at the request of the Installation Contractor to comply with contractual dates for construction.

ARTICLE 5 – CONTRACT PRICE

5.01 Buyer shall pay Seller for furnishing the Goods and Special Services in accordance with the Contract Documents.

ARTICLE 6 – PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payment*

A. Seller shall submit Applications for Payment in accordance with Article 10 of the General Conditions and Section 01 29 76 - Schedule of Payments. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 *Progress Payments; Retainage*

A. Buyer shall make progress payments on account of the Contract Price on the basis of Section 01 29 76 – Schedule of Payments on or about the 30th day of each month during performance of the Work provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below, but, in each case, less the aggregate of payments previously made and less such amounts as Buyer may withhold, including but not limited to liquidated damages, in accordance with the Contract.

a. 95 percent of Work completed (with the balance being retainage); and

b. 95 percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Seller to 100 percent of the Work completed, less such amounts set off by Buyer pursuant to Paragraph 10.04 of the General Conditions, and less 200 percent of

Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.03 *Final Payment*

A. Upon receipt of the final Application for Payment accompanied by Engineer's recommendation of payment, Buyer shall pay Seller the amount recommended by Engineer, less any sum Buyer is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages.

ARTICLE 7 – INTEREST

7.01 [Reserved.]

ARTICLE 8 – SELLER'S REPRESENTATIONS

8.01 In order to induce Buyer to enter into this Agreement, Seller makes the following representations:

A. Seller has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents, as applicable to Seller's obligations identified in Article 1 above.

B. If required by the Bidding Documents to visit the Point of Destination and site where the Goods are to be installed or Special Services will be provided, or if, in Seller's judgment, any local condition may affect cost, progress, or the furnishing of the Goods and Special Services, Seller has visited the Point of Destination and site where the Goods are to be installed or Special Services will be provided and become familiar with and is satisfied as to the observable local conditions that may affect cost, progress, and the furnishing of the Goods and Special Services.

C. Seller is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and the furnishing of the Goods and Special Services.

D. Seller has carefully studied, considered, and correlated the information known to Seller; information commonly known to sellers of similar goods doing business in the locality of the Point of Destination and the site where the Goods will be installed or where Special Services will be provided; information and observations obtained from Seller's visits, if any, to the Point of Destination and site where the Goods are to be installed or Services will be provided; and any reports and drawings identified in the Bidding Documents regarding the Point of Destination and the site where the Goods will be installed or where Special Services will be provided, with respect to the effect of such information, observations, and documents on the cost, progress, and performance of Seller's obligations under the Contract Documents.

E. Seller has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Seller has discovered in the Contract Documents, and the written resolution (if any) thereof by Engineer and Buyer is acceptable to Seller.

F. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for furnishing Goods and Special Services.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 *Contents*

A. The Contract Documents consist of the following:

1. Notice Inviting Bids;
2. Instruction to Bidders;
3. Bid Forms including the Bid, Information required of Bidder, Bid Bond, and all required certificates and affidavits;
4. This Procurement Agreement (EJCDC P-520);
5. Performance Bond;
6. Payment Bond;
7. General Conditions (EJCDC P-700);
8. Supplementary Conditions (EJCDC P-800);
9. Specifications as listed in the Table of Contents;
10. Addenda (Numbers ____ to ___, inclusive);
11. Exhibits to this Agreement (enumerated as follows):
    a. Seller's Bid, solely as to the prices set forth therein;
12. The following, which may be delivered or issued on or after the Effective Date of the Agreement:
    a. Written Amendments to this Agreement;
    b. Notice to Proceed;
    c. Change Order(s);
    d. Work Change Directive(s).

B. The documents listed in Paragraph 9.01.A are incorporated into this Agreement by reference (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 9.

D. The Contract Documents may only be amended or supplemented as provided in Paragraph 3.04 of the General Conditions.

ARTICLE 10 – MISCELLANEOUS

10.01 *Terms*

A. Terms used in this Agreement will have the meanings indicated in the General Conditions and the Supplementary Conditions.

10.02 *Successors and Assigns*

A. Buyer and Seller each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.03 *Severability*

A. Any provision or part of the Contract Documents held to be void or unenforceable by a court of competent jurisdiction under any applicable Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Buyer and Seller. The Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

10.04 *Seller's Certifications*

A. Seller certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 11.04:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Buyer, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Buyer of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Buyer, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

10.05 *Limitations*

A. Buyer and Seller waive against each other, and against the other's officers, directors, members, partners, employees, agents, consultants, and subcontractors, any and all claims for or entitlement to incidental, indirect, or consequential damages arising out of, resulting from, or related to the Contract. The terms of this mutual waiver do not apply to or limit any claim by either Buyer or Seller against the other based on any of the following: (a)

contribution or indemnification, (b) costs, losses, or damages attributable to personal or bodily injury, sickness, disease, or death, or to injury to or destruction of the tangible property of others, (c) intentional or reckless wrongful conduct, or (d) rights conferred by any bond provided by Seller under this Contract.

10.06 *Insurance*

A. Prior to the Buyer's execution of this Procurement Agreement, Seller shall secure, and shall thereafter maintain until completion of the Contract, such public liability and property damage insurance as shall protect Seller from claims for damages for personal injury, including accidental death, as well as from claims for property damage which may arise from or which may concern operations under the Contract, whether such operations be by or on behalf of Seller, any Subvendor or anyone directly or indirectly employed by, connected with or acting for or on behalf of any of them.

B. All liability insurance shall be issued by an insurance company or companies authorized to transact liability insurance business in the State of Idaho and shall cover comprehensive general and automobile liability for both bodily injury (including death) and property damage, including, but not limited to aggregate products, aggregate operations, aggregate protective and aggregate contractual with the limits as specified in the Supplementary General Conditions.

10.07 *Assignment of Procurement Contract*

A. The Contract may at the Owner's discretion be assigned by Owner to Contractor, and Vendor will accept such assignment, pursuant to the Procurement Documents. In the application of the terms and conditions of the Procurement Documents after said assignment, Vendor will function as a subcontractor to the Contractor, and all obligations of the Vendor to Owner will become obligations of the Vendor to Contractor. Notwithstanding this assignment, the guarantees and warranties specified in the Procurement Documents are intended for the benefit of Owner and the Contractor and may be enforced by either party.

B. Assignment of the Purchase Agreement shall be accomplished on Exhibits A-1 and A-2, copies of which are attached to this Purchase Agreement.

C. Miscellaneous Assignments. No further assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and specifically but without limitation monies that may become due and monies that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

IN WITNESS WHEREOF, Buyer and Seller have executed this Agreement and acknowledge that all portions of the Contract Documents have been signed or identified by Buyer and Seller or on their behalf.

This Agreement will be effective on _____("Effective Date").

Buyer: _____	Seller: _____
By: _____	By: _____
Date: _____	Date: _____
[Corporate Seal]	[Corporate Seal]
Attest: _____	Attest: _____
Address for giving notice:	Address for giving notice:
_____	_____
_____	_____
_____	_____
(If Buyer is a corporation, attach evidence of authority to sign. If Buyer is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of Buyer-Seller Agreement.)	Agent for service of process:
	_____
	_____
	_____
	_____
	(If Seller is a corporation or a partnership, attach evidence of authority to sign.)
Designated Representative:	Designated Representative:
Name: _____	Name: _____
Title: _____	Title: _____
Address: _____	Address: _____
Phone: _____	Phone: _____
Facsimile: _____	Facsimile: _____

SECTION P-520 - EXHIBIT A-1
to Procurement Agreement
ASSIGNMENT OF CONTRACT

The Contract between the City of Aberdeen, Idaho (Owner) and Vendor for furnishing Goods and Special Services under the Contract Documents entitled

"City of Aberdeen - WWTP Equipment Pre-Purchase"

Is hereby assigned, transferred, and set over to _____ (Installation Contractor), who shall be totally responsible for all work performed by the assigned and for the duties, rights and obligations of the Owner, not otherwise retained by the Owner, under the terms of the Contract between the Owner and Vendor.

This assignment will be effective on the effective date of the Contract between the Owner and the Contractor for the General Construction Work.

ASSIGNMENT DIRECTED BY: _____
For: Owner

By: _____ _____
(Signature) (Title)

ASSIGNMENT ACKNOWLEDGED AND CONSENTED TO BY: _____
For: Vendor

By: _____ _____
(Signature) (Title)

ASSIGNMENT ACCEPTED BY: _____
For: Contractor

By: _____ _____
(Signature) (Title)

SECTION 00500 – EXHIBIT A-2
to Procurement Agreement
ASSIGNMENT OF CONTRACT

Surety hereby acknowledges and agrees that the Contract for furnishing Goods and Special Services under the Contract Documents entitled "City of Aberdeen - WWTP Equipment Pre-Purchase" by and between the City of Aberdeen, Idaho (Owner) and Vendor may be assigned, transferred, and set over to _____ (Installation Contractor), in accordance with Article 10.07 of Agreement between Owner and Vendor.

Surety further agrees that, upon assignment of the Contract, the Installation Contractor shall have all the rights of the Owner under the Performance Bond.

(Corporate Seal) Surety

Company: _____

By: _____
Signature and Title
(Attach Power of Attorney)

PERFORMANCE BOND
FOR PROCUREMENT CONTRACTS

Any singular reference to Seller, Surety, Buyer, or other party shall be considered plural where applicable.

SELLER (Name and Address):

SURETY (Name and Address of Principal Place of Business):

BUYER (Name and Address):

CONTRACT
Date:
Amount:
Description (Name and Location):

BOND
Date (Not earlier than Contract Date):
Bond Number:
Amount:
Modifications to this Bond Form:

Surety and Seller, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

Seller as Principal
Company: (Corp. Seal)

Signature:
Name and Title:

Surety
Company: (Corp. Seal)

Signature:
Name and Title:
(Attach Power of Attorney)
Address:

Telephone Number:

(Space is provided below for signatures of additional parties, if required.)

Seller as Principal
Company: (Corp. Seal)

Signature:
Name and Title:

Surety
Company: (Corp. Seal)

Signature:
Name and Title:
Address:
Telephone Number:

1. Seller and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to Buyer for the performance of the Contract, which is incorporated herein by reference. For purposes of this bond, Buyer means Buyer's assigns, if and when Buyer has assigned the Contract.

2. If Seller performs the Contract, Surety and Seller have no obligation under this Bond, except to participate in conferences as provided in Paragraph 3.1.

3. If there is no Buyer Default, Surety's obligation under this Bond shall arise after:

   3.1. Buyer has notified Seller and Surety pursuant to Paragraph 10 that Buyer is considering declaring a Seller Default and has requested and attempted to arrange a conference with Seller and Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. (If Buyer, Seller, and Surety agree, Seller shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive Buyer's right, if any, subsequently to declare a Seller Default); and

   3.2. Buyer has declared a Seller Default and formally terminated Seller's right to complete the Contract. Such Seller Default shall not be declared earlier than 20 days after Seller and Surety have received notice as provided in Paragraph 3.1; and

   3.3. Buyer has agreed to pay the Balance of the Contract Price to:

      a. Surety in accordance with the terms of the Contract;

      b. Another seller selected pursuant to Paragraph 4.3 to perform the Contract.

4. When Buyer has satisfied the conditions of Paragraph 3, Surety shall promptly and at Surety's expense take one of the following actions:

   4.1. Arrange for Seller, with consent of Buyer, to perform and complete the Contract; or

   4.2. Undertake to perform and complete the Contract itself, through its agents or through independent contractors; or

   4.3. Obtain bids or negotiated proposals from qualified sellers acceptable to Buyer for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by Buyer and a seller selected with Buyer's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the Bonds issued on the Contract, and pay to Buyer the amount of damages as described in Paragraph 6 in excess of the Balance of the Contract Price incurred by Buyer resulting from Seller Default; or

   4.4. Waive its right to perform and complete, arrange for completion, or obtain a new seller, and with reasonable promptness under the circumstances, either:

      a. determine the amount for which it may be liable to Buyer and, as soon as practicable after the amount is determined, tender payment therefore to Buyer; or

      b. deny liability in whole or in part and notify Buyer citing reasons therefore.

5. If Surety does not proceed as provided in Paragraph 4 with reasonable promptness, Surety shall be deemed to be in default on this Bond 15 days after receipt of an additional written notice from Buyer to Surety demanding that Surety perform its obligations under this Bond, and Buyer shall be entitled to enforce any remedy available to Buyer. If Surety proceeds as provided in paragraph 4.4, and Buyer refuses the payment tendered or Surety has denied liability, in whole or in part, without further notice Buyer shall be entitled to enforce any remedy available to Buyer.

6. After Buyer has terminated Seller's right to complete the Contract, and if Surety elects to act under Paragraph 4.1, 4.2, or 4.3, then the responsibilities of Surety to Buyer shall not be greater than those of Seller under the Contract, and the responsibilities of Buyer to Surety shall not be greater than those of Buyer under the Contract. To a limit of the amount of this Bond, but subject to commitment by Buyer of the Balance of the Contract Price to mitigation of costs and damages on the Contract, Surety is obligated without duplication for:

   6.1. the responsibilities of Seller for correction or replacement of defective Goods and Special Services and completion of the Contract;

   6.2. additional legal, design professional, and delay costs resulting from Seller's Default, and resulting from the actions of or failure to act of Surety under Paragraph 4; and

   6.3. liquidated damages, or if no liquidated damages are specified in the Contract, actual damages caused by delayed performance or non-performance of Seller.

7. Surety shall not be liable to Buyer or others for obligations of Seller that are unrelated to the Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than Buyer or its heirs, executors, administrators, successors, or assigns.

8. Surety hereby waives notice of any change, including changes of time, to the Contract or to related subcontracts, purchase orders and other obligations.

9. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location of the Point of Destination, and shall be instituted within two years after Seller Default or within two years after Seller ceased working or within two years after Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

10. Notice to Surety, Buyer or Seller shall be mailed or delivered to the address shown on the signature page.

11. When this Bond has been furnished to comply with a statutory or other legal requirement in the location of the Point of Destination, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted here from and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

12. Definitions.

   12.1. *Balance of the Contract Price:* The total amount payable by Buyer to Seller under the Contract after all proper adjustments have been made, including allowance to Seller of any amounts

received or to be received by Buyer in settlement of insurance or other Claims for damages to which Seller is entitled, reduced by all valid and proper payments made to or on behalf of Seller under the Contract.

12.2. *Contract:* The agreement between Buyer and Seller identified on the signature page, including all Contract Documents and changes thereto.

12.3. *Seller Default:* Failure of Seller, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Contract.

12.4. *Buyer Default:* Failure of Buyer, which has neither been remedied nor waived, to pay Seller as required by the Contract or to perform and complete or comply with the other terms thereof.

PAYMENT BOND
FOR PROCUREMENT CONTRACTS

Any singular reference to Seller, Surety, Buyer, or other party shall be considered plural where applicable.

SELLER (Name and Address):

SURETY (Name and Address of Principal Place of Business):

BUYER (Name and Address):

CONTRACT
Date:
Amount:
Description (Name and Location):

BOND
Date (Not earlier than Contract Date):
Bond Number:
Amount:
Modifications to this Bond Form:

Surety and Seller, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

Seller as Principal		**Surety**	
Company:	(Corp. Seal)	Company:	(Corp. Seal)
Signature:		Signature:	
Name and Title:		Name and Title: (Attach Power of Attorney)	
		Address:	
		Telephone Number:	

(Space is provided below for signatures of additional parties, if required.)

Seller as Principal		**Surety**	
Company:	(Corp. Seal)	Company:	(Corp. Seal)
Signature:		Signature:	
Name and Title:		Name and Title:	
		Address:	
		Telephone Number:	

1. Seller and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to Buyer to pay for labor, materials and equipment furnished for use in the performance of the Contract, which is incorporated herein by reference. For purposes of this bond, Buyer means Buyer's assigns, if and when Buyer has assigned the Contract.

2. With respect to Buyer, this obligation shall be null and void if Seller:

   2.1. Promptly makes payment, directly or indirectly, for all sums due Claimants, and

   2.2. Defends, indemnifies and holds harmless Buyer from all claims, demands, liens or suits by any person or entity who furnished labor, materials or equipment for use in the performance of the Contract, provided Buyer has promptly notified Seller and Surety (at the addresses described in Paragraph 12) of any claims, demands, liens or suits and tendered defense of such claims, demands, liens or suits to Seller and Surety, and provided there is no Buyer Default.

3. With respect to Claimants, this obligation shall be null and void if Seller promptly makes payment, directly or indirectly, for all sums due.

4. Surety shall have no obligation to Claimants under this Bond until:

   4.1. Claimants who are employed by or have a direct contract with Seller have given notice to Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to Buyer stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.

   4.2. Claimants who do not have a direct contract with Seller:

      a. have furnished written notice to Seller and sent a copy, or notice thereof, to Buyer, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials were furnished or supplied or for whom the labor was done or performed; and

      b. have either received a rejection in whole or in part from Seller or not received within 30 days of furnishing the above notice any communication from Seller by which Seller had indicated the claim will be paid directly or indirectly; and

      c. not having been paid within the above 30 days, have sent a written notice to Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to Buyer stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to Seller.

5. If a notice required by Paragraph 4 is given by Buyer to Seller or to Surety, that is sufficient compliance.

6. Reserved.

7. Surety's total obligation shall not exceed the amount of this Bond, and the amount of this bond shall be credited for any payments made in good faith by Surety.

8. Amounts owed by Buyer to Seller under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any Performance Bond. By Seller furnishing and Buyer accepting this Bond, they agree that all funds earned by Seller in the performance of the Contract are dedicated to satisfy obligations of Seller and Surety under this Bond, subject to Buyer's priority to use the funds for the completion of the furnishing the Goods and Special Services.

9. Surety shall not be liable to Buyer, Claimants or others for obligations of Seller that are unrelated to the Contract. Buyer shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

10. Surety hereby waives notice of any change, including changes of time, to the Contract or to related subcontracts, purchase orders, and other obligations.

11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the Goods relevant to the claim are located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by Paragraph 4.1 or paragraph 4.2.3, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to Surety, Buyer or Seller shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, Buyer or Seller, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory Bond and not as a common law bond.

14. Upon request of any person or entity appearing to be a potential beneficiary of this Bond, Seller shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15. Definitions

    15.1 *Claimant:* An individual or entity having a direct contract with Seller or with a Subcontractor of Seller to furnish labor, materials or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Contract, architectural and engineering services required for furnishing the Goods and Special Services by Seller and Seller's Subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

    15.2. *Contract:* The agreement between Buyer and Seller identified on the signature page, including all Contract Documents and changes thereto.

    15.3. *Buyer Default:* Failure of Buyer, which has neither been remedied nor waived, to pay Seller as required by the Contract or to perform and complete or comply with the other terms thereof.

CONDITIONS OF THE CONTRACT

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STANDARD GENERAL CONDITIONS FOR PROCUREMENT CONTRACTS

ARTICLE 1 − DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Whenever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to the singular or plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument signed by both Buyer and Seller covering the Goods and Special Services and which lists the Contract Documents in existence on the Effective Date of the Agreement.

3. *Application for Payment*—The form acceptable to Buyer which is used by Seller in requesting progress and final payments and which is accompanied by such supporting documentation as is required by the Contract Documents.

4. *Bid*— The offer or proposal of a Seller submitted on the prescribed form setting forth the prices for the Goods and Special Services to be provided.

5. *Bidder*—The individual or entity that submits a Bid directly to Buyer.

6. *Bidding Documents*—The Bidding Requirements and the proposed Contract Documents (including all Addenda).

7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and Bid Form with any supplements.

8. *Buyer*—The individual or entity purchasing the Goods and Special Services.

9. *Change Order*—A document which is signed by Seller and Buyer and authorizes an addition, deletion, or revision to the Contract Documents or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement. Change Orders may be the result of mutual agreement by Buyer and Seller, or of resolution of a Claim.

10. *Claim*—A demand or assertion by Buyer or Seller seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract*—The entire and integrated written agreement between Buyer and Seller concerning the Goods and Special Services. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents*—Those items so designated in the Agreement. Shop Drawings and other Seller submittals are not Contract Documents, even if accepted, reviewed, or approved by Engineer or Buyer.

13. *Contract Price*—The moneys payable by Buyer to Seller for furnishing the Goods and Special Services in accordance with the Contract Documents as stated in the Agreement.

14. *Contract Times*—The times stated in the Agreement by which the Goods must be delivered and Special Services must be furnished.

15. *Drawings*—That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Goods and Special Services to be furnished by Seller. Shop Drawings and other Seller submittals are not Drawings as so defined.

16. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

17. *Engineer*—The individual or entity designated as such in the Agreement.

18. *Field Order*—A written order issued by Engineer which requires minor changes in the Goods or Special Services but which does not involve a change in the Contract Price or Contract Times.

19. *General Requirements*—Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.

20. *Goods*—The tangible and movable personal property that is described in the Contract Documents, regardless of whether the property is to be later attached to realty.

21. *Goods and Special Services*—The full scope of materials, equipment, other items, and services to be furnished by Seller, including Goods, as defined herein, and Special Services, if any, as defined herein. This term refers to both the Goods and the Special Services, or to either the Goods or the Special Services, and to any portion of the Goods or the Special Services, as the context requires.

22. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

23. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to the Contract Times.

24. *Notice of Award*—The written notice by Buyer to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Buyer will sign and deliver the Agreement.

25. *Notice to Proceed*—A written notice given by Buyer to Seller fixing the date on which the Contract Times commence to run and on which Seller shall start to perform under the Contract.

26. *Point of Destination*—The specific address of the location where delivery of the Goods shall be made, as stated in the Agreement.

27. *Project*—The total undertaking of which the Goods and Special Services may be the whole, or only a part.

28. *Project Manual*—The documentary information prepared for bidding and furnishing the Goods and Special Services. A listing of the contents of the Project Manual is contained in its table of contents.

29. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Goods and Special Services and which establish the standards by which such portion of the Goods and Special Services will be judged.

30. *Seller*—The individual or entity furnishing the Goods and Special Services.

31. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Seller and submitted by Seller to illustrate some portion of the Goods and Special Services.

32. *Special Services*—Services associated with the Goods to be furnished by Seller as required by the Contract Documents.

33. *Specifications*—That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the furnishing of the Goods and Special Services, and certain administrative requirements and procedural matters applicable thereto.

34. *Successful Bidder*—The Bidder submitting a responsive Bid, to whom Buyer makes an award.

35. *Supplementary Conditions*—That part of the Contract Documents which amends or supplements these General Conditions.

36. *Work Change Directive*—A written statement to Seller issued on or after the Effective Date of the Agreement and signed by Buyer ordering an addition, deletion, or other revision in the Contract Documents with respect to the Goods and Special Services. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 *Terminology*

A. The words and terms discussed in Paragraphs 1.02.B and 1.02.C are not defined, but have the indicated meanings when used in the Bidding Requirements or Contract Documents.

B. *Intent of Certain Terms or Adjectives:*

1. The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Goods and Special Services. It is intended that such exercise of professional judgment, action, or determination will be commercially reasonable and will be solely to evaluate, in general, the Goods and Special Services for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to Engineer any duty or authority to supervise or direct the furnishing of Goods or Special Services or any duty or authority to undertake responsibility contrary to any other provision of the Contract Documents.

2. The word "non-conforming" when modifying the words "Goods and Special Services," "Goods," or "Special Services," refers to Goods and Special Services that fail to conform to the Contract Documents.

3. The word "receipt" when referring to the Goods, shall mean the physical taking and possession by the Buyer under the conditions specified in Paragraph 8.01.B.3.

4. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

5. The word "furnish," when used in connection with the Goods and Special Services shall mean to supply and deliver said Goods to the Point of Destination (or some other specified location) and to perform said Special Services fully, all in accordance with the Contract Documents.

C. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 − PRELIMINARY MATTERS

2.01 *Delivery of Bonds*

A. When Seller delivers the executed counterparts of the Agreement to Buyer, Seller also shall deliver such bonds as Seller may be required to furnish.

2.02 *Evidence of Insurance*

A. When Seller delivers the executed counterparts of the Agreement to Buyer, Seller shall deliver to Buyer, with copies to each additional insured identified by name in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Seller is required to purchase and maintain in accordance with Article 4.

2.03 *Copies of Documents*

A. Buyer shall furnish Seller up to five printed or hard copies of the Contract Documents. Additional copies will be furnished upon request at the cost of reproduction.

2.04 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.05 *Designated Representatives*

A. Buyer and Seller shall each designate its representative at the time the Agreement is signed. Each representative shall have full authority to act on behalf of and make binding decisions in any matter arising out of or relating to the Contract.

2.06 *Progress Schedule*

A. Within 15 days after the Contract Times start to run, Seller shall submit to Buyer and Engineer an acceptable progress schedule of activities, including at a minimum, Shop Drawing and Sample submittals, tests, and deliveries as required by the Contract Documents. No progress payment will be made to Seller until an acceptable schedule is submitted to Buyer and Engineer.

B. The progress schedule will be acceptable to Buyer and Engineer if it provides an orderly progression of the submittals, tests, and deliveries to completion within the specified Milestones and the Contract Times. Such acceptance will not impose on Buyer or Engineer responsibility for the progress schedule, for sequencing, scheduling, or progress of the work nor interfere with or relieve Seller from Seller's full responsibility therefor. Such acceptance shall not be deemed to acknowledge the reasonableness and attainability of the schedule.

2.07 *Preliminary Conference*

A. Within 20 days after the Contract Times start to run, a conference attended by Seller, Buyer, Engineer and others as appropriate will be held to establish a working understanding among the parties as to the Goods and Special Services and to discuss the schedule referred to in Paragraph 2.06.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

2.08 *Safety*

A. Buyer and Seller shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss. When Seller's personnel, or the personnel of any subcontractor to Seller, are present at the Point of Destination or any work area or site controlled by Buyer, the Seller shall be responsible for the

compliance by such personnel with any applicable requirements of Buyer's safety programs that are made known to Seller.

ARTICLE 3 − CONTRACT DOCUMENTS: INTENT AND AMENDING

3.01 *Intent*

A. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

B. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce or furnish the indicated Goods and Special Services will be provided, whether or not specifically called for, at no additional cost to Buyer.

C. Clarifications and interpretations of, or notifications of minor variations and deviations in, the Contract Documents, will be issued by Engineer as provided in Article 9.

3.02 *Standards, Specifications, Codes, Laws and Regulations*

A. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws and Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws and Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

B. No provision of any such standard, specification, manual or code, or any instruction of a supplier shall be effective to change the duties or responsibilities of Buyer or Engineer, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall any such provision or instruction be effective to assign to Buyer or Engineer, or any of their consultants, agents, or employees any duty or authority to supervise or direct the performance of Seller's obligations or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

1. *Seller's Review of Contract Documents Before the Performance of the Contract*: Before performance of the Contract, Seller shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Seller shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Seller discovers or has actual knowledge of and shall obtain a written interpretation or clarification from Engineer before proceeding with the furnishing of any Goods and Special Services affected thereby.

2. *Seller's Review of Contract Documents During the Performance of the Contract:* If, during the performance of the Contract, Seller discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Contract, any standard, specification, manual or code, or of any instruction of any Supplier, Seller shall

promptly report it to Engineer in writing. Seller shall not proceed with the furnishing of the Goods and Special Services affected thereby until an amendment to or clarification of the Contract Documents has been issued.

3. Seller shall not be liable to Buyer or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Seller had actual knowledge thereof.

B. *Resolving Discrepancies:* Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

1. the provisions of any standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

2. the provisions of any Laws or Regulations applicable to the furnishing of the Goods and Special Services (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Clarifying Contract Documents*

A. The Contract Documents may be amended to provide for additions, deletions, and revisions to the Goods and Special Services or to modify contractual terms and conditions by a Change Order.

B. Buyer may issue a Work Change Directive providing for additions, deletions, or revisions to the Goods and Special Services, in which case (1) the Contract Price shall be equitably adjusted to account for any reasonable and necessary credits to Buyer for any such deletion, or for costs (including reasonable overhead and profit) incurred by Seller to accommodate such an addition or revision and (2) the Contract Times shall be equitably adjusted to account for any impact on progress and completion of performance. Such adjustments subsequently shall be duly set forth in a Change Order.

C. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Goods and Special Services may be authorized, by one or more of the following ways:

1. A Field Order;

2. Engineer’s approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 5.06.D.3); or

3. Engineer’s written interpretation or clarification.

ARTICLE 4 − BONDS AND INSURANCE

4.01 *Bonds*

A. Seller shall furnish to Buyer performance and payment bonds, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Seller's obligations under the Contract Documents. These bonds shall remain in effect until 1) one year after the date when final payment becomes due or 2) completion of the correction period specified in Paragraph

8.03, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Seller shall also furnish such other bonds as are required by the Contract Documents.

B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.

C. If the surety on any bond furnished by Seller is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 4.01.B, Seller shall promptly notify Buyer and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 4.01.B and 4.02.

4.02 *Insurance*

A. Seller shall provide insurance of the types and coverages and in the amounts stipulated in the Supplementary Conditions.

B. Failure of Buyer to demand certificates of insurance or other evidence of Seller's full compliance with these insurance requirements or failure of Buyer to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Seller's obligation to maintain such insurance.

C. Upon assignment of this Contract, Seller shall comply with the written request of assignee to provide certificates of insurance to assignee.

D. Buyer does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Seller.

E. The insurance and insurance limits required herein shall not be deemed as a limitation on Seller's liability under the indemnities granted to Buyer in the Contract Documents.

4.03 *Licensed Sureties and Insurers*

A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Buyer or Seller shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

ARTICLE 5 − SELLER'S RESPONSIBILITIES

5.01 *Supervision and Superintendence*

A. Seller shall supervise, inspect, and direct the furnishing of the Goods and Special Services competently and efficiently, devoting such attention thereto and applying such skills and expertise

as may be necessary to perform its obligations in accordance with the Contract Documents. Seller shall be solely responsible for the means, methods, techniques, sequences, and procedures necessary to perform its obligations in accordance with the Contract Documents. Seller shall not be responsible for the negligence of Buyer or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure that is shown or indicated in and expressly required by the Contract Documents.

5.02 *Labor, Materials and Equipment*

A. Seller shall provide competent, qualified and trained personnel in all aspects of its performance of the Contract.

B. All Goods, and all equipment and material incorporated into the Goods, shall be as specified, and unless specified otherwise in the Contract Documents, shall be:

1. new, and of good quality;

2. protected, assembled, connected, cleaned, and conditioned in accordance with the original manufacturer's instructions; and

3. shop assembled to the greatest extent practicable.

5.03 *Laws and Regulations*

A. Seller shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of its obligations in accordance with the Contract Documents. Except where otherwise expressly required by such Laws and Regulations, neither Buyer nor Engineer shall be responsible for monitoring Seller's compliance with any Laws or Regulations.

B. If Seller furnishes Goods and Special Services knowing or having reason to know that such furnishing is contrary to Laws or Regulations, Seller shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such performance. It shall not be Seller's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this provision shall not relieve Seller of Seller's obligations under Paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance shall be the subject of an adjustment in Contract Price or Contract Times. If Buyer and Seller are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 9.06.

5.04 *Or Equals*

A. Whenever the Goods, or an item of material or equipment to be incorporated into the Goods, are specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular supplier or manufacturer, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item is

permitted, other items of material or equipment or material or equipment of other suppliers or manufacturers may be submitted to Buyer for Engineer's review.

1. If in Engineer's sole discretion, such an item of material or equipment proposed by Seller is functionally equal to that named and sufficiently similar so that no change in related work will be required, it may be considered by Engineer as an "or-equal" item.

2. For the purposes of this paragraph, a proposed item of material or equipment may be considered functionally equal to an item so named only if:

    a. in the exercise of reasonable judgment, Engineer determines that: 1) it is at least equal in quality, durability, appearance, strength, and design characteristics; 2) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole; 3) it has an acceptable record of performance and availability of responsive service; and

    b. Seller certifies that if approved: 1) there will be no increase in any cost, including capital, installation or operating costs, to Buyer; and 2) the proposed item will conform substantially to the detailed requirements of the item named in the Contract Documents.

B. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraph 5.04.A. Engineer will be the sole judge of whether to accept or reject such a proposal or submittal. No "or-equal" will be ordered, manufactured or utilized until Engineer's review is complete, which will be evidenced by an approved Shop Drawing. Engineer will advise Buyer and Seller in writing of any negative determination. Notwithstanding Engineer's approval of an "or-equal" item, Seller shall remain obligated to comply with the requirements of the Contract Documents.

C. *Special Guarantee:* Buyer may require Seller to furnish at Seller's expense a special performance guarantee or other surety with respect to any such proposed "or-equal."

D. *Data:* Seller shall provide all data in support of any such proposed "or-equal" at Seller's expense.

5.05 *Taxes*

A. Seller shall be responsible for all taxes and duties arising out of the sale of the Goods and the furnishing of Special Services. All taxes are included in the Contract Price, except as noted in the Supplementary Conditions.

5.06 *Shop Drawings and Samples*

A. Seller shall submit Shop Drawings and Samples to Buyer for Engineer's review and approval in accordance with the schedule required in Paragraph 2.06.A. All submittals will be identified as required and furnished in the number of copies specified in the Contract Documents. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Seller proposes to provide.

B. Where a Shop Drawing or Sample is required by the Contract Documents, any related work performed prior to Engineer's approval of the pertinent submittal will be at the sole expense and responsibility of Seller.

C. *Submittal Procedures:*

1. Before submitting each Shop Drawing or Sample, Seller shall have determined and verified:

   a. all field measurements (if required), quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto; and

   b. that all materials are suitable with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the furnishing of Goods and Special Services.

2. Seller shall also have reviewed and coordinated each Shop Drawing or Sample with the Contract Documents.

3. Each submittal shall bear a stamp or include a written certification from Seller that Seller has reviewed the subject submittal and confirmed that it is in compliance with the requirements of the Contract Documents. Both Buyer and Engineer shall be entitled to rely on such certification from Seller.

4. With each submittal, Seller shall give Buyer and Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both in a written communication separate from the submittal and by specific notation on each Shop Drawing or Sample.

D. *Engineer's Review:*

1. Engineer will provide timely review of Shop Drawings and Samples.

2. Engineer's review and approval will be only to determine if the Goods and Special Services covered by the submittals will, after installation or incorporation in the Project, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole.

3. Engineer's review and approval shall not relieve Seller from responsibility for any variation from the requirements of the Contract Documents unless Seller has complied with the requirements of Paragraph 5.06.C.4 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Seller from responsibility for complying with the requirements of Paragraph 5.06.C.1.

E. *Resubmittal Procedures:*

1. Seller shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review

and approval. Seller shall direct specific attention in writing to any revisions other than the corrections called for by Engineer on previous submittals.

5.07 *Continuing Performance*

A. Seller shall adhere to the progress schedule established in accordance with Paragraph 2.06.A., and the Goods shall be delivered and the Special Services furnished within the Contract Times specified in the Agreement.

B. Seller shall carry on furnishing of the Goods and Special Services and adhere to the progress schedule during all disputes or disagreements with Buyer. No furnishing of Goods and Special Services shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraphs 11.03 or 11.04, or as Buyer and Seller may otherwise agree in writing.

5.08 *Seller's Warranties and Guarantees*

A. Seller warrants and guarantees to Buyer that the title to the Goods conveyed shall be proper, its transfer rightful, and free from any security interest, lien, or other encumbrance. Seller shall defend, indemnify, and hold Buyer harmless against any liens, claims, or demands contesting or affecting title of the Goods conveyed.

B. Seller warrants and guarantees to Buyer that all Goods and Special Services will conform with the Contract Documents, and with the standards established by any Samples approved by Engineer. Engineer shall be entitled to rely on Seller's warranty and guarantee. If the Contract Documents do not otherwise specify the characteristics or the quality of the Goods, the Goods shall comply with the requirements of Paragraph 5.02.B.

C. Seller's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, improper modification, improper maintenance, or improper operation by persons other than Seller; or

2. corrosion or chemical attack, unless corrosive or chemically-damaging conditions were disclosed by Buyer in the Contract Documents and the Contract Documents required the Goods to withstand such conditions;

3. use in a manner contrary to Seller's written instructions for installation, operation, and maintenance; or

4. normal wear and tear under normal usage.

D. Seller's obligation to furnish the Goods and Special Services in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Goods and Special Services that are non-conforming, or a release of Seller's obligation to furnish the Goods and Special Services in accordance with the Contract Documents:

1. observations by Buyer or Engineer;

2. recommendation by Engineer or payment by Buyer of any progress or final payment;

3. use of the Goods by Buyer;

4. any acceptance by Buyer (subject to the provisions of Paragraph 8.02.D.1) or any failure to do so;

5. the issuance of a notice of acceptance by Buyer pursuant to the provisions of Article 8;

6. any inspection, test or approval by others; or

7. any correction of non-conforming Goods and Special Services by Buyer.

E. Buyer shall promptly notify Seller of any breach of Seller's warranties or guarantees.

F. Seller makes no implied warranties under this Contract.

5.09 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, Seller shall indemnify and hold harmless Buyer and Engineer, and the officers, directors, members, partners, employees, agents, consultants, contractors, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of Seller's obligations under the Contract Documents, provided that any such claim, cost, loss, or damages attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Goods themselves), including the loss of use resulting therefrom, but only to the extent cause by any negligent act or omission of Seller, or any individual or entity directly or indirectly employed by Seller or anyone for whose acts Seller may be liable.

B. In any and all claims against Buyer or Engineer or any of their respective assignees, consultants, agents, officers, directors, members, partners, employees, agents, consultants, contractors, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Seller, any subcontractor, any supplier, or any individual or entity directly or indirectly employed by any of them to furnish any of the Goods and Special Services, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 5.09.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for seller or any such subcontractor, supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Seller under Paragraph 5.09.A shall not extend to the liability of Engineer and Engineer's officers, directors, partners, employees, agents, and consultants arising out of:

1. the preparation or approval of, or the failure to prepare or approve, maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

5.10 *Delegation of Professional Design Services*

A. Seller will not be required to provide professional design services unless such services are specifically required by the Contract Documents or unless such services are required to carry out

Seller's responsibilities for furnishing the Goods and Special Services. Seller shall not be required to provide professional services in violation of applicable law.

B. If professional design services or certifications by a design professional related to the Goods and Special Services are specifically required of Seller by the Contract Documents, Buyer and Engineer will specify all performance and design criteria that such services must satisfy. Seller shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Goods and Special Services designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

C. Buyer and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Buyer and Engineer have specified to Seller all performance and design criteria that such services must satisfy.

D. Pursuant to this Paragraph 5.10, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 5.06.D.2.

E. Seller shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 6 − SHIPPING AND DELIVERY

6.01 *Shipping*

A. Seller shall select the carrier and bear all costs of packaging, transportation, insurance, special handling and any other costs associated with shipment and delivery.

6.02 *Delivery*

A. Seller shall deliver the Goods F.O.B. the Point of Destination in accordance with the Contract Times set forth in the Agreement, or other date agreed to by Buyer and Seller.

B. Seller shall provide written notice to Buyer at least 10 days before shipment of the manner of shipment and the anticipated delivery date. The notice shall also include any instructions concerning special equipment or services required at the Point of Destination to unload and care for the Goods. Seller shall also require the carrier to give Buyer at least 24 hours notice by telephone prior to the anticipated time of delivery.

C. Buyer will be responsible and bear all costs for unloading the Goods from carrier.

D. Buyer will assure that adequate facilities are available to receive delivery of the Goods during the Contract Times for delivery set forth in the Agreement, or another date agreed by Buyer and Seller.

E. No partial deliveries shall be allowed, unless permitted or required by the Contract Documents or agreed to in writing by Buyer.

6.03 *Risk of Loss*

A. Risk of loss and insurable interests transfer from Seller to Buyer upon Buyer's receipt of the Goods.

B. Notwithstanding the provisions of Paragraph 6.03.A, if Buyer rejects the Goods as non-conforming, the risk of loss on such Goods shall remain with Seller until Seller corrects the non-conformity or Buyer accepts the Goods. If rejected Goods remain at the Point of Destination pending modification and acceptance, then Seller shall be responsible for arranging adequate protection and maintenance of the Goods at Seller's expense.

6.04 *Progress Schedule*

A. Seller shall adhere to the progress schedule established in accordance with Paragraph 2.06 as it may be adjusted from time to time as provided below.

1. Seller shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.06) proposed adjustments in the progress schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the progress schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 7. Adjustments in Contract Times may only be made by a Change Order.

ARTICLE 7 − CHANGES: SCHEDULE AND DELAY

7.01 *Changes in the Goods and Special Services*

A. Buyer may at any time, without notice to any surety, make an addition, deletion, or other revision to the Contract Documents with respect to the Goods and Services, within the general scope of the Contract, by a Change Order or Work Change Directive. Upon receipt of any such document, Seller shall promptly proceed with performance pursuant to the revised Contract Documents (except as otherwise specifically provided).

B. If Seller concludes that a Work Change Directive issued by Buyer affects the Contract Price or Contract Times, then Seller shall notify Buyer within 15 days after Seller has received the Work Change Directive, and submit written supporting data to Buyer within 45 days after such receipt. If Seller fails to notify Buyer within 15 days, Seller waives any Claim for such adjustment. If Buyer and Seller are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 9.06.

C. Seller shall not suspend performance while Buyer and Seller are in the process of making such changes and any related adjustments to Contract Price or Contract Times.

7.02 *Changing Contract Price or Contract Times*

A. The Contract Price or Contract Times may only be changed by a Change Order.

B. Any Claim for an adjustment in the Contract Price or Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 9.06.

C. If Seller is prevented from delivering the Goods or performing the Special Services within the Contract Times for any unforeseen reason beyond its control and not attributable to its actions or inactions, then Seller shall be entitled to an adjustment of the Contract Times to the extent attributable to such reason. Such reasons include but are not limited to acts or neglect by Buyer, inspection delays, fires, floods, epidemics, abnormal weather conditions, acts of God, and other like matters. If such an event occurs and delays Seller's performance, Seller shall notify Buyer in writing within 15 days of knowing or having reason to know of the beginning of the event causing the delay, stating the reason therefor.

D. Seller shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Seller. Delays attributable to and within the control of Seller's subcontractors or suppliers shall be deemed to be delays within the control of Seller.

E. If Seller is prevented from delivering the Goods or furnishing the Special Services within the Contract Times due to the actions or inactions of Buyer, Seller shall be entitled to any reasonable and necessary additional costs arising out of such delay to the extent directly attributable to Buyer.

F. Neither Buyer nor Seller shall be entitled to any damages arising from delays which are beyond the control of both Buyer and Seller, including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God, and other like matters.

ARTICLE 8 − BUYER'S RIGHTS

8.01 *Inspections and Testing*

A. *General:*

1. The Contract Documents specify required inspections and tests. Buyer shall have the right to perform, or cause to be performed, reasonable inspections and require reasonable tests of the Goods at Seller's facility, and at the Point of Destination. Seller shall allow Buyer a reasonable time to perform such inspections or tests.

2. Seller shall reimburse Buyer for all expenses, except for travel, lodging, and subsistence expenses of Buyer's and Engineer's representatives, for inspections and tests specified in the Contract Documents. If as the result of any such specified testing the Goods are determined to be non-conforming, then Seller shall also bear the travel, lodging, and subsistence expenses of Buyer's and Engineer's representatives, and all expenses of re-inspection or retesting.

3. Buyer shall bear all expenses of inspections and tests that are not specified in the Contract Documents (other than any re-inspection or retesting resulting from a determination of non-conformity, as set forth in Paragraph 8.01.A.2 immediately above); provided, however, that if as the result of any such non-specified inspections or testing the Goods are determined to be non-conforming, then Seller shall bear all expenses of such inspections and testing, and of any necessary re-inspection and retesting.

4. Seller shall provide Buyer timely written notice of the readiness of the Goods for all inspections, tests, or approvals which the Contract Documents specify are to be observed by Buyer prior to shipment.

5. Buyer will give Seller timely notice of all specified tests, inspections, and approvals of the Goods which are to be conducted at the Point of Destination.

6. If, on the basis of any inspections or testing, the Goods appear to be conforming, Buyer will give Seller prompt notice thereof. If on the basis of said inspections or testing, the Goods appear to be non-conforming, Buyer will give Seller prompt notice thereof and will advise Seller of the remedy Buyer elects under the provisions of Paragraph 8.02.

7. Neither payments made by Buyer to Seller prior to any tests or inspections, nor any tests or inspections shall constitute acceptance of non-conforming Goods, or prejudice Buyer's rights under the Contract.

B. Inspection on Delivery:

1. Buyer or Engineer will visually inspect the Goods upon delivery solely for purposes of identifying the Goods and general verification of quantities and observation of apparent condition in order to provide a basis for a progress payment. Such visual inspection will not be construed as final or as receipt of any Goods and Special Services that, as a result of subsequent inspections and tests, are determined to be non-conforming.

2. Within ten days of such visual inspection, Buyer shall provide Seller with written notice of Buyer's determination regarding conformity of the Goods. In the event Buyer does not provide such notice, it will be presumed that the Goods appear to be conforming and that Buyer has acknowledged their receipt upon delivery.

3. If, on the basis of the visual inspection specified in Paragraph 8.01.B.1, the Goods appear to be conforming, Buyer's notice thereof to Seller will acknowledge receipt of the Goods.

C. Final Inspection:

1. After all of the Goods have been incorporated into the Project, tested in accordance with such testing requirements as are specified, and are functioning as indicated, Buyer or Engineer will make a final inspection.

2. If, on the basis of the final inspection, the Goods are conforming, Buyer's notice thereof will constitute Buyer's acceptance of the Goods.

3. If, on the basis of the final inspection, the Goods are non-conforming, Buyer will identify the non-conformity in writing.

8.02 *Non-Conforming Goods and Special Services*

A. If, on the basis of inspections and testing prior to delivery, the Goods and Special Services are found to be non-conforming, or if at any time after Buyer has acknowledged receipt of delivery and before the expiration of the correction period described in Paragraph 8.03, Buyer determines that the Goods and Special Services are non-conforming, then Seller shall promptly, without cost to Buyer and in response to written instructions from Buyer, either correct such non-conforming

Goods and Special Services, or, if Goods are rejected by Buyer, remove and replace the non-conforming Goods with conforming Goods, including all work required for reinstallation.

B. Buyer's Rejection of Non-Conforming Goods:

1. If Buyer elects to reject the Goods in whole or in part, Buyer's notice to Seller will describe in sufficient detail the non-conforming aspect of the Goods. If Goods have been delivered to Buyer, Seller shall promptly, and within the Contract Times, remove and replace the rejected Goods.

2. Seller shall bear all costs, losses and damages attributable to the removal and replacement of the non-conforming Goods as provided in Paragraph 8.02.E.

3. Upon rejection of the Goods, Buyer retains a security interest in the Goods to the extent of any payments made and expenses incurred in their testing and inspection.

C. Remedying Non-Conforming Goods and Special Services:

1. If Buyer elects to permit the Seller to modify the Goods to correct the non-conformance, then Seller shall promptly provide a schedule for such modifications and shall make the Goods conforming within a reasonable time.

2. If Buyer notifies Seller in writing that any of the Special Services are non-conforming, Seller shall promptly provide conforming services acceptable to Buyer. If Seller fails to do so, Buyer may delete the Special Services and reduce the Contract Price a commensurate amount.

D. Buyer's Acceptance of Non-Conforming Goods:

Instead of requiring correction or removal and replacement of non-conforming Goods discovered either before or after final payment, Buyer may accept the non-conforming Goods. Seller shall bear all reasonable costs, losses, and damages attributable to Buyer's evaluation of and determination to accept such non-conforming Goods as provided in Paragraph 8.02.E.

E. Seller shall pay all claims, costs, losses, and damages, including but not limited to all fees and charges for re-inspection, retesting and for any engineers, architects, attorneys and other professionals, and all court or arbitration or other dispute resolution costs arising out of or relating to the non-conforming Goods and Special Services. Seller's obligations shall include the costs of the correction or removal and replacement of the non-conforming Goods and the replacement of property of Buyer and others destroyed by the correction or removal and replacement of the non-conforming Goods, and obtaining conforming Special Services from others.

F. *Buyer's Rejection of Conforming Goods:*

If Buyer asserts that Goods and Special Services are non-conforming and such Goods and Special Services are determined to be conforming, or if Buyer rejects as non-conforming Goods and Special Services that are later determined to be conforming, then Seller shall be entitled to reimbursement from Buyer of costs incurred by Seller in inspecting, testing, correcting, removing, or replacing the conforming Goods and Special Services, including but not limited to fees and charges of engineers, architects, attorneys and other professionals, and all court or arbitration or other dispute resolution

costs associated with the incorrect assertion of non-conformance or rejection of conforming Goods and Special Services.

8.03 *Correction Period*

A. Seller's responsibility for correcting all non-conformities in the Goods and Special Services will extend for a period of one year after the earlier of the date on which Buyer has placed the Goods in continuous service or the date of final payment, or for such longer period of time as may be prescribed by Laws or Regulations or by the terms of any specific provisions of the Contract Documents.

ARTICLE 9 − ROLE OF ENGINEER

9.01 *Duties and Responsibilities*

A. The duties and responsibilities and the limitations of authority of Engineer are set forth in the Contract Documents.

9.02 *Clarifications and Interpretations*

A. Engineer will issue with reasonable promptness such written clarifications or interpretations of the Contract Documents as Engineer may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents. Such written clarifications and interpretations will be binding on Buyer and Seller. If either Buyer or Seller believes that a written clarification or interpretation justifies an adjustment in the Contract Price or Contract Times, either may make a Claim therefor.

9.03 *Authorized Variations*

A. Engineer may authorize minor deviations or variations in the Contract Documents by: 1) written approval of specific variations set forth in Shop Drawings when Seller has duly noted such variations as required in Paragraph 5.06.C.4, or 2) a Field Order.

9.04 *Rejecting Non-Conforming Goods and Special Services*

A. Engineer will have the authority to disapprove or reject Goods and Special Services that Engineer believes to be non-conforming. Engineer will also have authority to require special inspection or testing of the Goods or Special Services as provided in Paragraph 8.01 whether or not the Goods are fabricated or installed, or the Special Services are completed.

9.05 *Decisions on Requirements of Contract Documents*

A. Engineer will be the initial interpreter of the Contract Documents and judge of the acceptability of the Goods and Special Services. Claims, disputes and other matters relating to the acceptability of the Goods and Special Services or the interpretation of the requirements of the Contract Documents pertaining to Seller's performance will be referred initially to Engineer in writing with a request for a formal decision in accordance with this paragraph.

B. When functioning as interpreter and judge under this Paragraph 9.05, Engineer will not show partiality to Buyer or Seller and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by Engineer pursuant to this

Paragraph 9.05 with respect to any such Claim, dispute, or other matter (except any which have been waived by the making or acceptance of final payment as provided in Paragraph 10.07) will be a condition precedent to any exercise by Buyer or Seller of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such Claim, dispute, or other matter.

9.06 *Claims and Disputes*

A. *Notice*: Written notice of each Claim relating to the acceptability of the Goods and Special Services or the interpretation of the requirements of the Contract Documents pertaining to either party's performance shall be delivered by the claimant to Engineer and the other party to the Agreement within 15 days after the occurrence of the event giving rise thereto, and written supporting data shall be submitted to Engineer and the other party within 45 days after such occurrence unless Engineer allows an additional period of time to ascertain more accurate data.

B. *Engineer's Decision*: Engineer will review each such Claim and render a decision in writing within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any.

C. If Engineer does not render a formal written decision on a Claim within the time stated in Paragraph 9.06.B., Engineer shall be deemed to have issued a decision denying the Claim in its entirety 31 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any.

D. Engineer's written decision on such Claim or a decision denying the Claim in its entirety that is deemed to have been issued pursuant to Paragraph 9.06.C, will be final and binding upon Buyer and Seller 30 days after it is issued unless within 30 days of issuance Buyer or Seller appeals Engineer's decision by initiating the mediation of such Claim in accordance with the dispute resolution procedures set forth in Article 13.

E. If Article 13 has been amended to delete the mediation requirement, then Buyer or Seller may appeal Engineer's decision within 30 days of issuance by following the alternative dispute resolution process set forth in Article 13, as amended; or if no such alternative dispute resolution process has been set forth, Buyer or Seller may appeal Engineer's decision by 1) delivering to the other party within 30 days of the date of such decision a written notice of intent to submit the Claim to a court of competent jurisdiction, and 2) within 60 days after the date of such decision instituting a formal proceeding in a court of competent jurisdiction.

F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 9.06.

G. The parties agree to endeavor to avoid or resolve Claims through direct, good faith discussions and negotiations whenever practicable. Such discussions and negotiations should at the outset address whether the parties mutually agree to suspend the time periods established in this Paragraph 9.06; if so, a written record of such mutual agreement should be made and jointly executed.

ARTICLE 10 − PAYMENT

10.01 *Applications for Progress Payments*

A. Seller shall submit to Buyer for Engineer's review Applications for Payment filled out and signed by Seller and accompanied by such supporting documentation as is required by the Contract Documents and also as Buyer or Engineer may reasonably require. The timing and amounts of progress payments shall be as stipulated in the Agreement.

1. The first application for Payment will be submitted after review and approval by Engineer of all Shop Drawings and of all Samples required by the Contract Documents.

2. The second Application for Payment will be submitted after receipt of the Goods has been acknowledged in accordance with Paragraph 8.01.B and will be accompanied by a bill of sale, invoice, or other documentation reasonably satisfactory to Buyer warranting that Buyer has rightfully received good title to the Goods from Seller and that, upon payment, the Goods will be free and clear of all liens. Such documentation will include releases and waivers from all parties with viable lien rights. In the case of multiple deliveries of Goods, additional Applications for Payment accompanied by the required documentation will be submitted as Buyer acknowledges receipt of additional items of the Goods.

10.02 *Review of Applications for Progress Payments*

A. Engineer will, within ten days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Buyer, or return the Application to Seller indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Seller may make the necessary corrections and resubmit the Application.

1. Engineer's recommendation of payment requested in the first Application for Payment will constitute a representation by Engineer, based on Engineer's review of the Application for Payment and the accompanying data, that the Shop Drawings and Samples have been reviewed and approved as required by the Contract Documents and Seller is entitled to payment of the amount recommended.

2. Engineer's recommendation of payment requested in the Application for Payment submitted upon Buyer's acknowledgment of receipt of the Goods will constitute a representation by Engineer, based on Engineer's review of the Application for Payment and the accompanying data Seller is entitled to payment of the amount recommended. Such recommendation will not constitute a representation that Engineer has made a final inspection of the Goods, that the Goods are free from non-conformities, acceptable or in conformance with the Contract Documents, that Engineer has made any investigation as to Buyer's title to the Goods, that exhaustive or continuous inspections have been made to check the quality or the quantity of the Goods beyond the responsibilities specifically assigned to Engineer in the Contract Documents or that there may not be other matters or issues between the parties that might entitle Seller to additional payments by Buyer or Buyer to withhold payment to Seller.

3. Engineer may refuse to recommend that all or any part of a progress payment be made, or Engineer may nullify all or any part of any payment previously recommended if, in Engineer's opinion, such recommendation would be incorrect or if on the basis of subsequently discovered evidence or subsequent inspections or tests Engineer considers

such refusal or nullification necessary to protect Buyer from loss because the Contract Price has been reduced, Goods are found to be non-conforming, or Seller has failed to furnish acceptable Special Services.

10.03 *Amount and Timing of Progress Payments*

A. Subject to Paragraph 10.02.A., the amounts of the progress payments will be as provided in the Agreement. Buyer shall within 30 days after receipt of each Application for Payment with Engineer's recommendation pay Seller the amount recommended; but, in the case of the Application for Payment upon Buyer's acknowledgment of receipt of the Goods, said 30-day period may be extended for so long as is necessary (but in no event more than 60 days) for Buyer to examine the bill of sale and other documentation submitted therewith. Buyer shall notify Seller promptly of any deficiency in the documentation and shall not unreasonably withhold payment.

10.04 *Suspension of or Reduction in Payment*

A. Buyer may suspend or reduce the amount of progress payments, even though recommended for payment by Engineer, under the following circumstances:

1. Buyer has reasonable grounds to conclude that Seller will not furnish the Goods or the Special Services in accordance with the Contract Documents, and

2. Buyer has requested in writing assurances from Seller that the Goods and Special Services will be delivered or furnished in accordance with the Contract Documents, and Seller has failed to provide adequate assurances within ten days of Buyer’s written request.

B. If Buyer refuses to make payment of the full amount recommended by Engineer, Buyer will provide Seller and Engineer immediate written notice stating the reason for such action and promptly pay Seller any amount remaining after deduction of the amount withheld. Buyer shall promptly pay Seller the amount withheld when Seller corrects the reason for such action to Buyer’s satisfaction.

10.05 *Final Application for Payment*

A. After Seller has corrected all non-conformities to the reasonable satisfaction of Buyer and Engineer, furnished all Special Services, and delivered all documents required by the Contract Documents, Engineer will issue to Buyer and Seller a notice of acceptance. Seller may then make application for final payment following the procedure for progress payments. The final Application for Payment will be accompanied by all documentation called for in the Contract Documents, a list of all unsettled Claims, and such other data and information as Buyer or Engineer may reasonably require.

10.06 *Final Payment*

A. If, on the basis of final inspection and the review of the final Application for Payment and accompanying documentation, Engineer is reasonably satisfied that Seller has furnished the Goods and Special Services in accordance with the Contract Documents, and that Seller's has fulfilled all other obligations under the Contract Documents, then Engineer will, within ten days after receipt of the final Application for Payment, recommend in writing final payment subject to the provisions of Paragraph 10.07 and present the Application to Buyer. Otherwise, Engineer will return the Application to Seller, indicating the reasons for refusing to recommend final payment, in which case Seller shall make the necessary corrections and resubmit the Application for payment. If the

Application and accompanying documentation are appropriate as to form and substance, Buyer shall, within 30 days after receipt thereof, pay Seller the amount recommended by Engineer, less any sum Buyer is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages to which Buyer is entitled.

10.07 *Waiver of Claims*

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Buyer against Seller, except Claims arising from unsettled liens from non-conformities in the Goods or Special Services appearing after final payment, from Seller's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Seller's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by Seller against Buyer (other than those previously made in accordance with the requirements herein and listed by Seller as unsettled as required in Paragraph 10.05.A, and not resolved in writing).

ARTICLE 11 − CANCELLATION, SUSPENSION, AND TERMINATION

11.01 *Cancellation*

A. Buyer has the right to cancel the Contract, without cause, at any time prior to delivery of the Goods by written notice. Cancellation pursuant to the terms of this paragraph shall not constitute a breach of contract by Buyer. Upon cancellation:

1. Buyer shall pay Seller for the direct costs incurred in producing any Goods that Seller has specially manufactured for the Project, plus a fair and reasonable amount for overhead and profit.

2. For Goods that are not specially manufactured for the Project, Seller shall be entitled to a restocking charge of 10 percent of the unpaid Contract Price of such Goods.

11.02 *Suspension of Performance by Buyer*

A. Buyer has the right to suspend performance of the Contract for up to a maximum of ninety days, without cause, by written notice. Upon suspension under this paragraph, Seller shall be entitled to an increase in the Contract Times and Contract Price caused by the suspension, provided that performance would not have been suspended or delayed for causes attributable to Seller.

11.03 *Suspension of Performance by Seller*

A. Subject to the provisions of Paragraph 5.07.B, Seller may suspend the furnishing of the Goods and Special Services only under the following circumstance:

1. Seller has reasonable grounds to conclude that Buyer will not perform its future payment obligations under the Contract; and,

2. Seller has requested in writing assurances from Buyer that future payments will be made in accordance with the Contract, and Buyer has failed to provide such assurances within ten days of Seller's written request.

11.04 *Breach and Termination*

A. Buyer's Breach:

1. Buyer shall be deemed in breach of the Contract if it fails to comply with any material provision of the Contract Documents, including but not limited to:

a. wrongful rejection or revocation of Buyer's acceptance of the Goods,

b. failure to make payments in accordance with the Contract Documents, or

c. wrongful repudiation of the Contract.

2. Seller shall have the right to terminate the Contract for cause by declaring a breach should Buyer fail to comply with any material provisions of the Contract. Upon termination, Seller shall be entitled to all remedies provided by Laws and Regulations.

a. In the event Seller believes Buyer is in breach of its obligations under the Contract, Seller shall provide Buyer with reasonably prompt written notice setting forth in sufficient detail the reasons for declaring that it believes a breach has occurred. Buyer shall have seven days from receipt of the written notice declaring the breach (or such longer period of time as Seller may grant in writing) within which to cure or to proceed diligently to cure such alleged breach.

B. Seller's Breach:

1. Seller shall be deemed in breach of the Contract if it fails to comply with any material provision of the Contract Documents, including, but not limited to:

a. failure to deliver the Goods or perform the Special Services in accordance with the Contract Documents,

b. wrongful repudiation of the Contract, or

c. delivery or furnishing of non-conforming Goods and Special Services.

2. Buyer may terminate Seller's right to perform the Contract for cause by declaring a breach should Seller fail to comply with any material provision of the Contract Documents. Upon termination, Buyer shall be entitled to all remedies provided by Laws and Regulations.

a. In the event Buyer believes Seller is in breach of its obligations under the Contract, and except as provided in Paragraph 11.04.B.2.b, Buyer shall provide Seller with reasonably prompt written notice setting forth in sufficient detail the reasons for declaring that it believes a breach has occurred. Seller shall have seven days from receipt of the written notice declaring the breach (or such longer period of time as Buyer may grant in writing) within which to cure or to proceed diligently to cure such alleged breach.

b. If and to the extent that Seller has provided a performance bond under the provisions of Paragraph 4.01, the notice and cure procedures of that bond, if any, shall supersede the notice and cure procedures of Paragraph 11.04.B.2.a.

ARTICLE 12 − LICENSES AND FEES

12.01 *Intellectual Property and License Fees*

A. Unless specifically stated elsewhere in the Contract Documents, Seller is not transferring any intellectual property rights, patent rights, or licenses for the Goods delivered. However, in the event the Seller is manufacturing to Buyer's design, Buyer retains all intellectual property rights in such design.

B. Seller shall pay all license fees and royalties and assume all costs incident to the use or the furnishing of the Goods, unless specified otherwise by the Contract Documents.

12.02 *Seller's Infringement*

A. Subject to Paragraph 12.01.A, Seller shall indemnify and hold harmless Buyer, Engineer and their officers, directors, members, partners, employees, agents, consultants, contractors, and subcontractors from and against all claims, costs, losses, damages, and judgments (including but not limited to all reasonable fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement or alleged infringement of any United States or foreign patent or copyright by any of the Goods as delivered hereunder.

B. In the event of suit or threat of suit for intellectual property infringement, Buyer will promptly notify Seller of receiving notice thereof.

C. Seller shall promptly defend the claim or suit, including negotiating a settlement. Seller shall have control over such claim or suit, provided that Seller agrees to bear all expenses and to satisfy any adverse judgment thereof.

1. If Seller fails to defend such suit or claim after written notice by Buyer, Seller will be bound in any subsequent suit or claim against Seller by Buyer by any factual determination in the prior suit or claim.

2. If Buyer fails to provide Seller the opportunity to defend such suit or claim after written notice by Seller, Buyer shall be barred from any remedy against Seller for such suit or claim.

D. If a determination is made that Seller has infringed upon intellectual property rights of another, Seller may obtain the necessary licenses for Buyer's benefit, or replace the Goods and provide related design and construction as necessary to avoid the infringement at Seller's own expense.

12.03 *Buyer's Infringement*

A. Buyer shall indemnify and hold harmless Seller, and its officers, directors, partners, employees, agents, consultants, contractors, and subcontractors from and against all claims, costs, losses, damages, and judgments (including but not limited to all reasonable fees and charges of engineers,

architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement or alleged infringement of any United States or foreign patent or copyright caused by Seller's compliance with Buyer's design of the Goods or Buyer's use of the Goods in combination with other materials or equipment in any process (unless intent of such use was known to Seller and Seller had reason to know such infringement would result).

B. In the event of suit or threat of suit for intellectual property infringement, Seller must after receiving notice thereof promptly notify Buyer.

C. Upon written notice from Seller, Buyer shall be given the opportunity to defend the claim or suit, including negotiating a settlement. Buyer shall have control over such claim or suit, provided that Buyer agrees to bear all expenses and to satisfy any adverse judgment thereof.

1. If Buyer fails to defend such suit or claim after written notice by Seller, Buyer will be bound in any subsequent suit or claim against Buyer by Seller by any factual determination in the prior suit or claim.

2. If Seller fails to provide Buyer the opportunity to defend such suit or claim after written notice by Buyer, Seller shall be barred from any remedy against Buyer for such suit or claim.

12.04 *Reuse of Documents*

A. Neither Seller nor any other person furnishing any of the Goods and Special Services under a direct or indirect contract with Seller shall: (1) acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media versions; or (2) reuse any of such Drawings, Specifications, other documents, or copies thereof on any other project without written consent of Buyer and Engineer and specific written verification or adaptation by Engineer. This prohibition will survive termination or completion of the Contract. Nothing herein shall preclude Seller from retaining copies of the Contract Documents for record purposes.

12.05 *Electronic Data*

A. Unless otherwise stated in the Supplementary Conditions, copies of data furnished by Buyer or Engineer to Seller, or by Seller to Buyer or Engineer that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. The transferring party will correct any errors detected within the 60-day acceptance period.

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from

the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

ARTICLE 13 − DISPUTE RESOLUTION

13.01 *Dispute Resolution Method*

A. Either Buyer or Seller may initiate the mediation of any Claim decided in writing by Engineer under Paragraph 9.06.B or 9.06.C before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the Engineer's decision from becoming final and binding.

B. Buyer and Seller shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the mediation process does not result in resolution of the Claim, then Engineer's written decision under Paragraph 9.06.B or a denial pursuant to Paragraph 9.06.C shall become final and binding 30 days after termination of the mediation unless, within that time period, Buyer or Seller:

1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions, or

2. agrees with the other party to submit the Claim to another dispute resolution process, or

3. if no dispute resolution process has been provided for in the Supplementary Conditions, delivers to the other party written notice of the intent to submit the Claim to a court of competent jurisdiction, and within 60 days of the termination of the mediation institutes such formal proceeding.

ARTICLE 14 − MISCELLANEOUS

14.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if: 1) delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or 2) if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

14.02 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Point of Destination is located.

B. In the case of any conflict between the express terms of this Contract and the Uniform Commercial Code, as adopted in the state whose law governs, it is the intent of the parties that the express terms of this Contract shall apply.

14.03 *Computation of Time*

A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day shall be omitted from the computation.

14.04 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents, and the provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

14.05 *Survival of Obligations*

A. All representations, indemnifications, warranties and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Goods and Special Services and termination or completion of the Agreement.

14.06 *Entire Agreement*

A. Buyer and Seller agree that this Agreement is the complete and final agreement between them, and supersedes all prior negotiations, representations, or agreements, either written or oral. This Agreement may not be altered, modified, or amended except in writing signed by an authorized representative of both parties.

SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions for Procurement Contracts, EJCDC P-700 (2010 Edition), and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions will have the meanings indicated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings indicated below, which are applicable to both the singular and plural thereof.

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

SC-1.01 Add the following terms and definitions to Article 1:

37. Engineer – The Engineer is further defined as Keller Associates Inc., 305 North 3rd Steet, Ste. A, Pocatello, ID 83201.
38. Buyer – The Buyer is further defined as the City of Aberdeen.
39. Owner – The terms Owner and Buyer may be used interchangeably in the Contract Documents to refer to the same party.
40. Vendor – The terms Seller and Vendor may be used interchangeably in the Contract Documents to refer to the same party.
41. Installation Contractor – The Installation Contractor is further defined as the contractor responsible for installation of the Goods furnished under this project.
42. Construction Contractor – The terms Construction Contractor and Installation Contractor may be used interchangeably in the Contract Documents to refer to the same party.
43. Notice of Intent to Award — Written notice by Buyer to the Bidder with the highest scoring responsive bid, which notice notifies the Bidder of the Buyer's intent to recommend award of the bid to the Bidder, provided the Bidder returns the signed agreement and bonds, when required, to the Buyer. This is not an award.

ARTICLE 2 – PRELIMINARY MATTERS

SC-2.03 Delete Part A and add the following in its place:

A. Engineer shall furnish Seller up to three hard copies of the Contract Documents as requested. Additional copies will be furnished upon request at the cost of reproduction.

SC-2.05 Delete Part A and add the following in its place:

A. Seller shall designate its representative at the time the Agreement is signed. Seller's representative shall have full authority to act on behalf of and make binding decisions in any matter arising out of or relating to the Contract.

ARTICLE 4 – BONDS AND INSURANCE

SC-4.02 Add the following new paragraphs immediately after Paragraph 4.02.E:

F. Seller shall purchase and maintain such liability and other insurance as is appropriate for the furnishing of Goods and Special Services and as will provide protection from claims set forth below which may arise out of or result from Seller's furnishing of the Goods or Special Services and Seller's other obligations under the Contract Documents, whether the furnishing of Goods and Special Services or other obligations are to be performed by Seller, any subcontractor or supplier, or by anyone directly or indirectly employed by any of them to furnish the Goods and Special Services, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;

2. claims for damages because of bodily injury, occupational sickness or disease, or death of Seller's employees;

3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Seller's employees;

4. claims for damages insured by reasonably available personal injury liability coverage which are sustained: (i) by any person as a result of an offense directly or indirectly related to the employment of such person by Seller, or (ii) by any other person for any other reason;

5. claims for damages, other than to the Goods, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

G. The policies of insurance so required by this Paragraph 4.02 to be purchased and maintained shall:

1. with respect to insurance required by Paragraphs SC-4.02.F.3 through SC-4.02.F.6 inclusive, include as additional insureds (subject to any customary exclusion in respect of professional liability) City of Aberdeen and Keller Associates, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided below or required by Laws or Regulations, whichever is greater;

3. include completed operations insurance;

4. include contractual liability insurance covering Seller's indemnity obligations under Paragraphs 5.09 and 12.02.

5. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least thirty days prior written notice has been given to Buyer and Seller and to each other additional insured identified in these Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Seller pursuant to Paragraph SC-4.02.I);

6. remain in effect at least until final payment and at all times thereafter when Seller may be correcting, removing, or replacing non-conforming Goods in accordance with Paragraph 8.03;

7. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment (and Seller shall furnish Buyer and each other additional insured identified in these Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Buyer and any such additional insured of continuation of such insurance at final payment and one year thereafter); and

8. with respect to any delegation of professional design services to Seller pursuant to Paragraph 5.10 of the General Conditions, include professional liability coverage by endorsement or otherwise.

H. The limits of liability for the insurance required by Paragraph SC-4.02.F shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. Workers' Compensation, and related coverages under Paragraphs SC-4.02.F.1 and F.2 that comply with Idaho Laws and Regulations:

a. State:	Statutory
b. Applicable Federal (e.g., Longshoreman's):	Statutory
c. Employer's Liability:	Statutory

2. Seller's General Liability under Paragraphs SC-4.02.F.3 through F.6 which shall include completed operations and product liability coverages and eliminate the exclusion with respect to property under the care, custody and control of Seller:

a. General Aggregate	$2,000,000
b. Products - Completed 1) Operations Aggregate	$2,000,000
c. Personal and Advertising 1) Injury	$1,000,000
2) Each Occurrence (Bodily Injury and Property Damage)	$1,000,000

d. Property Damage liability insurance will provide Explosion, Collapse, and Underground coverages where applicable.

e. Excess or Umbrella Liability
   1) General Aggregate $2,000,000
   2) Each Occurrence $2,000,000

3. Automobile Liability under Paragraph SC-4.02.F.6:

   a. Bodily Injury:
      1) Each person $1,000,000
      2) Each Accident $1,000,000

   b. Property Damage:
      1) Each Accident $1,000,000

   c. Combined Single Limit of $1,000,000

I. Seller shall deliver to Buyer, with copies to each additional insured identified in these Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Buyer or any other additional insured) which Seller is required to purchase and maintain.

J. If Buyer has any objection to the coverage afforded by or other provisions of the insurance required to be purchased and maintained on the basis of non-conformance with the Contract Documents, Buyer shall notify Seller in writing within 10 days after receipt of the certificates or other evidence required by Paragraph SC-4.02.F. Seller shall provide such additional information in respect to insurance as Buyer shall reasonably request.

ARTICLE 5 – SELLER'S RESPONSIBILITIES

SC-5.04.A.2 Replace subparagraphs a) and b) with the following:

All requirements are satisfied as listed in Section 01 25 13 – Product Substitution Procedures.

SC-5.05.A Replace paragraph 5.05.A with the following:

A. The Installation Contractor installing the Owner-selected equipment specified in these Contract Documents shall be responsible for all taxes and duties (if any) arising out of the sale of the Goods and furnishing of the special services provided by the Seller.

SC-5.06 Add the following new paragraphs immediately after Paragraph 5.06.E:

F. Seller shall furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than two submittals. Engineer will record Engineer's time for reviewing subsequent submittals of Shop Drawings, samples, or other items requiring approval and Seller shall reimburse Buyer for Engineer's charges for such time.

G. In the event the Seller requests a change of a previously approved item, Seller shall reimburse Buyer for Engineer's charges for its review time unless the need for such change is beyond the control of Seller.

SC-5.08.B Delete Paragraph 5.08.B in its entirety and insert the following in its place:

Seller warrants and guarantees to Buyer that all Goods and Special Services will conform with the Contract Documents, including any samples approved by Engineer, and the Goods will meet the Buyer's Technical Specifications. Engineer shall be entitled to rely on representation of Seller's warranty and guarantee.

SC-5.08 Add the following new paragraph immediately after Paragraph 5.08.F:

G. For warranties on Goods supplied by Seller to remain in effect, any replacement or addition of Goods to the system must be made using Goods approved in writing by Seller.

ARTICLE 6 – SHIPPING AND DELIVERY

SC-6.02.E Delete Paragraph 6.02.E in its entirety and insert the following in its place:

Partial deliveries and payment will be allowed. Seller shall be responsible for providing bill of sale or shipping receipt that allows Buyer to inventory each shipment.

SC-6.03.A Delete Paragraph 6.03.A in its entirety and insert the following in its place:

Risk of loss and insurable interests transfer from Seller to Buyer upon delivery of Goods to the Point of Destination.

ARTICLE 8 – BUYER'S RIGHTS

SC-8.03.A Delete Paragraph 8.03.A in its entirety and insert the following in its place:

Seller's responsibility for correcting all non-conformities in Goods and Special Services will extend for a period of one year after the substantial completion date for the construction project. *Substantial completion* is defined as "the time at which the Work has progressed to the point where, in the opinion of Engineer, the Work is sufficiently complete, in accordance with the Contract Documents, so that the Work can be utilized for the purposes for which it is intended."

ARTICLE 10 – PAYMENT

SC-10.01. A Delete last sentence and insert: "Payment will be in accordance with Specification Section 01 29 76 - Schedule of Payments."

SC-10.02.A.1 Delete Paragraph 10.02.A.1 in its entirety and insert the following in its place:

Engineer's recommendation of payment requested for submittal of Shop Drawing and Samples for Payment will constitute a representation by Engineer, based on Engineer's review of the Application for Payment and the accompanying data that the Shop Drawings and Samples have been reviewed and approved as required by the Contract Documents and Seller is entitled to payment of the amount recommended.

ARTICLE 12 – LICENSES AND FEES

SC-12.04 Add the following new paragraph immediately after Paragraph 12.04.A:

B. Nothing herein shall preclude Buyer or Engineer from retaining copies of the Contract Documents for record purposes. This prohibition will survive termination or completion of the Contract.

ARTICLE 14 – Miscellaneous

SC-14 Add the following paragraphs immediately after Paragraph 14.06:

14.07 *Independent Contractor*

A. The Parties agree that Seller is an independent contractor with no employment relationship with Buyer or Engineer.

14.08 *Contracting Authority*

A. Each Party warrants that the person or persons executing this Contract on behalf of such Party has the full right, power, and authority to enter into and execute this Contract on such Party's behalf, and that no consent from any other person or entity is necessary as a condition precedent to the legal effect of this Contract.

14.09 *Performance/Waiver*

A. The failure of a Party hereto to insist upon strict performance or observance of the terms of this Contract shall not be a waiver of any breach of any terms or conditions of this Contract by the other Party.

14.10 *Counterparts*

A. This Contract may be executed in counterparts, each of which shall be deemed to be an original, but all of which, taken together, shall constitute one and the same Contract.

END OF SECTION P-800

TECHNICAL SPECIFICATIONS

SECTION 01 11 00 – SUMMARY OF WORK

PART 1 - GENERAL

1.1 WORK INCLUDED

A. It is required that there be furnished, in accordance with these Contract documents, wastewater treatment equipment as set forth in these Technical Specifications.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The successful bidder shall enter into a Procurement Agreement (PA) with the City to provide one or more of the following goods. There will be a separate PA for each equipment system selected. Each Vendor may provide more than one type of equipment.

B. The Procurement Agreement entered into with the Owner shall also include the following services. These services are required to be included with each equipment system provided.

C. Submittals: The Vendor will provide design of the Goods, submittal of the shop drawings, general arrangement drawings of equipment, and a control strategy description; will participate in meetings and assist Engineer during the design; and will make changes to the equipment system as required to coordinate the design with the Engineer during the submittal review process. Submittals shall meet the requirements of Section 01 30 00 – Vendor Submittals.

1.3 PROJECT INFORMATION

A. Equipment provided as part of this contract will be supplied as part of the Aberdeen Wastewater Treatment Plant Improvements Project.

B. Treatment Plant Description:

1. The WWTP will be undergoing a major plant upgrade which will include modification to the existing headworks building to accommodate a new screen, new IFAS activated sludge process in existing basins, new building containing process blowers, new building for sand filters, and a new admin and solids handling building. Treated effluent will be discharged to Hazard Creek (Little Hole Draw). Waste activated sludge will be pumped to existing digesters, and subsequently be pumped to the new solids handling building prior to offsite disposal.

C. Site Characteristics:

1. Site Elevation: 4394 ft

2. Maximum Ambient Temperature: 87.9°F

3. Minimum Ambient Temperature: 11.0°F

4. Average Annual Max Temperature: 59.4°F

5. Average Annual Min Temperature: 30.2°F

6. Average Annual Precipitation: 8.80 in (Precipitation) and 21.0 in (Snowfall)

D. Wastewater Flow Characteristics: The flow entering the treatment plant can be classified as standard domestic municipal waste with approximately 26% from commercial connections. Aberdeen's wastewater is mostly residential and does not have major commercial, institutional, septage, leachate, or industrial contributions. The hospital is the largest non-residential connection.

1. Design Influent:

a. Design Average Day Flow: 0.36 MGD

b. Max Month Flow: 0.50 MGD

c. Peak Day Flow: 0.67 MGD

d. Peak Hour Flow: 1.73 MGD

e. Max Month BOD: 1,446 ppd

f. Max Month TSS: 1,683 ppd

g. Max Month TKN: 107 ppd

h. Max Month Phosphorus: 24 ppd

i. Water Temperature: 7-19 degrees Celsius

2. Required Effluent Characteristics:

a. Average Monthly BOD: 30 mg/L

b. Average Monthly TSS: 30 mg/L

c. Average Monthly Phosphorus as P: 1.36 lb/day

d. Monthly Geometric E. Coli: 126 MPN/100 mL

1.4 CONTRACT METHOD

A. The Equipment, hereunder, shall be furnished under a lump sum Contract as shown in the Bid Schedule. The Contract shall be assigned to the Installation Contactor as described in the Purchase Agreement. It is expected that the contract with the Installation Contractor will be established in the First Quarter 2024. Payment shall be made in accordance with schedule of payments listed in Section 01 29 76 – Schedule of Payments.

1.5 DELIVERY

A. Vendor is responsible for equipment being adequately and effectively protected against damage from handling, or other cause, during transport from Vendor's premises to the place of delivery.

B. Delivery of equipment to be furnished under the Contract shall be completed at the Owner's job site, within the number of calendar days, after receipt by the Vendor of the Notice to Proceed, as specified in the Agreement. Delivery of all items shall be witnessed by the Owner and verified on the invoice by the Owner.

1.6 FACTORY REPRESENTATIVE

A. Vendor shall provide the services of a qualified factory representative as specified in Section 01 31 13 – Project Coordination and Section 01 43 33 – Vendor's Field Services. Such services shall include installation coordination, startup, operator training assistance and testing. Any services of the factory representative required because of deficiencies in materials and workmanship shall be borne by the Vendor.

1.7 EQUIPMENT FIELD TESTING

A. After installation, all mechanical systems shall be tested for proper operation, efficiency, and capacity by the Installation Contractor and the Vendor, in the presence of the Owner and Engineer. Vendor's factory representative shall perform any final adjustments and inspection during this test. All parts shall operate satisfactorily in all respects. If any part of a unit shows evidence of unsatisfactory or improper operation during the test period, correction or repairs shall be made by the Vendor and the full test operation shall be repeated.

B. All tests shall be performed during normal working hours.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 11 00

SECTION 01 25 13 – PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This document describes the requirements for submission of product information and procedures for consideration of substitutions by Owner, including products proposed to be used by Vendor under "or equal" or "acceptable alternate" provisions.

B. Where equipment, materials or process have been specifically named, it is the intention of the Engineer to use these items. If a Vendor desires to have an alternate considered, they are to provide the information herein. It will be the responsibility of the Vendor to convince the Engineer that the alternate materials are equal and will perform the intended function at or above that of the specified equipment. The burden of proof is on the Vendor to convince the Engineer that the product is equal for the purpose of a particular function.

C. Substitution or Alternative Product Options: The alternative materials shall be submitted to Engineer no less than 15 business days before the bid opening. Engineer shall evaluate the materials, and if Engineer approves the substitution, an addendum shall be issued allowing the equipment alternatives.

1.2 DEFINITIONS

A. The word “Products,” as used herein, is defined to include purchased items incorporated into the work, regardless of whether specifically purchased for the project or taken from Vendor’s stock of previously manufactured products. The word “Materials,” is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form units of work. The word “Equipment” is defined as products with operating parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items). Definitions in this paragraph are not intended to negate the meaning of other terms used in the Contract Documents, including “specialties”, “system”, “structure”, “finishes”, “accessories”, “furnishings”, “special construction”, and similar items, which are self-explanatory and have recognized meanings in the construction industry.

B. Neither “Products” nor “Materials” nor “Equipment” includes machinery and equipment used for preparation, fabrication, conveying and erection of the Goods.

1.3 VENDOR’S OPTIONS

A. For products specified only by reference standards, select any product meeting standards, by any manufacturer.

B. For products specified by naming several products or manufacturers, select any product and manufacturer named.

C. For products specified by naming one or more products but indicating the option of selecting equivalent products by stating "or equal" or "acceptable alternate" after specified product, Vendor must submit request, as required for substitution, for any product not specifically named.

1. "Or-Equal" Items: if in the Engineer's sole judgment an item of material or equipment proposed by Vendor is functionally equal to that named and sufficiently similar so that no change in related work will be required, it may be considered by the Engineer as an "or-equal" item, in which case review and approval of the proposed item may in the Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purpose of the paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. It is at least equal in quality, durability, appearance, strength, and design characteristics.

b. It will reliably perform at least equally well the function imposed by the design concept of the complete project as a functioning whole.

c. There is no increase in cost to the Owner; and

d. It will conform to the detailed requirements of the item named in the Contract Documents.

D. For products specified by name, brand, model, etc., the Vendor shall provide information as required below for the Engineer to review and determine under their sole discretion that the product is acceptable.

1.4 SUBSTITUTIONS

A. If in the Engineer's sole judgment an item of material or equipment proposed by Vendor does not qualify as an "or-equal" item, it will be considered a proposed substitute item and subject to the review process.

B. If Vendor wishes to furnish or use a substitute item of material or equipment, Vendor shall first make written application to the Engineer for review of a proposed substitute item of material or equipment. The application shall certify that the proposed substitute will perform adequately the function and achieve the results called for by the general design, be similar in substance to the specified, and be suited for the same use that is specified.

C. The procedure for review by the Engineer will include the following:

1. If the Vendor wishes to provide a substitution item, the Vendor shall make written application to the Engineer.

2. Unless otherwise provided by law or authorized in writing by the Engineer, the request shall be submitted 15 days before the bid opening.

3. Wherever a proposed substitution item has not been submitted within said 15-day period, or wherever the submission of a proposed substitution material or equipment has been judged to be unacceptable by the Engineer, the Vendor shall provide the material or equipment indicated in the Contract Documents.

4. The Engineer will evaluate each proposed substitution within a reasonable period of time.

5. As applicable, no shop drawing submittals shall be made for a substitution item nor shall any substitution item be ordered, installed, or utilized without the Engineer's prior written acceptance of the Vendor's request.

D. Vendor shall submit sufficient information as provided below to allow the Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and therefore an acceptable substitute, therefore. Requests for review of proposed substitute items of materials or equipment will not be accepted by the Engineer from anyone other than the Vendor. Include the following minimum information in the application:

1. The Vendor shall certify that the proposed substitution will perform adequately the functions and achieve the results called for by the general design and be similar and of equal substance to that indicated and be suited for the same use as the specified.

2. For products:

a. Product identification, including manufacturer's name and address.

b. Manufacturer's literature:

1) Product description

2) Performance and test data

3) Reference standards

3. Samples.

4. Name and address of similar projects on which product was used and date of installation.

5. All variations of the proposed substitute item for the specified shall be identified in the application and available engineering, sales, maintenance, repair, and replacement service shall be indicated.

6. The application shall state the extent, if any, to which the use of the proposed substitute will prejudice Vendor's achievement of delivery on time, whether or not use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provision of any other direct contract with Owner for work on the project) to adapt the design to the proposed substitute item, and whether or not incorporation or use of the substitute in connection with the work is subject to payment of any license fee or royalty.

7. Relation to separate contracts.

8. The application shall also contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other sellers affected by any resulting change, all of which will be considered by the Engineer in evaluating the proposed substitute item.

E. In making a request for substitution, Vendor shall:

1. Investigate proposed product or method and determine that it is equal or superior in all respects to that specified.

2. Provide the same guarantee for substitution as for product or method specified.

3. Coordinate installation of accepted substitution into work, making such changes as may be required for work to be complete in all respects.

4. Waive all claims for additional costs related to substitution which consequently become apparent.

5. Ensure cost data is complete and includes all related costs under this contract, but excludes:

a. Costs under separate contracts.

b. Engineer's redesign.

F. Substitutions will not be considered if:

1. They are indicated or implied on shop drawings or product data submittals without formal request submitted in accordance with Paragraph 1.4;

2. Acceptance will require substantial revision of work.

G. Vendor shall provide all data in support of any proposed substitute or “or-equal” at Vendor’s expense.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 25 13

SECTION 01 29 76 – SCHEDULE OF PAYMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section defines the partial payment milestones and the corresponding payment amount, specified as a percent of the lump sum total contract price as submitted on Vendor's bid forms.

1.2 SCHEDULE OF PAYMENTS

A. The schedule of payments, less retainage, for the supplying of the Goods and Special Services shall be based on the following schedule:

Task Completion	Amount
Engineer's Approval of Submittals	100% of Item A in the Bid Schedule
Delivery of all Goods	60% of Item B in the Bid Schedule
Manufacturer's Installation Certification	10% of Item B in the Bid Schedule
Successful Completion of Testing	10% of Item B in the Bid Schedule
Engineer's Approval of O&M Manual	5% of Item B in the Bid Schedule
Completion of All Training	5% of Item B in the Bid Schedule
Substantial Completion	10% of Item B in the Bid Schedule

B. No partial payments will be paid for delivery of goods. Once all components are delivered to the site, Vendor will be eligible for payment for that task.

C. No payments shall be made beyond 80 percent until the Owner's Manuals have been approved and received by Owner.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 29 76

SECTION 01 30 00 – VENDOR SUBMITTALS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Wherever submittals are required hereunder, all such submittals by the Vendor shall be submitted to the Engineer per schedule listed in the Agreement.

B. Within 7 days after the date of commencement as stated in the Notice to Proceed, the Vendor shall submit the following items to the Engineer for review:

1. A preliminary progress schedule indicating the starting date of manufacture and assembly, and shipping dates of the Goods.

2. A preliminary schedule of Shop Drawings, Samples, and proposed Substitutes ("Or-Equal") submittals listed in the Bid.

1.2 SHOP DRAWINGS

A. Wherever called for in the Contract Documents, or where required by the Engineer, the Vendor shall furnish to the Engineer for review, three (3) copies, plus one electronic copy, of each shop drawing submittal. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, list, graphs, catalog sheets, data sheets, and similar items.

1. Whenever the Vendor is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the project is to be built, unless otherwise directed.

B. Verify that the material or equipment described in each submittal conforms to all requirements of the Specifications and drawings. All Vendor shop drawings submittals shall be carefully reviewed by an authorized representative of the Vendor, prior to submission to the Engineer. Each submittal shall be dated, signed, and certified by the Vendor, as being correct and in strict conformance with the Contract Documents. In the case of shop drawings, each sheet shall be so dated, signed, and certified. No consideration for review by the Engineer of any Vendor submittals will be made for any items which have not been so certified by the Vendor. All non-certified submittals will be returned to the Vendor without action taken by the Engineer, and any delays caused thereby shall be the total responsibility of the Vendor.

C. Where the detailed Specifications require specific submittal data, submit all data at the same time. A multiple page submittal shall be collated into sets, and each set shall be stapled or bound, as appropriate, prior to transmittal to the Engineer. Submittals are to be accompanied by the transmittal form attached at the end of this Section. The Engineer may return for resubmittal any information not accompanied by the specified transmittal form, properly completed.

1. Sequentially number the transmittal forms. Ensure that resubmittals have original number with an alphabetic suffix.

2. A separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required.

D. Except as may otherwise be indicated herein, the Engineer will return prints of each submittal to the Vendor with its comments. The Vendor shall make a complete and acceptable submittal to the Engineer by the second submission of a submittal item. The Owner reserves the right to withhold monies due to the Vendor to cover additional costs of the Engineer's review beyond the second submittal.

E. If copies of a submittal are returned to the Vendor marked "No Exceptions Taken" or “Furnish as Corrected”, formal revision and resubmission of said submittal will not be required.

F. If a submittal is returned to the Vendor marked "Revise and Resubmit" or “Rejected”, the Vendor shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the Engineer.

G. Fabrication of an item shall be commenced only after the Engineer has reviewed the pertinent submittals and returned copies to the Vendor marked either "No Exceptions Taken" or “Furnish as Corrected." Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis for changes to the contract requirements.

1.3 EFFECT OF ACCEPTANCE OF VENDOR INFORMATION

A. Acceptance by the Engineer of any drawings, method of work, or any information regarding materials or equipment the Vendor proposes to provide shall not relieve the Vendor of his responsibility for any errors therein and shall not be regarded as an assumption of risk or liability by the Engineer or Owner, or by any officer or employees thereof, and the Vendor shall have no claim under the contract on account of the failure or partial failure or inefficiency of any plan or method of work or material or equipment so accepted. Such acceptance shall be considered to mean merely that the Engineer has no objection to the Vendor using, upon his own full responsibility, the plan or method of work proposed, or providing the materials or equipment proposed.

B. Approval of shop drawings by the Engineer is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications. The Vendor is responsible for dimensions which shall be confirmed and correlated at the job site, fabrication process and techniques of construction, coordination of his work with that of all other trades and the satisfactory performance of his work.

1.4 DEVIATIONS FROM CONTRACT

A. If the Vendor proposes to provide material or equipment which does not conform to all of the Specifications and Drawings, the transmittal form accompanying the submittal copies shall indicate any deviations under "comments."

1.5 PRODUCT DATA AND SAMPLES

A. Where required in the Specifications and as determined by the Engineer, test specimens or samples of materials, appliances, and fittings to be used or offered for use in connection with the work shall be submitted to the Engineer at the Vendor's expense, with information as to their sources, with all freight charges prepaid, and in such quantities and sizes as may be required for proper examination and tests to establish the quality or equality thereof, as applicable.

B. All samples and test specimens are to be submitted in ample time to enable the Engineer to make any tests or examinations necessary, without delay to the work. The Vendor will be held responsible for any loss of time due to the neglect or failure to deliver the required samples to the Engineer as specified.

C. Samples may also be taken during the course of the work, as required by the Engineer.

D. Laboratory tests and examinations that the Owner elects to make will be made at no cost to the Vendor, except that, if a sample of any material or equipment proposed for use by the Vendor fails to meet the Specifications, the cost of testing subsequent samples will be borne by the Vendor.

E. All tests required by the Specifications to be performed by an independent laboratory are to be made, and the samples therefore furnished shall be at the sole expense of the Vendor.

F. Material used in the work is to conform to the submitted samples and test certificates as approved by the Engineer.

1.6 VENDOR'S SCHEDULES

A. Within 7 calendar days after the Commencement Date in the Notice to Proceed, the Vendor shall furnish the Owner and the Engineer a schedule showing the dates that manufacturing and assembly is to start, and shipment is to commence. This schedule shall be developed and followed to ensure the timely review and approval of shop drawings, and delivery of the equipment. The schedule shall be subject to the Engineer's review and Vendor resubmittal of the schedule shall be as required by the Engineer.

B. The following table is provided as a guidance for the deliverables required to be submitted as well as the required point at which they are to be submitted. This table is provided to identify the minimum requirements for submittals and is not intended to be all inclusive of all deliverables that may be necessary.

Deliverable	When to Submit
Performance Guarantee	Initial Submittal
Warranty	
Shop Drawings	
AutoCad Drawings	
Hydraulic Headloss Calculations	
Product Data	
List of Major Products Proposed	
Factory Inspection Logs and Testing Logs	
Process Calculations	
Performance Testing Plan	
Operation and Maintenance Manual	90 Days Prior to Shipment
Structural Requirements and Calculations	
Manufacturer's Installation Instructions	Prior to Shipment
List of hardware, fasteners, or materials required to interface with mechanical, structural, electrical, control and monitoring instrumentation	
Bill of Materials	
Delivery and Storage Requirements	
Panel Factory Acceptance Testing	
Field Testing Plan	
Operational Readiness Testing (ORT) forms	
Startup procedures	
Manufacturer's Certification of Proper Installation	Prior to Startup
Performance and ORT Testing Reports, including I/O checklist	Startup
Final PLC and HMI Applications and Passwords to Owner	
Operator Training	

1.7 OWNER'S OPERATIONS AND MAINTENANCE MANUAL

A. Refer to requirements in Section 01 78 23 – Operation and Maintenance Data.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 30 00

STANDARD SUBMITTAL FORM

DATE: _____ SUBMITTAL NO._____

FROM: _____ TO: _____
(To be completed afterward)

_____ _____

_____ _____

Vendor: This is: (Check one)

_____ An Original Submittal_____

_____ A 2nd Submittal_____

_____ A ___ Submittal_____

Previous Submittal Nos. _____

No. of Submittal Copies _____

SPECIFICATION OR SUBJECT OF SUBMITTAL	EQUIPMENT DESIGNATION	DRAWING REFERENCE

We have verified that this submittal contains all applicable material and information required for evaluation against the project Specifications. Furthermore, we submit these items, which comply with the Drawings and Specifications (check one):

____ With no exceptions

____ Except for the following deviations

NO.	DEVIATIONS

_____
Vendor's Authorized Representative

SECTION 01 31 13 – PROJECT COORDINATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Equipment Vendor shall accommodate the overall design and construction schedule by submitting shop drawings of proposed equipment to Engineer within the timeframe specified in Section P-520 - Procurement Agreement. In addition, special services requiring the manufacturer's assistance will require interface with the Engineer and timely submittals to maintain design and construction schedule.

B. During the engineering, manufacturing, installation and startup of the Goods, the interface will be between Vendor, the Engineer, and the Owner as stated in Section P-700 – General Conditions.

C. Before and during the installation and startup of the Goods, the Vendor shall be interfacing with both the Engineer and the Installation Contractor. It is understood that direct interface between the Vendor and Installation Contractor will be required. However, it is the Vendor's responsibility to keep the Engineer and Owner informed of all Information passing between itself and the Installation Contractor. Therefore, the Vendor shall send copies of all letters, drawings, telephone notes, etc. exchanged between itself and the Installation Contractor, to the Engineer for distribution.

D. Notice: Any notice, order, request or other communication shall be given in accordance with the provisions of Section P-700 – General Conditions. Any notice sent by first-class mail shall be deemed to have been given two days after the day of mailing.

E. Work by Owner and Others: The Vendor shall fully cooperate and coordinate its activity with the activities of the Owner, Installation Contractor, and other contractors so that work on the entire scheme of development may be performed with utmost speed consistent with good practice.

1.2 VENDOR SUBMITTALS

A. The Vendor shall submit a startup plan to Engineer in accordance with Section 01 30 00 - Vendor Submittals at least 60 days prior to scheduled startup date indicated by Installation Contractor. The startup plan shall include the following:

1. Equipment testing schedule.
2. Performance testing.
3. Instrumentation calibration and alarm review.
4. Programmable logic controller verification and testing.
5. Develop on-going approach to move equipment from startup to full operational status.

B. The start-up plan shall satisfy requirements listed in Section 01 75 16 – Startup Procedures.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 31 13

SECTION 01 42 13 - ABBREVIATIONS AND ACRONYMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Wherever in these Specifications references are made to the standards, specifications, or other published data of the various international, national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user of these Specifications, the following acronyms or abbreviations which may appear in these Specifications shall have the meanings indicated herein.

1.2 ABBREVIATIONS

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturer's Association
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturer's Association, Inc.
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AHAM	Association of Home Appliance Manufacturers
AI	The Asphalt Institute
AlA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANS	American Nuclear Society
ANSI	American National Standards Institute, Inc.
APA	American Plywood Association (or) American Parquet Association, Inc.
API	American Petroleum Institute

APWA	American Public Works Association
ARI	Air-Conditioning and Refrigeration Institute
ASA	Acoustical Society of America
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society of Nondestructive Testing
ASQC	American Society for Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWCI	American Wire Cloth Institute
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BBC	Basic Building Code, Building Officials and Code Administrators
BHMA	Builders Hardware Manufacturer's Association
CBM	Certified Ballast Manufacturers
CDA	Copper Development Association
CEMA	Conveyors Equipment Manufacturer's Association
CGA	Compressed Gas Association
CLFMI	Chain Link Fence Manufacturer's Institute
CLPCA	California Lathing and Plastering Contractors Association
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
DCDMA	Diamond Core Drill Manufacturer's Association
DEQ	Department of Environmental Quality
DHI	Door and Hardware Institute

DIPRA	Ductile Iron Pipe Research Association
DOE	Department of Ecology
DWR	Department of Water Resources
EIA	Electronic Industries Association
ETL	Electrical Test Laboratories
EPA	Environmental Protection Agency
FCI	Fluid Controls Institute
FM	Factory Mutual System
FPL	Forest Products Laboratory
HI	Hydronics Institute (or) Hydraulics Institute
HPMA	Hardwood Plywood Manufacturers Association
IAPMO	International Association of Plumbing and Mechanical Officials
IBC	International Building Code
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IFC	International Fire Code
IME	Institute of Makers of Explosives
IP	Institute of Petroleum (London)
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
ISDSI	Insulated Steel Door Systems Institute
ISEA	Industrial Safety Equipment Association
ISO	International Organization for Standardization
ISPWC	Idaho Standards for Public Works Construction
ITE	Institute of Traffic Engineers
MBMA	Metal Building Manufacturer's Association
MIL	Military Standards (DoD)
MPTA	Mechanical Power Transmission Association

MSS	Manufacturers Standardization Society
MTI	Marine Testing Institute
NAAMM	National Association of Architectural Metal Manufacturer's
NACE	National Association of Corrosion Engineers
NAGDM	National Association of Garage Door Manufacturers
NB	National Board of Boiler and Pressure Vessel Inspectors (alternate NBBPVI)
NBS	National Bureau of Standards (Now NIST)
NCCLS	National Committee for Clinical Laboratory Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association (or) National Fluid Power Association (or) National Forest Products Association
NISO	National Information Standards Organization
NLGI	National Lubricating Grease Institute
NMA	National Microfilm Association
NSF	National Sanitation Foundation
NWMA	National Woodwork Manufacturers Association
NWWDA	National Wood Window and Door Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PPI	Plastics Pipe Institute
RCRA	Resource Conservation and Recovery Act
RIS	Redwood Inspection Service
RMA	Rubber Manufacturers Association
RVIA	Recreational Vehicle Industry Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SAMA	Scientific Apparatus Makers Association
SDI	Steel Door Institute
SMA	Screen Manufacturers Association

SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SPI	Society of the Plastics Industry, Inc.
SPIB	Southern Pine Inspection Bureau
SPR	Simplified Practice Recommendation
SSA	Swedish Standards Association
SSBC	Southern Standard Building Code, Southern Building Code Congress
SSPC	Steel Structures Painting Council
SSPWC	Standard Specifications for Public Works Construction
TAPPI	Technical Association of the Pulp and Paper Industry
TFI	The Fertilizer Institute
TIA	Telecommunications Industries Association
UBC	Uniform Building Code
UFC	Uniform Fire Code
UL	Underwriters Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WCRSI	Western Concrete Reinforcing Steel Institute
WEF	Water Environment Federation
WIC	Woodwork Institute of California
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 42 13

SECTION 01 43 33 – VENDOR'S FIELD SERVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Vendor shall furnish erection assistance as required for consultation at the job site during installation of all equipment. Vendor shall also furnish qualified personnel for inspection, testing and startup of the finished installation and training of operational personnel.

B. Vendor's representative for the equipment specified herein shall be present at the job site and/or classroom designated by the Owner for a minimum number of workdays noted in equipment specific sections. Where recommended by the Vendor for any of the services, the number of additional days or trips, as well as the cost for these additional services, shall be identified in the proposal.

C. The Bid shall include all associated expenses incurred by the technical representative during the jobsite visits.

D. Excluded from this time requirement shall be travel time, time spent at the table during shipping of equipment, time spent at the jobsite correcting any fabrication or manufacturing errors, and time spent preparing and operating the equipment to meet performance requirements.

E. Work Day: For all specifications, a "workday" and a "calendar day" shall both be defined as an eight (8) hour work period onsite, excluding all travel time to and from the site.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 Vendor's services shall conform to the requirements of Section 01 31 13 - Project Coordination with the following additional requirements:

A. At least 30 working days prior to equipment startup, Vendor shall submit a detailed resume with appropriate qualifications of each individual proposed as a technical representative. Substitution of an accepted individual shall require notification and resume submittal at least 10 working days prior to startup and shall be subject to the Engineer's review and acceptance. Minimum qualifications include previous startup experience at a minimum of two (2) projects with similar equipment.

B. Startup services and training of Owner's personnel shall be at such times as requested by the Owner. Vendor shall submit an overall training plan and a detailed lesson plan for each training activity at least 7 working days prior to the training. The Installation Contractor will notify Vendor of the anticipated startup date, at least 30 working days prior to the startup date.

C. Vendor on-site work hours shall be coordinated with the Installation Contractor.

D. Training sessions shall be performed between 8:00 a.m. and 2:30 p.m., Monday through Thursday. Training sessions may be performed in the same day, however no training session for a single group shall last more than 4 hours.

E. Vendor shall videotape all training sessions and provide a copy to Owner for continuing operator training.

F. Vendor shall not be paid for field startup services which are unauthorized or made necessary due to delays, omissions, errors,or defects for which Vendor is responsible.

G. Vendor's erection supervisor(s) shall not assume executive charge of such work, but shall provide necessary direction so that the Installation Contractor, to the extent it follows the recommendations of Vendor, shall be relieved for any claims by Vendor when failure is due to erection, startup and operation during the employment of Vendor's Service Representative.

3.2 TESTING

A. The equipment shall not be considered ready for the performance and 30-day testing until the following conditions are satisfied:

1. Manufacturer's certification of equipment installation has been submitted to the Engineer.

2. Related Owner's Operation and Maintenance Manual and Final Shop Drawing have been accepted by the Engineer.

3. All required functional, electrical tests, and electrical adjustments have been completed to the satisfaction of the Engineer.

4. All safety devices and equipment are installed, fully functional, adjusted, and tested.

B. All testing shall be witnessed by the Owner or Engineer to be considered valid.

C. Vendor shall provide all materials, labor and equipment to prepare all equipment furnished under the Contract to be brought on line. Vendor's scope for field services is limited to supporting the equipment supplied and installed, under this procurement Contract.

END OF SECTION 01 43 33

SECTION 01 45 00 – QUALITY CONTROL

PART 1 - GENERAL

1.1 DEFINITION

A. The term Quality Control includes inspection, sampling and testing, and associated requirements.

1.2 INSPECTION AT PLACE OF MANUFACTURE

A. Unless otherwise indicated, all products, materials, and equipment shall be subject to inspection by the Engineer at the place of manufacture.

B. The presence of the Engineer at the place of manufacturer, however, shall not relieve the Vendor of the responsibility for furnishing products, materials, and equipment which comply with all requirements of the Contract Documents. Compliance is a duty of the Vendor and said duty shall not be avoided by any act or omission on the part of the Engineer.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION

A. The Owner and Installation Contractor shall inspect materials or equipment upon the arrival on the job site and immediately prior to installation and reject damaged and defective items.

B. The Vendor shall verify measurements and dimensions of the Work, as an integral step of starting each installation.

END OF SECTION 01 45 00

SECTION 01 65 00 – PRODUCT DELIVERY REQUIRMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The required delivery date for the Goods shall be as set forth in these Contract Documents and approved by the Engineer.

1.2 EQUIPMENT DELIVERY

A. The Vendor shall deliver the Goods to the Installation Contractor as necessary to meet the approved schedule. The Vendor shall be prepared to ship the Goods from the storage location or Vendor plant within twenty (20) calendar days of Vendor's receipt of written notice from Installation Contractor to ship.

1. The Vendor shall include the cost of shipment of all equipment associated with the Goods to the Point of Destination for the Installation Contractor in its lump sum bid.

2. The Vendor shall notify the Installation Contractor five (5) working days prior to shipment of the equipment, of the details of the shipping schedule.

3. The Vendor shall prepare all articles and materials for shipment in such a manner as to protect them from damage in transit. The Vendor shall be responsible for and make good any and all damage due to improper preparation and loading for shipment and shall ship to the location(s) designated herein.

4. Buyer shall be responsible for unloading the Goods at the site. The Vendor shall provide detailed instructions for off-loading and storage of equipment. The Vendor is hereby notified that all truck unloading activities may occur immediately upon receipt of shipment, and that the unloading activity will not be delayed accommodate the schedule of the individual(s) designated by the Vendor to supervise unloading. The Vendor shall supply all special tools, slings, and components necessary for unloading Vendor's equipment. Such tools, slings, and components shall be included with the shipment in a separate, clearly marked container. Any articles or materials that might otherwise be lost shall be boxed or wired in bundles and plainly marked for identification.

5. The Vendor shall obtain All Risk Transit Insurance covering the value of the materials and equipment being transported to the Project site. This shall include ocean cargo coverage as applicable.

B. The Vendor will arrange to have the Goods delivered to the project site between 8:00 A.M. and 3:30 P.M., Monday to Thursday, except statutory holidays. The Installation Contractor nor the Owner shall not be responsible for Goods delivered outside the acceptable time for delivery.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 65 00

SECTION 01 75 16 – STARTUP PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Equipment testing and startup are requisite to satisfactory completion of the contract and, therefore, shall be completed within the construction contract time.

B. The Vendor shall coordinate with the Installation Contractor all Work necessary for the successful operation of equipment system.

1.2 SUBMITTALS

A. Testing and Startup Plan: Not less than 60 days prior to startup, the Vendor shall submit for review a detailed Testing and Startup Plan. The Plan shall include schedules for equipment certifications, submittal of final Owner's Manuals, training of the Owner's personnel, electrical testing, and a detailed schedule of operations to achieve successful equipment testing, startup, performance and acceptance testing and activities to implement the 7-day and 30-day tests. The Plan shall include test checklists and data forms for each item of equipment and shall address coordination with the Owner's staff. The Vendor shall revise the Plan as necessary based on review comments.

B. Records and Documentation:

1. Submit documentation that the equipment has been properly installed, is in accurate alignment, is free from undue stresses from connecting piping and anchoring and has operated satisfactorily under full load conditions.

2. Testing and Startup Records as specified in Section 3.8.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Prior to scheduling any operations testing, the Vendor shall have previously furnished the Owner's Manuals required under Section 01 78 23 – Operation and Maintenance Data.

B. The Vendor shall coordinate the scheduling of all operations testing. The Vendor is advised that the Engineer and the Owner's operating personnel will witness operations testing and that the Vendor's representative shall be required to instruct the Owner's operating personnel in correct operation and maintenance procedures.

C. The Vendor shall notify the Engineer at least 7 days in advance for testing installed equipment.

3.2 SUPPLIES

A. The Installation Contractor will furnish all process liquid, washwater, compressed air, electrical power, and all other necessary equipment, facilities, and services required for conducting the tests, except for items listed in the equipment specifications to be provided by Vendor.

3.3 FACTORY ACCEPTANCE TESTING

A. The Vendor shall be responsible for conducting a factory acceptance test and achieving Engineer approval as to the outcome of the test prior to the field installation of the equipment, if required by the specifications for the equipment.

B. The Vendor is advised that the Engineer and the Owner’s operating personnel may witness factory testing.

C. The Vendor shall be responsible for scheduling all factory acceptance testing. The Vendor shall coordinate the factory acceptance testing schedule with the Engineer at least 1 week in advance.

D. Factory acceptance testing shall be conducted per the requirements in the equipment specifications.

3.4 EQUIPMENT INSTALLATION AND TESTING

A. The Installation Contractor shall coordinate directly with the Vendor to provide the services of an experienced and authorized representative of the manufacturer, who shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation.

B. The Installation Contractor shall arrange to have the manufacturer's representative revisit the job site as often as necessary until any and all trouble is corrected, and the equipment installation and operation are satisfactory to the Buyer and Engineer.

C. The Installation Contractor shall require that Vendor furnish to the Engineer a written certification addressed to the Owner certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts and has been operated satisfactorily and tested under full-load conditions.

3.5 FUNCTIONAL SYSTEM TESTING

A. In addition to individual equipment and subsystem testing, the Vendor shall perform testing of all process control, electrical and other systems, as listed in the equipment specifications to demonstrate proper operation with equipment operating over full operating ranges and under actual operating conditions, in all of the automatic and manual modes as specified in the control strategies and descriptions in the equipment specifications.

B. The Vendor shall repeat the system tests as necessary to demonstrate proper operation to the satisfaction of the Engineer. The Vendor shall be back charged the cost of Owner's personnel and Engineer's personnel for all tests beyond the second test.

C. Prior to initiating the system testing, the Vendor shall submit the testing procedures to the Engineer for approval. Systems that are included in a 7-day test shall be tested and accepted prior to commencement of the 30-day startup test. The systems that shall be included in the 7-day and 30-day tests include all equipment included in the Vendor's scope of supply.

D. System testing in general shall involve demonstration that all controls, instrumentation loops, alarm/status indication, and all controls described in the equipment specifications function properly. In addition, the Vendor shall demonstrate sustained equipment operation for a minimum of eight continuous hours when operated in conjunction with other system components. The Vendor shall schedule, provide, and coordinate the services of all manufacturers, suppliers, the Engineer, the Installation Contractor, and the Owner for successful system testing.

E. All system testing activities shall follow detailed test procedures, check lists, etc., previously developed and submitted by the Vendor which have been reviewed by the Engineer. Completion of all system testing activities shall be documented by a certified report. Successful completion of the system testing is required prior to commencement of the 7-day test and 30-day test specified below.

F. The Vendor shall test and fully demonstrate proper operation of the utility, safety equipment, and other support systems before commencing the process system testing.

G. The Vendor shall give the Engineer written notice confirming the date of any system test at least (3) working days before the time the system is scheduled to be tested. The Owner's staff will observe system's testing.

3.6 7-DAY PERFORMANCE TEST

A. The startup of the equipment system will require the combined technical expertise of the Vendor, Installation Contractor, Owner, and the Engineer. The Installation Contractor shall provide the effective coordination of all parties necessary for successful 7-day test.

B. The Installation Contractor and Vendor shall provide operating personnel for the duration of the 7-day test.

C. The 7-day test shall not be commenced until all required equipment tests have been completed to the satisfaction of the Engineer.

D. All defects in materials or workmanship which appear during this test period shall be immediately corrected by the Vendor.

E. During the 7-day test, the Installation Contractor and Vendor shall provide the services of authorized representatives, in addition to those services required under operations testing, as necessary, to correct faulty equipment operation.

F. 7-Day Test: The Vendor, in coordination with the Contractor and Owner, shall be required to assist in conducting the 7-day test, operate facilities being tested, and pass a 7-day test. The vendor must be present on site for the duration of the 7-day test; completion of 7-day test by phone or video conferencing will not be acceptable. All equipment must properly run as specified in the equipment specifications during the 7-day test period at test flow rates. If any item provided by the Vendor malfunctions during the test, the item shall be repaired, and the test restarted at day zero with no credit given for the operating time before the aforementioned malfunction.

1. The Vendor shall lubricate and maintain the equipment in accordance with the manufacturer's recommendations.

2. Prerequisites: The following shall be completed before 7-day testing begins.

   a. All Owner's manuals information required by the Contract Documents has been furnished.

   b. Provide all safety equipment, protective guards and shields required by the Contract Documents. Devices and equipment shall be fully functional, adjusted and tested.

   c. Manufacturer's certification of proper installation has been accepted.

   d. Electrical tests, and equipment adjustments have been completed.

   e. The Engineer has approved the 7-day testing and startup plan. The plan shall include a check list documenting that all the prerequisites have been provided and/or completed.

   f. Functional verification of the individual instrumentation loops (analog, status, alarm, and control).

   g. Adjustment of the pressure switches, timing relays, level switches, temperature switches, HMI monitors, and all other control devices to the settings determined by the Engineer or the equipment manufacturer.

   h. Functional verification of the individual interlocks between the field-mounted control devices and the motor control circuits, control circuits of variable-speed controllers, and packaged system controls.

3.7 30-DAY TEST AND PLANT STARTUP

A. The Installation Contractor shall be required to operate the equipment system and pass a 30-day test prior to acceptance. Each equipment system shall be started up as determined by the Contractor's phasing plan and after each has completed the 7-day test. All Vendor equipment must properly run for the 30-day test period. If any item malfunctions during the test, the item shall be repaired, and the test restarted at day zero with no credit given for the operating time before the aforementioned malfunction.

1. Prerequisites: The following shall be completed before plant testing and startup begins.

   a. 7-day performance testing shall be completed and accepted.

   b. The Engineer has approved the 30-day Startup Plan.

B. The Owner and/or Engineer shall provide the effective coordination of all parties necessary for successful 30-day test.

C. After approval of the 30-day Startup Plan and coordination with the Owner, the Installation Contractor shall start the 30-day test by introducing process flow through the equipment. This test, to the greatest extent possible, will take place at 80% of the design flow for each process or piece of equipment.

D. All defects in material or workmanship which appear during the tests shall be immediately corrected by the Vendor or Installation Contractor as applicable.

E. The Owner and Installation Contractor shall provide operating personnel for the duration of the 30-day test.

F. The Vendor shall lubricate and maintain the equipment in accordance with the manufacturer's recommendations.

G. During the 30-day test, the Vendor shall provide the services of authorized representative, in addition to those services required under operations testing, as necessary, to correct faulty equipment operation.

H. Testing and startup records per Section 3.8.

I. After successful completion and acceptance of the 30-day test, the Vendor shall:

1. Complete closeout of the project per Section 01 77 00 – Closeout Procedures.

3.8 RECORDS OF TESTING AND STARTUP

A. The Vendor shall maintain the following during the 7-day and 30-day testing and startup and submit originals to Engineer prior to acceptance of tests and before substantial completion will be considered:

1. Test results from performance testing as specified in the equipment specifications.
2. Lubrication and service records for each mechanical and electrical equipment item.
3. Hours of daily operation for each mechanical and electrical equipment item.
4. Equipment alignment and vibration measurement records, as specified.
5. Logs of electrical measurements and tests.
6. Instrumentation calibration and testing logs.
7. Testing and validation of status indications and alarms.
8. Factory and field equipment settings.
9. Log of problems encountered and adjustments made.
10. Other records, logs, and checklists as required by the Contract Documents.

3.9 TRAINING

A. The Vendor shall coordinate the training periods with the Owner and manufacturer's representatives and shall submit a training schedule and detailed agenda for each piece of equipment or system for which training is to be provided. Said training schedule and agenda shall be submitted not less than 14 calendar days prior to the time that the associated training is to be provided. The Vendor shall confirm each training period a minimum of two days prior to scheduled time.

B. Additional requirements for training are listed in the equipment specifications.

END OF SECTION 01 75 16

SECTION 01 77 00 – CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 CLOSEOUT TIMETABLE

A. The Installation Contractor shall establish dates for equipment testing, acceptance periods, and on-site instructional periods (as required under the Contract). Such dates shall be established not less than two weeks prior to beginning any of the foregoing items, to allow the Vendor, Installation Contractor, Engineer, and their authorized representatives sufficient time to schedule attendance at such activities.

1.2 FINAL SUBMITTALS

A. The Vendor, prior to requesting final payment, shall obtain and submit the following items to the Installation Contractor for transmittal to the Owner:

1. Written guarantees, where required.

2. Owner's Operation and Maintenance Manuals as specified in Section 01 78 23 – Operation and Maintenance Data.

3. Recommended spare parts, special tools.

4. Certificates indicating that all tests and activities required by Section 01 75 16 – Startup Procedures have been successfully completed to the satisfaction of the Engineer.

5. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

6. Process Guarantee, where required.

1.3 MAINTENANCE AND GUARANTEE

A. The Vendor shall comply with the maintenance and guarantee requirements contained in Article 5.08 of the General Conditions.

B. If the Goods fail to perform as warranted, the Vendor shall make all repairs and replacements promptly upon receipt of written order from the Owner. If the Vendor fails to make such repairs or replacements promptly, the Owner reserves the right to do the work and the Vendor and his surety shall be liable to the Owner for the cost thereof.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 77 00

SECTION 01 78 23 – OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall submit technical operation and maintenance information for each item of mechanical and electrical equipment in an organized manner in the Owner's Manual. It shall be written so that it can be used and understood by the Owner's operation and maintenance staff. The Owner's Manual information shall also be submitted in electronic format on a flash drive.

1.2 OWNER'S MANUAL

A. The Owner's Manual shall include the following for each item of mechanical and electrical equipment (as applicable):

1. Equipment Summary: A summary table shall include the equipment name and equipment number, the manufacturer's model number, serial number, and other nameplate information specific to the equipment provided.

2. Operational Procedures: Manufacturer-recommended procedures on the following shall be included:

    a. Installation

    b. Adjustment

    c. Startup

    d. Location of controls, special tools, equipment required, or related instrumentation needed for operation

    e. Operation procedures

    f. Load changes, Calibration, Shutdown

3. Troubleshooting, Disassembly, Reassembly

    a. Realignment

    b. Testing to determine performance efficiency

    c. Tabulation of proper settings for all pressure relief valves, low and high-pressure switches, and other protection devices

    d. List of all electrical relay settings including alarm and contact settings

4. Preventive Maintenance Procedures:

   a. Procedures: Preventive maintenance procedures shall include all manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by leaving the equipment in place.

   b. Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade, type, and temperature ranges, shall be covered.

5. Parts List and Drawings:

   a. Parts List: A complete parts list shall be furnished, including a generic description and manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included.

   b. Drawings: Cross-sectional or exploded view drawings shall accompany the part list.

6. Wiring Diagrams: Include complete internal and connection wiring diagrams for electrical equipment items.

7. Shop Drawings: Include approved shop or fabrication drawings, complete with dimensions. Include performance curves for pumps furnished.

8. Safety: This part describes the safety precautions to be taken when operating and maintaining the equipment or working near it.

9. Documentation: All equipment warranties, affidavits, and certifications required by the Technical Specifications shall be placed in this part.

10. Spare Parts: This part shall contain spare parts information for all mechanical, electrical, and instrumentation equipment. The spare parts list shall include the current list price of each spare part. The spare parts list shall be limited to those spare parts which each manufacturer recommends be maintained by the Owner in inventory at the plant site. Each manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts to facilitate the Owner in ordering. The Vendor shall cross-reference all spare parts lists to the equipment numbers designated in the Contract Documents.

B. If manufacturer’s standard brochures and manuals are used to describe operating and maintenance procedures, modify such brochures and manuals to reflect only the model or series of equipment used on this project and features provided. Cross out neatly or remove extraneous material, or otherwise annotate or eliminate.

1.3 TRANSMITTAL PROCEDURE

A. Provide three (3) original hard copies and one (1) electronic copy in PDF format of all operating and maintenance information. For ease of identification, label each manufacturer's brochure and manual with the equipment name. Organize the information in 3-ring binders and use an indexing feature within the PDF submission, in numerical order, per specification section number. Include in the manuals a table of contents and tab sheets to permit easy location of desired information.

B. The Vendor shall submit to the Engineer three identical Owner's Manuals a minimum of 90 calendar days prior to the scheduled startup of the equipment. Initial submittal for Engineer's review shall consist of one electronic copy and one hard copy.

C. The Engineer will review the Owner's Manuals within 30 days following their receipt by the Engineer. The Vendor shall then make any corrections and changes noted and compile all the corrected Owner's Manuals for final submittal to the Engineer.

1.4 PAYMENT

A. Acceptable operating and maintenance information for the project must be delivered to the Engineer prior to the project being 75 percent complete or at least two weeks prior to startup of any equipment. Progress payments for work in excess of 80 percent completion or 2 weeks prior to startup will not be made until the specified acceptable operating and maintenance information has been delivered to the Engineer.

1.5 FIELD CHANGES

A. Following the acceptable installation and operation of an equipment item, the item's instructions and procedures are to be modified and supplemented to reflect any field changes or information requiring field data.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 78 23

SECTION 26 05 00 – ELECTRICAL, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Work included under this specification consists of furnishing all labor, materials, services, tools and other equipment necessary for the electrical and control equipment fabrication, delivery, and testing as specified herein.

B. The intent of the electrical specifications is to provide enough information to the Vendor to illustrate the electrical equipment standards for which the power and control system are to be fabricated. All field installation (except the required manufacturer's checking, start-up, and testing) will be done under a separate contract.

C. For all separate non-packaged systems, motor control centers, motor starters and variable frequency drives will be provided under a separate contract.

D. For all skid mounted packaged systems, the Vendor will provide the motor starters, variable frequency drives, and all applicable controls.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. The Work of this and other sections is required for operation of electrical equipment provided under specifications in other Divisions. The Vendor's attention is directed to the requirement for proper coordination of the Work of this Section with the Work required by all sections.

1.3 REFERENCE STANDARDS

A. All equipment, materials, and methods of design and installation are to comply with the National Electrical Code, the basic Electrical Regulations of the State where the work is to be completed, the Occupational Safety and Health Act (OSHA), and the requirements of all other applicable codes. Codes and standards of the following organizations may be referred to in this Section and shall be considered as the minimum acceptable. A reference herein to any portion of the standard or code is not to be considered as negating any other portion of the standard or code.

1.	ANSI	American National Standards Institute, Inc.
2.	IEEE	Institute of Electrical & Electronic Engineers
3.	ASTM	American Society for Testing & Materials
4.	UL	Underwriters Laboratories, Inc.
5.	NEMA	National Electric Manufacturers Association
6.	IPECA	Insulated Power and Cable Engineers Institute
7.	NEC	National Electric Code
8.	IES	Illuminating Engineering Society
9.	ISA	Instrument Society of America

B. All electrical equipment shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL) or an independent testing laboratory acceptable to the local code enforcement agency having jurisdiction.

C. Where the Plans or these specifications require a higher degree of workmanship or quality of material than the above codes and standards imply, then these Plans and specifications will prevail.

1.4 VENDOR SUBMITTALS

A. Make all submittals in accordance with Section 01 30 00 – Vendor Submittals.

B. Within 15 days after the contract award, submit material lists for this Section of the work. Lists will include manufacturer and brand name of each class of material.

C. Submit complete shop drawings for review prior to manufacture of power distribution and control equipment.

1. The Vendor shall provide detailed shop drawings depicting necessary wiring, interlocks, etc. for use by a subsequent Installation Contractor. Shop Drawings will show:

a. Elevations

b. Plan layout and dimensions

c. Construction details

d. Elementary diagrams

e. Connection and interconnection diagrams

f. Internal wiring diagrams

g. Bill of Material

h. Nameplates

i. Temperature limitations

j. Voltage requirement, phase, and current, as applicable

k. Grounding requirements

l. Control diagrams

m. Catalog cut sheets or brochures for mass produced, non-custom manufactured material.

D. Motor control center diagrams, motor controller diagrams, and package drive diagrams are to be of the elementary type and show terminal identifications and associated field connections for each drive. Shop drawing shall show the scope of supply by the Vendor.

E. Schematics for all control circuits are to be laid out as a ladder diagram with each line numbered in a sequential manner and all relays having their contact location summary on the line with the relay coil, (per JIC standards). Clearly show and identify interconnection with other systems.

F. Provide and submit for review complete interconnection diagrams for all equipment showing:

1. Terminal blocks of all distribution and control equipment

2. All power, control, and signal raceways

G. Provide Owner's Manuals in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.5 QUALITY ASSURANCE

A. All equipment furnished under this Section will be guaranteed for a minimum period of one (1) year from date of accepted installation against defective materials, design, and workmanship in accordance with the provisions of the General Conditions.

B. Tests

1. The Vendor shall be responsible for factory and field tests required by specifications and by the Engineer or other authorities having jurisdiction. The Vendor shall furnish necessary testing equipment and pay costs of test, including replacement parts and labor, due to damage resulting from damaged equipment or from testing and correction of faulty installation.

2. Where test reports are indicated, proof of design tests reports for mass-produced equipment shall be submitted with the Shop Drawings, and factory performance test reports for custom-manufactured equipment shall be submitted and be approved prior to shipment. Filed test reports shall be submitted for review prior to Submittal completion.

3. Equipment or material that fails a test shall be removed and replaced. All tests which do not pass shall be repeated after identifying and correcting the problems. Any corrections to equipment or materials that are furnished with time for factory personnel to perform startup and/or testing shall be corrected per the recommendations and under the supervision of the factory representative. Any corrections to equipment or materials that are furnished with a factory warranty shall be corrected per the recommendations of the manufacturer and in a manner, which does not violate the terms of the warranty.

1.6 AREA DESIGNATIONS

A. Electrical Work shall comply with requirements listed in the table below:

Area	NEMA ENCLOSURE CLASSIFICATION							
	1	3R	4	4X	7	8	12	Notes
Below grade vaults, manholes, etc.				X				
Outdoors, non-hazardous, non corrosive locations		X						UL listed for outdoor & wet locations
Outdoors, hazardous, non-corrosive locations						X		UL listed for outdoor & wet locations, or add rain Shields
Outdoors, hazardous & corrosive locations						X		UL listed for outdoor & wet locations, or add rain Shields
Building Interior, non-hazardous, non-corrosive locations							X	
Building Interior, non-hazardous, corrosive locations				X				
Building Interior, hazardous & corrosive locations					X			Class 1, Div 1/2 as required by applicable codes. Only non-corroding materials allowed.

B. Electrical Work not included in the table above shall be NEMA 4X carbon steel unless applicable code requires otherwise.

C. Installation in hazardous locations shall conform strictly to the requirements of the Class, Group and Division indicated or required by applicable codes.

1.7 PERMITS

A. Installation Contractor shall obtain and pay for all permits and inspections pertinent to the electrical installation and obtain such permits from the proper governing body before any progress payment will be certified for electrical work.

1.8 SITE INSPECTION

A. Prior to submitting a bid, visit the project site and ascertain conditions affecting the proposed work and all existing electrical facilities. Additional costs / change orders will not be allowed for required work that should have been readily apparent during a pre-bid site visit.

1.9 UTILITY CONNECTION

A. The Owner shall pay any and all fees to utilities for costs associated with installation, connection, and turn-on charges for permanent service. The Vendor shall be responsible for coordination of work with the Installation Contractor for providing temporary utilities as needed. Cost for temporary utilities to be paid by the Installation Contractor.

1.10 TEMPORARY INSTALLATION

A. Temporary installation is to conform to the requirements of the National Electric Code and the State and local governing bodies.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment and material are to be new, free from defects, of current manufacture, and listed by Underwriters Laboratories, Inc., (UL) where UL requirements apply. All materials are to be products of reputable and experienced manufacturers. Similar items in the project are to be of the same manufacturer. Use only equipment and materials of industrial quality and durability, and capable of long, reliable, trouble free service.

B. The Owner reserves the right to operate defective equipment or that equipment which fails to conform to detailed specifications or does not operate satisfactorily until the defects are corrected or the equipment is repaired or replaced, without cost for depreciation, use or wear. Rejected equipment will be removed from operation only at times approved by the Owner.

2.2 MOUNTING HARDWARE

A. Miscellaneous Hardware

1. All nuts and bolts shall be Type 316 stainless steel.

2. Threaded rods for trapeze supports shall be continuous threaded, galvanized steel, 3/8-inch diameter minimum.

3. Strut for mounting of conduits and equipment shall be galvanized steel. Where contact with concrete or dissimilar metals may cause galvanic corrosion, suitable non-metallic insulators shall be utilized to prevent such corrosion. Strut shall be as manufactured by Unistrut, B-Line, or equal.

4. Anchors for attaching equipment to concrete walls, floors and ceilings shall be stainless steel expansion anchors, such as “Rawl-Bolt,” “Rawl-Stud” or “Lok-Bolt” as manufactured by Rawl; similar by Star, or equal. Wood plugs shall be permitted. The Installation Contractor shall provide the anchors.

2.3 ELECTRICAL IDENTIFICATION

A. Nameplates: Nameplates shall be fabricated from black-letter, white face laminated plastic engraving stock, Formica Type ES-1, or equal. Each shall be fastened securely, using fasteners of brass, cadmium plated steel, or stainless steel, screwed into inserts or tapped holes as required. Adhesive attachment is not allowed. Engraved characters shall be block style with no characters small than 1/8-inch top to bottom.

B. Conductor and Equipment Identification: Conductor and equipment identification devices shall be either imprinted plastic-coated cloth marking devices such as manufactured by Brady, Thomas & Betts, or equal, or shall be heat-shrink plastic tubing, imprinted split-sleeve markers cemented in place, or equal.

2.4 SIGNAGE AND MARKINGS

A. Provide danger, caution, and warning signs and equipment identification markings in accordance with applicable federal and state OSHA and NEC requirements.

B. Local Disconnect Switches: Provide local disconnect switches for all equipment. Each local disconnect switch for motors and equipment shall be legibly marked to indicate its purpose unless the purpose is indicated by the location and arrangement.

C. Isolating Switches: Isolating switches not interlocked with an approved circuit interrupting device shall be provided with a sign warning against opening them under load.

2.5 TERMINAL BLOCKS

A. Terminal Blocks where required shall be screw terminal, heavy duty, rated at 20 amperes minimum, 600 volt AC. Terminals shall be provided with integral marking strips which shall be permanently identified with the connecting wire numbers. Each terminal block shall be uniquely identified.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Documents: The Vendor shall provide detailed installation drawings depicting necessary wiring, interlocks, etc. for use by a subsequent Installation Contractor.

B. Incidental: The Installation Contractor who will be awarded the construction installation contract shall provide all incidentals materials required for a complete and operable system. Typical incidentals are terminal lugs not furnished with vendor supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and control wiring required by vendor furnished equipment to connect with other equipment indicated in the Contract Documents.

C. Mounting Height: All panel boards, LCP’s and other non-freestanding panels shall be mounted such that the top of the panel is between 5’- 6” and 6’- 6” above the finished floor or grade unless specifically indicated otherwise in the Contract Documents.

3.2 PROTECTION OF EQUIPMENT AND MATERIALS

A. Provide protection for materials and equipment against loss or damage throughout the contract. Protect everything from the effect of weather prior to installation, store items to be installed in indoor location.

B. Any item subject to corrosion under damp conditions and items containing insulation such as transformers and motors are to be kept in heated locations.

C. The Installation Contractor shall fully protect materials and equipment against damaged from any cause. Materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. Moving parts shall be kept clean and dry. The Installation Contractor shall replace or refinish damaged materials or equipment, including faceplates of panels and switchboard sections as part of the Work.

3.3 EQUIPMENT IDENTIFICATION

A. Equipment and devices shall be identified as follows:

1. Nameplates shall be provided for panel boards, control and instrumentation panels, starters, switches, and pushbutton stations. In addition to nameplates, control devices shall be equipped with standard collar-type legend plates.

2. Control devices within enclosures shall be identified as indicated. Identification shall be similar to the subparagraph above.

3. Toggle switches which control loads out of site of switch and multi-switch locations of more than 2 switches shall have suitable inscribed finish plates.

4. Equipment names and tag numbers shall be utilized on nameplates.

5. The Vendor shall furnish typewritten circuit directories of panel board; circuit directory shall accurately reflect the outlets connected to each circuit.

6. Terminal point on terminal blocks shall be labeled by identifiers attached to the terminal strip. Identifiers shall be pre-printed by the terminal manufacturer custom printed markers, hand lettered markers shall be acceptable.

END OF SECTION 26 05 00

SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes wires, cables and connectors for power, lighting, signal, control, and related systems rated 600 V and less.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by Underwriters Laboratories (UL) and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers complying with the Quality Assurance requirements are acceptable.

2.2 WIRES AND CABLES

A. General: Provide wire and cable suitable for the temperature, conditions, and location where installed.

B. Conductors: Provide solid conductors for power and lighting circuits No. 10 AWG and smaller. Provide stranded conductors for sizes No. 8 AWG and larger.

C. Conductor Material: Copper for all wires and cables. Aluminum conductors are not acceptable.

D. Insulation: Provide THHN/THWN insulation for all conductors No. 6 AWG and smaller. For No. 4 AWG and larger conductors provide XHHW-2 insulation. Type THHN insulation may be used for branch circuit and feeder sizes 100 amp and smaller in dry locations. Adjust conduit size as need to meet NEC fill requirements.

E. Color coding for phase identification:

1. 208/120-V Conductors:

a. Phase A: Black.

b. Phase B: Red.

c. Phase C: Blue.

d. Neutral: White.

e. Ground: Green.

2. 480/277-V Conductors:

a. Phase A: Brown.

b. Phase B: Orange.

c. Phase C: Yellow.

d. Neutral: Gray.

e. Ground: Green.

2.3 ANALOG SIGNAL CABLE

A. Plan Mark SC1: 18 AWG twisted, shielded pair, 600V insulation- General Cable catalog number 285150.

2.4 ETHERNET COMMUNICATION CABLE

A. Plan Mark EC1: Ethernet communication cable to be Category 6, 4-pair, 23AWG, Ethernet/IP compliant industrial ethernet cable, Belden DataTuff or equal.

2.5 DEVICENET COMMUNICATION CABLE:

A. Plan Mark: DN1: DeviceNet cable with construction and ratings fully compliant with ODVA specifications, manufactured by Belden.

2.6 MODBUS COMMUNICATION CABLE:

A. Plan Mark: MB1: Low capacitance twisted, shielded 24 AWG 2-pair. EIA RS-485, Belden 9842.

2.7 CONNECTORS FOR CONDUCTORS

A. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRES AND CABLES

A. General: Install electrical cables, wires, and connectors in compliance with NEC.

B. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant where necessary to keep pulling tension within manufacturer’s recommendations.

C. Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced. No joints or taps permitted in service or feeder circuits.

D. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.

3.2 FIELD QUALITY CONTROL

A. Prior to energizing, test wires and cables for electrical continuity and for short-circuits.

END OF SECTION 26 05 19

SECTION 26 29 13.13 - ACROSS-THE-LINE-MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes A.C. motor control devices rated 600 V and below that are not supplied as an integral part of a motor control center.

B. Related Sections include the following:

1. Section 26 05 00 – Electrical, General for general materials, installation methods, and labeling.

1.3 SUBMITTALS

A. Product data for products specified in this Section. Include dimensions, ratings, and data on features and components.

B. Maintenance Data: For products to include in the maintenance manuals specified in Division 1.

C. Load Current and Overload Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain similar motor-control devices through one source from a single manufacturer.

B. Comply with NFPA 70, UL, and NEMA.

C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms “Listed and Labeled”: As defined in the National Electrical Code, Article 100.

1.5 COORDINATION

A. Coordinate features of controllers and control devices with pilot devices and control circuits provided under Division 23, Division 40 through Division 46 Sections covering control systems.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Spare Fuses and Incandescent Indicating Lamps: Furnish 1 spare for every 5 installed units, but not less than 1 set of 3 of each kind.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Eaton

2. Allen-Bradley Co.; Industrial Control Group.

3. General Electric Co.; Electrical Distribution & Control Div.

4. Square D Co.

2.2 MANUAL MOTOR CONTROLLERS

A. Description: NEMA ICS 2, general purpose, Class A with toggle action and overload element.

2.3 MAGNETIC MOTOR CONTROLLERS

A. Description: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.

B. Control Circuit: 120 V. Provide control power transformer integral with controller where no other supply of 120 V control power to controller is indicated. Provide control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.

C. Combination Controller: Factory assembled with controller and arranged to disconnect switch with or without overcurrent protection as indicated.

1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by a nationally recognized testing laboratory.

D. Overload Relay: NEMA ICS 2, Class 10 tripping characteristics selected to protect motor against voltage unbalance and single phasing. Revise controller specifications to suit Project. Autotransformer Reduced-Voltage Controller: NEMA ICS 2, closed transition.

2.4 ENCLOSURES

A. Description: Flush or surface mounted cabinets as indicated. NEMA 250, Type 12, unless otherwise indicated to comply with environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.

2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

3. Hazardous Areas: NEMA 250, Type 7C.

2.5 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.

F. Current-Sensing, Phase-Failure Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

PART 3 - EXECUTION

3.1 APPLICATION

A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

C. Use fractional-horsepower manual controllers for single-phase motors, unless otherwise indicated.

D. Use manual controllers for 3-phase motors up to 5 hp not requiring automatic or remote control.

E. Pushbutton Stations: In covers of magnetic controllers for manually started motors where indicated, start contact connected in parallel with sealing auxiliary contact for low-voltage protection.

F. Hand-Off-Automatic Selector Switches: In covers of manual and magnetic controllers of motors started and stopped by automatic controls or interlocks with other equipment.

3.2 INSTALLATION

A. Install independently mounted motor-control devices according to manufacturer's written instructions.

B. Location: Locate controllers within sight of motors controlled, unless otherwise indicated.

C. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks.

D. Install freestanding equipment on concrete housekeeping bases conforming to Section 26 05 00 – Electrical, General.

E. Motor-Controller Fuses: Install indicated fuses in each fusible switch.

3.3 IDENTIFICATION

A. Identify motor control components and control wiring in accordance with Section 26 05 00 – Electrical, General.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between motor control devices in accordance to Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic control devices where available.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5, 7.6, and 7.16. Certify compliance with test parameters.

2. Remove and replace malfunctioning units with new units, and retest.

3.5 CONNECTIONS

A. Tighten connectors, terminals, bus joints, and mountings. Tighten field connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, comply with tightening torques specified in UL 486A and UL 486B.

3.6 FIELD QUALITY CONTROL

A. Testing: After installing motor controllers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NeTA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.

2. Remove and replace malfunctioning units with new units, and retest.

3.7 CLEANING

A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally using methods and materials as recommended by manufacturer.

END OF SECTION 26 29 13.13

SECTION 26 29 23 – VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes solid-state, PWM and VFD, VFCs for speed control of three-phase, induction motors. These VFCs are to be enclosed in freestanding NEMA 250, Type 12, unless otherwise indicated to comply with environmental conditions at installed location.

B. VFC vendor to provide VFC that will operate at installed altitude. Vendor shall verify altitude for derating.

1.2 SUBMITTALS

A. Product Data: For each type of VFC, provide dimensions; mounting arrangements; location for conduit entries; shipping and operating weights; and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.

B. The following shall be included in the bid package:

1. Description of equipment and tests included in bid to meet the indicated power quality requirements.

2. Nearest factory authorized service center meeting all points of 1.03A.

3. Qualification and name of engineering and technical persons responsible for support and warranty of this project.

C. The following shall be included in the submittal package and be approved by the engineer prior to any construction of the VFC system:

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.

b. Nameplate legends.

c. Short-circuit current ratings of integrated unit.

d. UL listing for series rating of overcurrent protective devices in combination controllers.

e. Features, characteristics, ratings, and factory settings of each motor-control unit.

2. Wiring Diagrams: Power, signal, and control wiring for VFC. Provide schematic wiring diagram for each type of VFC.

3. Detailed description of the filter equipment and sample graphs and data to meet IEEE 519-2014.

4. Carrier frequency information.

D. Qualification Data: For testing agency and manufacturer.

E. Field Test Reports: Written reports specified in Part 3.04D below.

F. Manufacturer's field service report.

G. Operation and Maintenance Data: For VFCs, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 26 05 00 – Electrical, General, include the following:

1. Routine maintenance requirements for VFCs and all installed components.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and 24 hour emergency maintenance and repairs.

B. Source Limitations: Obtain VFCs of a single type through one source from a single manufacturer.

C. The system shall be pre-integrated with the necessary harmonic mitigation equipment.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70, IEEE 519-2014, ANSI C37, and ANSI C57.

1.4 COORDINATION

A. Match features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.

B. Match features, accessories, and functions of each VFC and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load. See Division 40 sections for information on motor control sequence.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: To match existing parts and integration requirements, provide products by the following:

1. Allen Bradley; Rockwell Automation.

B. Contractor job site integration of reactors, harmonic filters, power components, etc. may be required. Start-up, harmonic testing and warranty support services must be supplied by the above or other qualified company approved by engineer. Allowable harmonic limits to be coordinated with Idaho Power Utilities.

2.2 VARIABLE FREQUENCY CONTROLLERS

A. Description: NEMA ICS 2, IGBT, PWM, VFD, VFC; listed and labeled as a complete unit and arranged to provide variable speed of a NEMA MG 1, Design B, 3-phase, induction motor by adjusting output voltage and frequency. Refer to Divisions 40 – 43 and 46 for additional information on motors controlled by VFCs.

B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

C. Output Rating: 3-phase; 6 to 120 Hz, with horsepower constant throughout speed range.

D. Unit Operating Requirements:

1. Input AC voltage tolerance of 480 V, plus or minus 10 percent.

2. Input frequency tolerance of 60 Hz, plus or minus 6 percent.

3. Output Rating: 3-phase; 6 to 66 Hz, with amperage equal or greater to motor nameplate amperage including altitude derating.

4. Minimum Inverter Efficiency: 96 percent at 60 Hz, full load.

5. Minimum Displacement Primary-Side Power Factor: 96 percent lagging.

6. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.

7. Starting Torque: Default to be 50% with adjustment to 120%.

8. Speed Regulation: Plus or minus 1 percent.

9. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.

E. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.

2. Maximum Speed: 80 to 100 percent of maximum rpm.

3. Acceleration: Adjustable from .01 to 3600 seconds.

4. Deceleration: Adjustable from .01 to 3600 seconds.

5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

F. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors.

2. Snubber networks to protect against malfunction due to system voltage transients.

3. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.

4. Filtering to prevent noise interference with other electronic equipment.

5. Motor Overload Relay: Adjustable.

6. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.

7. Instantaneous line-to-line and line-to-ground overcurrent trips.

8. Loss-of-phase protection.

9. Reverse-phase protection.

10. Short-circuit protection.

11. Motor overtemperature fault.

G. Automatic Reset and Restart: To attempt three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bi-directional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

H. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped. VFC to automatically re-start motor after outage.

I. Carrier Frequency Adjustment: Provide ability to manually adjust drive carrier frequency. VFCs 100HP and less shall provide carrier frequency adjustment capability from 1 to 10kHz. VFCs over 100HP shall include carrier frequency adjustment information recommended by the manufacturer.

J. Torque Boost: Automatically vary starting and continuous torque to at least 1.5 times the minimum torque to insure high-starting torque and increased torque at slow speeds.

K. Motor Temperature Compensation at Slow Speeds: Adjustable current fallback based on output frequency for temperature protection of self-cooled fan-ventilated motors at slow speeds.

L. Provide line and load side filtering to minimize total harmonic distortion.

M. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

N. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

O. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, and fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

P. Control Signal Interface: Provide VFC with the following:

1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
2. Pneumatic Input Signal Interface: 3 to 15 psig (20 to 104 kPa).

3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:

    a. 0 to 10-V dc.

    b. 0-20 or 4-20 mA.

    c. Potentiometer using up/down digital inputs.

    d. Fixed frequencies using digital inputs.

    e. RS485.

    f. Ethernet connectivity using Ethernet/IP or MODBUS protocol

    g. Keypad display for local hand operation.

    h. Remote start/stop input

4. Output Signal Interface:

    a. Provide two analog output signals (0/4-20 mA), which can be programmed for the following:

    b. Output frequency (Hz).

    c. Output current (load).

    d. DC-link voltage (VDC).

    e. Motor torque (percent).

    f. Motor speed (rpm).

    g. Set-point frequency (Hz).

5. Remote Indication Interface: Provide dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

    a. Motor running.

    b. Set-point speed reached.

    c. Fault and warning indication (overtemperature or overcurrent).

    d. PID high or low speed limits reached.

    e. Drive system is in remote.

Q. Provide bypass switch and contactor to allow manual bypass of the drive and across-the-line starting. Bypass shall be configured with three-contactors to isolate the VFC.

R. Integral Disconnecting Means: Provide HACR rated breaker.

2.3 ACCESSORIES

A. Devices shall be factory installed in motor control center.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Standard Displays:

1. Output frequency (Hz).

2. Set-point frequency (Hz).

3. Motor current (amperes).

4. DC-link voltage (VDC).

5. Motor torque (percent).

6. Motor speed (rpm).

7. Motor output voltage (V).

F. Historical Logging Information and Displays:

1. Real-time clock with current time and date.

2. Running log of total power versus time.

3. Total run time.

4. Fault log, maintaining last four faults with time and date stamp for each.

G. Current-Sensing, Phase-Failure Relays for Bypass Controller: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

H. Harmonic Mitigation: Complying with IEEE Standard 519-2014 shall be a requirement of this project. Harmonic filters, 18 pulse converter configurations, phase multiplication devices, or any other components required to mitigate harmonic voltage and current to IEEE Std. 519-2014 shall be an integral part of the VFC system. Designs which are not pre-integrated and factory wired as part of the UL label will not be acceptable.

1. Designs which cause voltage rise at the VFC terminals must document coordination with the total system variation to prevent nuisance tripping.

2. Designs which do not provide both true and displacement, measured at the VFC terminals, of at least 95% or better at full load are not acceptable. Designs that allow leading power factor at minimum loads are not acceptable.

I. Relevant data for VFC vendor calculations to meet IEEE Std. 519-2014 requirements are as follows:

1. The point of common coupling (PCC) shall be defined per 3.01.C below.

2. The calculated load current (I_L) shall be the total combined full load current of each ASD system supplied as part of this project or the total combined amperage of loads designated as “non-linear”.

3. The VFC vendor is responsible for determining the short circuit current (I_{SC}) available at the PCC.

2.4 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Select features of each VFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, drive, and load.

B. Select rating of controllers to suit motor controlled. The VFC vender shall certify that the supplied equipment is properly matched to the loads being fed.

C. The drive shall be capable of operating in compliance with IEEE 519-2014, with point of common coupling (PCC) defined as the point at which each individual device is connected to the electrical distribution system. Drive manufacturer shall provide harmonic calculations and on-site post installation harmonic testing with certified reports prior to final acceptance of installation. See 3.04D.

3.2 IDENTIFICATION

A. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

3. All tests necessary to prove compliance with IEEE Standard 519-2014.

B. Testing: Perform the following field quality-control testing:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pretesting and adjusting VFCs.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.

2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 sections.

C. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

A. Set field-adjustable switches.

3.7 CLEANING

A. Clean VFCs internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain VFCs.

END OF SECTION 26 29 23

SECTION 40 05 00 – PIPING, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide the piping systems indicated, complete and operable, in accordance with the Contract Documents.

B. The mechanical drawings define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are not pipe construction or fabrication drawings. Where pipe supports and spacings are indicated on the drawings and referenced to a standard detail, the Contractor shall use that detail. Where pipe supports are not indicated on the drawings, it is the Contractor's responsibility to develop the details necessary to design and construct all mechanical piping systems, to accommodate the specified equipment, and to provide all spacers, adapters, and connectors for a complete and functional system.

C. Piping system drawings are diagrammatic and are intended to show approximate location of equipment and piping. Dimensions given on the plans in figures take precedence over scaled dimensions. Verify dimensions, whether in figures or scaled, in the field. The Contractor shall be responsible for the installation of complete and workable systems whether completely detailed on the plans or not.

D. The Contractor shall ascertain locations of apparatus, fixtures, equipment, and piping in the field, and layout work accordingly. The Owner reserves the right to have minor changes in location of piping and equipment made up to the time of installation without additional cost.

1.2 REFERENCE STANDARDS

A. All mechanical work shall conform to latest edition of the International Mechanical Code.

B. Commercial Standards

1.	ASTM B 88	Hard Copper Tube
2.	ASME B 16.22	Copper Fittings
3.	ANSI/ASME B 1.20.1	Pipe Threads, General Purpose (inch)
4.	ANSI B 16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
5.	ANSI/AWWA C 207	Steel Pipe Flanges for Water Works Service; Sizes 4 in through 144 in.
6.	ANSI/AWWA C 606	Grooved and Shouldered Joints
7.	ANS/AWS D1.1	Structural Welding Code

8.	ASTM A 307	Specification for Carbon Steel Bolts and Studs, 6,000 psi Tensile
9.	ASTM A 325	Specification for High-Strength Bolts for Structural Steel Joints
10.	ASTM D 792	Test Methods for Specific Gravity and Density of Plastics by Displacement
11.	ASTM D 2000	Classification System for Rubber Products in Automotive Applications

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Submittal Procedures.

B. At a minimum, the following information shall be submitted for review and approval prior to ordering piping materials.

1. Manufacturer specifications for each pipe type, including all references to acceptable standards as referenced in each individual pipe section.

2. Indicate fittings and manufacturer recommended connections.

3. Pressure ratings.

4. Lining and coating type, thickness, and application procedures.

5. Fitting types and manufacturer recommended applications and acceptable installation procedures and tolerances.

C. Fabrication Drawings: The Contractor shall submit piping fabrication drawings show in all fittings, pipe material, supports, and all dimensions for proper installation of piping system as illustrated on mechanical drawings.

1.4 QUALITY CONTROL

A. Certifications: Necessary certificates, test reports, and affidavits of compliance shall be obtained by the Contractor. A certification from the pipe fabricator that each pipe will be manufactured subject to the fabricators or a recognized quality control program. An outline of the program shall be submitted to the Engineer for review prior to the manufacture of any pipe.

B. Where the assistance of a manufacturer's service representative is advisable, in order to obtain recommended pipe joints, supports, or special connections, the Contractor shall furnish such assistance at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. Extent of Work: Pipes, fittings, and appurtenances shall be provided in accordance with the requirements of the applicable sections of Divisions 31 and 40 and as indicated. Materials in contact with potable water shall be listed as compliant with NSF Standard 61.

B. Pipe Supports: Pipes shall be adequately supported, restrained, and anchored as indicated by the Installation Contractor.

C. Lining: Application, thickness, and curing of pipe lining shall be in accordance with the applicable sections of Division 40 unless otherwise indicated. Fittings and couplings shall be lined with the same material required for the pipeline in which the fittings and couplings are installed.

D. Coating: Application, thickness, and curing of pipe coating shall be in accordance with the applicable sections of Division unless otherwise indicated. Pipes above ground or in structures shall be field-coated as indicated by the Installation Contractor.

E. Pressure Rating: Piping systems shall be designed for the maximum expected pressure as indicated on the drawings and individual pipe specifications.

F. Grooved Piping Systems: Piping systems with grooved joints and fittings may be provided in lieu of flanged, joint systems for exposed ductile iron piping. To assure uniform and compatible piping components, all grooved fittings, couplings, and valves shall be from the same manufacturer. The Contractor shall make the coupling manufacturer responsible for the selection of the correct style of coupling and gasket for each individual location.

G. Tests: Except where otherwise indicated, materials used in the manufacture of the pipe shall be tested in accordance with the applicable specifications and standards. Welds shall be tested as indicated. The Contractor shall be responsible for performing material tests.

H. Welding Requirements: Qualification of welding procedures used to fabricate pipe shall be in accordance with the provisions of ANSI/AWS D1.1 - Structural Welding Code. Welding procedures shall be submitted for the Engineer's review.

I. Welder Qualifications: Welding shall be done by skilled welders and welding operators who have adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 or the ASME Boiler and Pressure Vessel Code, Section 9, by an independent local, approved testing agency not more than six (6) months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the Work shall be used in qualification tests. Qualification testing of welders and materials used during testing is part of the Work.

J. Joining Dissimilar Materials: Di-electric unions shall be used at the junction of two dissimilar metallic pipes as required by the local adopted plumbing code. It shall be the responsibility of the Contractor to identify any such conditions whether indicated in the Project Drawings or not. Di-electric unions shall be lead free, appropriate for the two dissimilar metals and be stamped with an approved UPC seal.

2.2 PIPE FLANGES

A. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise indicated. Attachment of the flanges to the pipe shall conform to the applicable requirements of AWWA C207. Flange faces shall be perpendicular to the axis of the adjoining pipe. Flanges for miscellaneous small diameter pipes shall be in accordance with the standards indicated for these pipes. Flanges shall have pressure ranges corresponding to the following:

1. 150 PSI or less: Flanges shall conform to either AWWA C207 - Steel Pipe Flanges for Waterworks Service-Sizes 4 In. Through 144 In., Class D, or ASME B16.5 - Pipe Flanges and Flanged Fittings, 150 Ib class.

2. 150 to 275 PSI: Flanges shall conform to either AWWA C207 Class E or Class F, or ASME B16.5 150 Ib class.

3. 275 to 700 PSI: Flanges shall conform to ASME B16.5, 300 Ib class.

4. AWWA flanges shall not be exposed to test pressures greater than 125 percent of rated capacity. For higher test pressures, the next higher rated AWWA flange or an ANSI-rated flange shall be selected.

B. Blind Flanges: Blind flanges shall be in accordance with AWWA C207, or as indicated for miscellaneous small pipes. Blind flanges for pipe sizes 12-inches and greater shall be provided with lifting eyes in the form of welded or screwed eye bolts.

C. Flange Coating: Machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.

D. Flange Bolts: Bolts and nuts shall conform the requirements of the applicable specifications and be provided and installed by the Installation Contractor. All-thread studs shall be used on all valve flange connections, where space restrictions preclude the use of regular bolts.

E. Insulating Flanges: Insulated flanges shall have bolt holes 1/4-inch diameter greater than the bolt diameter.

2.3 INSULATING CONNECTIONS

A. Insulating Flange Sets: Unless otherwise specified, insulating flange sets shall be provided at all locations where dissimilar metals are connected. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers, and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2 inch or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2 inch, insulating sleeves and washers shall be two (2) pieces and shall be made of polyethylene or phenolic material. Steel washers shall be in accordance with ASTM A 325 - Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength. Insulating gaskets shall be full-face.

1. Insulating Flange Manufacturers, or equal

a. JM Red Devil, Type E

b. Maloney Pipeline Products Co., Houston

c. PSI Products, Inc., (Frost Engineering Service Co., Costa Mesa, California).

B. Threaded insulating bushings, unions, or couplings, as appropriate, shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved. Threaded insulating connections shall be of nylon, teflon, polycarbonate, polyethylene, or other non-conductive materials, and shall have ratings and properties to suit the service and loading conditions.

C. Insulating Sleeve Couplings: Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a sleeve of an insulating compound material compatible with the fluid service in order to obtain insulation of all coupling metal parts from the pipe.

2.4 SOLID COPPER PIPE CONNECTIONS

A. Solid Filler Materials: ASTM B 32 lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Brazing Filler Metals: AWS AS.B, BCUP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated, and AWS AS.B, Bag 1, silver alloy for refrigerant piping, unless otherwise indicated.

2.5 MECHANICAL-TYPE COUPLINGS (GROOVED OR BANDED PIPE)

A. Cast mechanical-type couplings shall be provided where indicated. The couplings shall conform to the requirements of AWWA C606 - Grooved and Shouldered Joints. Bolts and nuts shall conform to the requirements of the applicable specifications and provided and installed by the Installation Contractor. Mechanical-type couplings shall be bonded. The Contractor shall have the coupling manufacturer's service representative verify the correct choice and application of couplings and gaskets, and the workmanship, to assure a correct installation. To assure uniform and compatible piping components, grooved fittings, couplings, and valves shall be furnished by the same manufacturer as the coupling. Grooving tools shall be of the same manufacturer as the grooved components.

B. Gaskets for mechanical-type couplings shall be compatible with the piping service and fluid utilized, in accordance with the coupling manufacturer's recommendations.

C. The wall thickness of grooved piping shall conform to the coupling manufacturer’s recommendations to suit the highest expected pressure.

D. To avoid stress on equipment; equipment connections with mechanical-type couplings shall have rigid-grooved couplings or flexible type coupling with harness in sizes where rigid couplings are not available, unless thrust restraint is provided by other means.

E. Manufacturers of couplings for steel pipe, or equal

1. Gustin-Bacon (Aeroquip Corp.) (banded or grooved)

2. Victaulic Style 41 or 44 (banded, flexible)

3. Victaulic Style 77 (grooved, flexible)

4. Victaulic Style 07 or HP-70 (grooved, rigid)

F. Manufacturers of ductile iron pipe couplings, or equal

1. Gustin-Bacon, (Aeroquip Corp.)

2. Victaulic Style 31 (flexible or rigid grooving)

Note: Ductile iron pipe couplings shall be furnished with flush seal gaskets.

2.6 SLEEVE-TYPE COUPLINGS

A. Sleeve-type couplings shall be provided where indicated. The Contractor will not be allowed to substitute a sleeve-split coupling for the sleeve coupling unless approved by the Engineer.

B. Construction: Sleeve couplings shall be in accordance with AWWA C219 - Standard for Bolted Sleeve- Type Couplings for Plain-End Pipe. Couplings shall be steel with steel bolts, without pipe stop. Couplings shall be of sizes to fit the pipe and fittings indicated.

1. The middle ring shall be not less than 1/4-inch thick or at least the same wall thickness as the pipe to which the coupling is connected. If the strength of the middle ring material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe. Buried sleeve-type couplings shall be epoxy-coated at the factory as indicated.

2. The coupling shall be either 5- or 7- inches long for sizes up to and including 30-inches and 10-inches long for sizes greater than 30-inches, for standard steel couplings, and 16-inches long for long-sleeve couplings.

3. The followers shall be single-piece contoured mill sections welded and cold-expanded as required for the middle rings, and of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket.

4. Bolts and nuts shall conform to the requirements of the applicable specifications and be provided and installed by the Installation Contractor.

C. Pipe Preparation: Where indicated, the ends of the pipe shall be prepared for flexible steel couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12-inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof- test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.

2.7 GASKETS

A. Gaskets for wastewater and sewerage applications shall be Buna N, Grade 60, or equivalent suitable elastomer.

B. Gaskets shall be full-faced type, with material and thickness in accordance with AWWA C207. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted, unless otherwise indicated. The rubber in the gasket shall meet the following specifications:

Color	Jet Black
Surface	Non-Blooming
Durometer Hardness	74 plus and minus 5
Tensile Strength	1000 psi Minimum
Elongation	175 percent Minimum
Temperature	700 Deg. F
pH	1 - 11

C. The gaskets shall be immune to attack by impurities normally found in water or wastewater. All gaskets shall meet the requirements of ASTM D 2000 - Classification System for Rubber Products in Automotive Applications, AA709Z, meeting Suffix B13 Grade 3, except as noted above. Where sleeve couplings are used in water containing chloramines or other fluids which attack rubber materials, gasket material shall be compatible with the piping service and fluid utilized.

D. Gaskets for flanged joints used in chemicals, air, solvents, hydrocarbons, steam, chlorine and other fluids shall be made of materials compatible with the service, pressure, and temperature.

2.8 FLANGE COUPLING ADAPTERS

A. Flange coupling adapters shall only be used where shown on the drawings or accepted by the Engineer. Otherwise, the Contractor shall only use dismantling joints if additional flexibility is required for the pipe installation.

B. Flange coupling adapters shall be designed for a water working pressure not less than the design pressure of the pipe on which they are to be installed and shall be equipped with suitable rubber gaskets.

C. Couplings shall be Romac RFCA, or equal. Thrust ties shall be provided for all flexible couplings to sustain the force developed by the test pressure. Anchor studs will not be acceptable.

2.9 FLEXIBLE CONNECTORS

A. Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, pumps and other vibrating equipment, and where indicated. Flexible

connectors for service temperatures up to 180 degrees F shall be flanged reinforced neoprene or butyl single-arched spools, rated for a working pressure of 40 to 150 psi, or reinforced flanged duck and rubber, as best suited for the application. Flexible connectors for service temperatures above 180 degrees F shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for minimum 150 psi working pressure, unless otherwise indicated. The connectors shall be a minimum of 9-inches long, face-to-face flanges, unless otherwise indicated. The final material selection shall be approved by the manufacturer. The Contractor shall submit manufacturer's shop drawings and calculations.

B. Grooved pipe flexible mechanical couplings may be used in lieu of the above paragraph on pumps only. The Contractor shall submit manufacturer's shop drawings and calculations.

2.10 MISCELLANEOUS

A. Expansion Joints: Piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement without exertion of undue forces to equipment or structures. This may be accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints. Expansion joints shall be flanged end, stainless steel, Monel, rubber, or other materials best suited for each individual service. The Contractor shall submit detailed calculations and manufacturer's Shop Drawings of all proposed expansion joints, piping layouts, and anchors and guides, including information on materials, temperature, and pressure ratings.

B. Piping Connection to Equipment: Where piping connects to mechanical equipment such as pumps, compressors, and blowers, the piping shall be brought to the equipment connection aligned and perpendicular to the axis of the flange or fitting for which the piping is to be connected to the equipment. The piping shall not impose excessive stress to the equipment connection so much to cause misalignment of the equipment. The Contractor shall assign the responsibility to the equipment manufacturer to review the piping connection to the equipment and submit any modifications to the Engineer for review.

C. Restrained Joints: Sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means. Harnesses shall be designed by the pipe manufacturer in accordance with Manual M11, or as indicated. Harness sets shall be designed for the maximum test pressure of the pipe in which they are installed. Where harness sets are installed near the suction and discharge of the pump. Harness bolts shall have zero elongation to prevent misalignment of the pump imparted by the thrust within the piping system. Thrust restraints systems shall be manufactured by Victaulic, “Depend-O-Lok”; Dresser, “Style 38”; Ford Meter Box Co., Inc., “Style FC1 or FC3”; and Smith-Blair, “Style 411.”

D. Pipe Threads: Pipe threads shall be in accordance with ANSI/ASME B1.20.1 - Pipe Threads, General Purpose (inch), and be made up with Teflon tape unless otherwise indicated.

E. Air and Gas Traps: Air and gas pipes shall slope to low points and be provided with drip legs, shut-off valves, strainers, and traps. The traps shall be piped to the nearest drain. Air and gas traps shall be not less than 150 lb iron body float type with copper or stainless steel float. Bracket, lever, and pins shall be of stainless steel. Drain traps shall have threaded connections acceptable manufacturers include Armstrong International, Inc. and Spirax Sarco, Inc.

2.11 COUPLINGS

A. Flexible Pipe Couplings – Smith Blair OMNI 441 coupling system or approved equal. Couplings shall be lined and coated with a minimum thickness of 0.012" fusion-bonded epoxy or approved equal. Coating must comply with ASTM C213 and AWWA C550.

2.12 DISMANTLING JOINTS

A. Dismantling joints shall be Romac Style DJ400, Smith Blair Model 975 or approved equal. Dismantling joints shall be coated with fusion bonded epoxy per AWWA C213. Provide high strength stainless steel bolts, nuts and tie rods. Use anti seize lubricant when assembling all stainless steel hardware.

2.13 TAPPING SADDLES

A. Tapping saddles shall have a ductile iron body meeting ASTM A536, Grade 65-45-12. Gasket shall be Nitrile Butadiene Rubber (NBR) for water and sewer service. Saddles shall have two, 2" straps constructed of Type 304 stainless steel with GMAW and GTAW welds. Stainless steel shall be passivated for corrosion resistance. Casting shall be coated with fusion bonded black nylon, 10 – 12 mils thick, with a dielectric strength of 1,000 v/mil. Threads as required for installation of instrumentation.

B. Bolts, nuts and washers shall be Type 304 (18-8) heavy gauge stainless steel.

C. Saddles shall comply with AWWA C800 and shall have a pressure rating of 350 psi for pipe sizes up to 24 inch.

D. Provide Romac 202 service saddles or equivalent.

2.14 THRUST BLOCKS

A. Concrete to have a minimum compressive strength of 2,500 psi at 7 days. Place in accordance with plan details.

2.15 MECHANICAL RESTRAINT

A. Type: Standard mechanical joint restraint gland, restraint devices for MJ fittings and appurtenances to conform to ANSI/AWWA C111 or ANSI/AWWA C153.

B. Product: EBAA Iron Series 2000 PV (for PVC Pipe) or EBAA Iron Series 1100 Megalug (for DIP) or approved equal, and to meet requirements of ASTM F1674.

C. Application: Approved for above ground installation and below ground where specifically specified on the Plans. Also, mechanical restraint shall be installed in locations where the pipeline must be used immediately as a temporary restraint while thrust blocks cure.

D. Pipe joints shall be restrained 30 ft. or a minimum of two pipe joints (whichever is longer) upstream and downstream of a mechanically restrained fitting.

2.16 INTERNALLY RESTRAINED PRESSURE PIPE

A. Internally restrained PVC Pressure Pipe shall conform to ANSI/AWWA C900, FM 1612 for 4" to 12" inside diameter pipe and ANSI/AWWA C905 for 14" to 24" inside diameter pipe. Pipe Compound shall conform to ASTM D1784 Cells Class 12454. Integral bell joints shall conform to ASTM D3139. All internally restrained pipe shall be ANSI/NSFF Standard 61 FM approved and certified and shall be provided in full pipe lengths.

B. Pipe shall be rated for pressures indicated or required within the Contract Documents.

C. Internally reinforced pipe shall consist of a molded metal casing within the bell end of the pipe. The casing will be equipped with uni-directional serrated grip rings. The casing and grip rings will be constructed of ductile iron and coated with a corrosion protection system.

D. Internally reinforced pipe lengths shall be labeled to identify that it is equipped with an internal restraining system.

E. Approved products include PVC pipe manufacturers who integrate the BullDog™ Integral Joint Restraint System, including Diamond Plastics Diamond Lok-21®, JM Eagle Eagle LOC 900™.

F. Application or use of the internally restrained pipe is approved for below ground installation where specifically specified on the Plans or in applications where pipelines must be used immediately or where use of alternative restraining methods or prohibitive.

G. Pipe joints shall be restrained 30 ft. or a minimum of two pipe joints (whichever is longer) upstream and downstream of a mechanically restrained fitting.

2.17 FOAM CONTROL SPRAY NOZZLES

A. Foam control spray nozzles shall be installed at the primary and secondary clarifiers as indicated on the drawings and shall be easily flushed. Provide split eye connector for mounting on spray header.

B. Nozzle discharge shall be between 3.0 and 3.5 gallons per minute with an operating pressure of 10 psig. Spray shall be flat, heavy sheet, fan-shaped with uniform distribution and a spray angle of 105 degrees.

C. Nozzle shall include a replaceable spray deflector insert able to rotate away from the orifice opening; nozzle shall be mechanically locked in place and counterweighted.

D. Pressure rating: 200 psi.

E. Spray nozzles shall be of bronze construction with an orifice diameter not less than ¼ inch and a neoprene spray deflector.

F. Coat dissimilar metals with bituminous coating when installing the foam control nozzles to prevent galvanic corrosion or provide other type of insulating connection.

G. Acceptable Manufacturers: Spraying Systems Co., Model No. 22561 or Approved Equal

2.18 BOLTS AND ANCHORS

A. Bolts and anchors for fittings, pipe couplings, valves, piping and accessories shall comply with the requirements of the applicable specifications.

PART 3 - EXECUTION

3.1 GENERAL

A. Piping, fittings, and appurtenances shall be installed in accordance with the requirements of applicable sections of Division 31 and Division 40. Proprietary manufactured couplings shall be installed in accordance with the coupling manufacturer's recommendation.

B. Care shall be taken to ensure that piping flanges, mechanical-type couplings, sleeve-type couplings, flexible connectors, and expansion joints are property installed as follows:

1. Gasket surfaces shall be carefully cleaned and inspected prior to making up the connection. Each gasket shall be centered properly on the contact surfaces.

2. Connections shall be installed to prevent inducing stress to the piping system or the equipment to which the piping is connected. Contact surfaces for flanges, couplings, and piping ends shall be aligned parallel, concentric, and square to each axis at the piping connections.

3. Bolts shall be initially hand-tightened with the piping connections properly aligned. Bolts shall be tightened with a torque wrench in a staggered sequence to the AISC recommended torque for the bolt material.

4. Groove ends shall be clean and free from indentations, projections, and roll marks in the area from the pipe end to the groove.

5. After installation, joints shall meet the indicated leakage rate. Flanges shall not be deformed nor cracked.

C. Soldered Pipe Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook", using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS ASB.

E. Lined Piping Systems: The lining manufacturer shall take full responsibility for the complete, final product and its application. Pipe ends and joints of lined pipes at screwed flanges shall be epoxy-coated to assure continuous protection.

F. Core Drilling: Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiograph of concrete construction to avoid damage to embedded raceways and reinforcing bars.

G. Cleanup: After completion of the Work, cuttings, joining and wrapping materials, and other scattered debris shall be removed from the Site. The entire piping system shall be handed over in a clean and functional condition.

H. Protective Coating: All pipes shall be coated as required by the Installation Contractor.

3.2 MATERIAL DELIVERY, STORAGE, AND PROTECTION

A. Piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground for protection against oxidation caused by ground contact. Defective or damaged materials shall be replaced with new materials.

END OF SECTION 40 05 00

SECTION 40 05 23 - STAINLESS STEEL PIPE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide stainless steel pipe and appurtenances, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A.	ASTM A 312	Seamless and Welded Austenitic Stainless Steel Pipe
B.	ASTM A 409	Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service
C.	ASTM A 778	Welded, Unannealed Austenitic Stainless Steel Tubular Products
D.	ANSI/ASME B 31.1	Power Piping, and ANSI/AWWA C606.
E.	ASTM A 967	Passivation of Stainless Steel Pipe.

PART 2 - PRODUCTS

2.1 PIPE MATERIAL

A. Unless otherwise indicated, stainless steel pipe shall be in accordance with ASTM A 312, Type 304 or 316, seamless with screwed fittings for sizes up to and including 2-1/2 inches. Stainless steel pipe 3 inches in diameter and larger shall be in accordance with ASTM A 409, Type 304 or 316 with welded or flanged fittings.

B. All fittings shall conform to the following schedule:

Fitting Type	Material	Standard
Threaded	Forged stainless steel per ANSI/ASME B 16.11	Type 304 & 316
Socket Welded	Forged stainless steel, ANSI/ASME B 16.11	Type 304 & 316
Butt-Welded	Wrought stainless steel, ASTM A 403, and ANSI/ASME B 16.9	Type 304 &316
Flanged	Forged Stainless Steel, ANSI/ASME B 16.5	Type 304 & 316

C. Flanged Joints

1. Bolts shall be ASTM A193, B8M Class 1 Stainless Steel.
2. Nuts shall be ASTM A194 Grade 8M Stainless Steel.

3. Washers shall be 316 Stainless Steel.

4. Gaskets shall be Viton.

D. Surface Treatment

1. All Stainless Steel pipe shall be surface treated and tested to meet ASTM A 967 Passivation Standard.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Stainless steel pipe shall be installed in a neat and workmanlike manner, properly aligned and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary all piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points. Installation shall be acceptable to the Engineer.

B. Valves and Unions: Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection.

C. Preparation. Prior to installation, each pipe length shall be carefully inspected, be flushed clean of any debris or dust, and be straightened if not true. Ends of threaded pipes shall be reamed and filed smooth. Pipe fittings shall be equally cleaned before assembly.

3.2 PIPE JOINTS

A. Threaded Joints: Pipe threads shall conform to ANSI/ASME B 1.20.1 - Pipe Threads, General Purpose (inch), and shall be full and cleanly cut with sharp dies. Not more than three threads shall remain exposed after installation.

B. Welded Joints: Welding shall be done by skilled and qualified welders.

1. Field welding shall be minimized to the greatest extent possible by use of couplings and prefabrication of pipe systems at the factory. Pipe butt welds may be performed at the Site, providing the butt welds are performed only with an inert gas shielded process and that other indicated welding requirements are followed rigidly.

2. Residue, oxide, and heat stain shall be removed from any type of field weld and the affected areas adjacent by the use of stainless steel wire brushes, followed by cleaning with an agent such as Eutectic Company's "Euclean" or equal, followed by complete removal of the agent.

3.3 INSPECTION AND FIELD TESTING

A. Inspection: The finished installation shall be carefully inspected for proper supports, anchoring, interferences, and damage to pipe, fittings, and coating. Damage shall be repaired to the satisfaction of the Engineer.

END OF SECTION 40 05 23

SECTION 40 05 51 – VALVES, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall provide valves, actuators, and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all valves and valve actuators pertaining to this work as outlined in the Contract Documents. Valves and actuators in particular locations may require a combination of units, sensors, and controls indicated in other sections of the Specifications.

C. Where a valve is to be supported by means other than the piping to which it is attached, the Vendor shall obtain from the valve manufacturer a design for support and foundation that satisfies the criteria in Section 43 05 01 – Equipment General Provisions. The design, including drawings and calculations sealed by an Engineer, shall be submitted with the Shop Drawings. When the design is approved, the support shall be provided.

D. Unit Responsibility: A single manufacturer shall be made responsible for coordination of design, assembly, testing, and furnishing of each valve; however, the Vendor shall be responsible to the Owner for compliance with the requirements of each valve section. Unless indicated otherwise, the responsible manufacturer shall be the manufacturer of the valve.

E. Single Manufacturer: Where two or more valves of the same type and size are required, the valves shall be furnished by the same manufacturer.

1.2 REFERENCE STANDARDS

A.	ANSI B1.20.1	Pipe Threads, General Purpose
B.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
C.	ANSI B16.5	Pipe Flanges and Flanged Fittings
D.	ANSI B16.18	Cast Copper Alloy Solder Joint Pressure Fittings Class 25, 125, 250 and 800
E.	AWWA C111	Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
F.	AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 through 144 IN
G.	NEMA	Motors and Generators

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 30 00 – Vendor Submittals.

B. Shop Drawings: Shop Drawings shall contain the following information:

1. Valve name, size, Cv factor, pressure rating, identification number (if any), and specification section number.

2. Complete information on valve actuator, including size, manufacturer, number, limit switches, and mounting.

3. Cavitation limits for control valves.

4. Assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, handwheels, position indicators, limit switches, integral control systems, needle valves, and control systems.

5. Data in accordance with Section 40 05 93 - Common Motor Requirements for Process Equipment for electric motor-actuated valves.

6. Complete wiring diagrams and control system schematics.

7. Valve Labeling: A schedule of valves to be furnished with stainless steel tags, indicating in each case the valve location and the proposed wording for the label.

8. Certification that products being used under meet requirements of standards referenced.

C. Operation and Maintenance Data: Provide in accordance with Section 01 78 23 – Operations Maintenance Data.

D. Spare Parts List: A Spare Parts List shall contain the required information for each valve assembly, where indicated.

E. Factory Test Data: Where indicated, signed, dated, and certified factory test data for each valve requiring certification shall be submitted before shipment of the valve. The data shall also include certification of quality and test results for factory-applied coatings.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Valve manufacturers shall have a successful record of not less than five (5) years in the manufacture of the valves indicated.

B. Valve Testing: As a minimum, unless otherwise indicated or recommended by the reference Standards, valves 3-inches in diameter and smaller shall be tested in accordance with manufacturer's standard, larger valves shall be factory tested as follows:

1. Hydrostatic Testing: Valve bodies shall be subjected to internal hydrostatic pressure equivalent to twice the water rated pressure of the valve. Metallic valves rating pressures shall be at 100 degrees F and plastic valves shall be at 73-degrees, higher temperature according to type of material. During the hydrostatic test, there shall be no leakage through the valve body, end joints, or shaft seals, nor shall any part of the valve be permanently deformed. The duration shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes.

2. Seat Testing: Valves shall be tested for leaks in the closed position with the pressure differential across the seat equal to the water rated pressure of the valve. The duration of test shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes. Leakage past the closed valve shall not exceed 1 fluid ounce per hour per inch diameter for metal seated valves and drop-tight for resilient seated valves.

3. Performance Testing: Valves shall be shop operated from fully closed to fully open position and reverse under no-flow conditions in order to demonstrate the valve assembly operates properly.

C. Certification: Prior to shipment, the Vendor shall submit for valves over 12- inches in size, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, or ASTM.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Valves shall be new and of current manufacture. Shut-off valves 6-inches and larger shall have actuators with position indicators. Gate valves 18-inches and larger or where chain wheel is required, shall be furnished with spur gear and hand wheel. Buried valves shall be provided with valve boxes and covers containing position indicators and valve extensions. Manual shut-off valves mounted higher than 7-feet above working level shall be provided with chain actuators.

B. Protective Coating: The exterior surfaces of all valves and the wet interior surfaces of ferrous valves of sizes 4-inches and larger shall be coated in accordance with manufacturer’s written instructions. The valve manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant prior to shipment. Flange faces of valves shall not be epoxy coated.

C. Valve Labeling: Except when such requirement is waived by the Engineer in writing, a label shall be provided on shut-off valves and control valves except for hose bibbs. The label shall be of 1/16-inch plastic or stainless steel, minimum 2-inches by 4-inches in size and shall be permanently attached to the valve or on the wall adjacent to the valve as directed by the Engineer.

2.2 MATERIALS

A. Materials shall be suitable for the intended application. Materials in contact with potable water shall be listed as compliant with NSF Standard 61. Materials not indicated shall be high-grade standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended. Unless otherwise indicated, valve and actuator bodies shall conform to the following requirements:

1. Cast Iron: Close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

2. Ductile Iron: ASTM A 536 - Ductile Iron Castings, or to ASTM A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

3. Steel: ASTM A 216 - Steel Castings, Carbon Suitable for Fusion Welding for High- Temperature Service, or to ASTM A 515 - Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service.

4. Bronze: ASTM B 62 - Composition Bronze or Ounce Metal Castings, and valve stems not subject to dezincification shall conform to ASTM B 584 - Copper Alloy Sand Castings for General Applications.

5. Stainless Steel: Stainless steel valve and operator bodies and trim shall conform to ASTM A 351 - Steel Castings, Austenitic, for High-Temperature Service, Grade CF8M, or shall be Type 316 stainless steel.

6. PVC: Polyvinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 12454.

7. CPVC: Chlorinated Polyvinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 23447.

2.3 VALVE CONSTRUCTION

A. Bodies: Valve bodies shall be cast, molded (in the case of plastic valves), forged, or welded of the materials indicated, with smooth interior passages. Wall thicknesses shall be uniform in agreement with the applicable standards for each type of valve, without casting defects, pinholes, or other defects that could weaken the body. Welds on welded bodies shall be done by certified welders and shall be ground smooth. Valve ends shall be as indicated and be rated for the maximum temperature and pressure to which the valve will be subjected.

B. Valve End Connections: Unless otherwise indicated, valves 2-1/2 inches diameter and smaller may be provided with threaded end connections. Valves 3-inches and larger shall have flanged end connections.

C. Bonnets: Valve bonnets shall be clamped, screwed, or flanged to the body and shall be of the same material, temperature, and pressure rating as the body. The bonnets shall have provision for the stem seal with the necessary glands, packing nuts, or yokes.

D. Stems: Valve stems shall be of the materials indicated, or, if not indicated, of the best commercial material for the specific service, with adjustable stem packing, O-rings, Chevron V-type packing, or other suitable seal. Where subject to dezincification, bronze valve stems shall conform to ASTM B 62, containing not more than 5 percent of zinc or more than 2 percent of aluminum, with a minimum tensile strength of 30,000 psi, a minimum yield strength of 14,000 psi, and an elongation of at least 10 percent in 2 inches.

E. Stem Guides: Stem guides shall be provided per the manufacturer's recommendations. Submerged stem guides shall be 304 stainless steel.

F. Internal Parts: Internal parts and valve trim shall be as indicated for each individual valve. Where not indicated, valve trim shall be of Type 316 stainless steel or other best suited material.

G. Nuts and Bolts: Nuts and bolts on valve flanges and supports shall be 316 stainless steel. Use anti-seize lubricant when assembling stainless steel hardware.

2.4 VALVE ACCESSORIES

A. Valves shall be furnished complete with the accessories required to provide a functional system.

2.5 SPARE PARTS

A. The Vendor shall furnish the required spare parts suitably packaged and labeled with the valve name, location, and identification number. The Vendor shall also furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve. Spare parts are intended for use by the Owner, after expiration of the correction of defects period.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation, inspect interconnecting piping and end connections to assure compatibility.

B. Prior to installation, inspect and verify condition of valve and appurtenances. Installation constitutes installer's acceptance of product condition for satisfactory installation.

C. Assure exposed piping is sufficiently supported to bear weight of valve when it is installed.

3.2 VALVE INSTALLATION

A. Valves, actuating units, stem extensions, and accessories shall be installed in accordance with the manufacturer's written instructions and as indicated. Valves shall be firmly supported to avoid undue stresses on the pipe.

B. Access: Valves shall be installed with easy access for actuation, removal, and maintenance and to avoid interference between valve actuators and structural members, handrails, or other equipment.

C. Valve Accessories: Where combinations of valves, sensors, switches, and controls are indicated, the Installation Contractor shall properly assemble and install such items so that systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on Shop Drawing submittals.

END OF SECTION 40 05 51

SECTION 40 05 57 – ACTUATORS FOR PROCESS VALVES AND GATES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall furnish and place into satisfactory operating condition all valve actuators and appurtenances, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all valves and gates, except where otherwise indicated in the Contract Documents. This Section includes manual operators and motorized valve operators, and mechanical, gear type limit switches.

C. Unit Responsibility: A single manufacturer shall be responsible for furnishing and coordinating design, assembly, testing, and installation of each type of valve and gate.

D. Single Manufacturer: Where two or more valve or gate actuators of the same type or size are required, the actuators shall all be produced by the same Manufacturer.

1.2 REFERENCE STANDARDS

A. Unless otherwise indicated and where applicable, all actuators shall be in accordance with ANSI/AWWA C540 - AWWA Standard for Power-Actuating Devices for Valves and Sluice Gates.

B. National Electrical Manufacturer’s Association (NEMA).

1.3 SUBMITTALS

A. Submittals shall be furnished in accordance with Section 01 30 00 – Vendor Submittals and Section 40 05 51 - Valves, General.

B. Shop Drawings: Shop Drawings of all actuators shall be submitted together with the valve and gate submittals as a complete package.

C. Motorized valve submittals shall include the following:

1. Installation list of similar municipal applications with contacts and phone numbers to verify experience.

2. Shop drawings and product data.

3. Motor, gear type and design information.

4. Design Data shall include:

a. Operating calculations for max break and max dynamic torques and minimum safety factor at which degree of valve opening and at break.

b. Submit data and calculations to substantiate operating time.

c. Submit proposed operator configuration and dimensions for each valve.

5. Wiring Schematics.

6. Manufacturer's published installation instructions.

7. Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 – Operation and Maintenance Data.

8. Warranty.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. The motorized operators offered for this project shall have a minimum of 5 years of commercial use in municipal wastewater installations of a similar scope and use. New and prototype hardware/software will not be accepted.

2. Submit evidence of satisfactory operation of the proposed product in at least five separate facilities in accordance with the following requirements. Include contact names and phone numbers.

B. Warranty:

1. Provide 2-year warranty for all motorized valves. Warranty shall cover site visits, labor, shipping, repair and replacement of valves and operators at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. All valve and gate actuators shall comply with the requirements of Section 40 05 51 – Valves, General.

B. Unless otherwise indicated, all shut-off and throttling valves, and externally actuated valves and gates, shall be provided with manual or power actuators. The Vendor shall furnish all actuators complete and operable with appurtenances, as applicable. All actuators shall be capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering. All wires of motor-driven actuators shall be identified by unique numbers.

C. Materials: All actuators shall be current models of the best commercial quality materials and liberally-sized for the maximum expected torque. All materials shall be suitable for the environment in which the valve or gate is to be installed.

D. Mounting: All actuators shall be securely mounted by means of brackets or hardware specially designed and sized for this purpose and of ample strength. The word "open" shall be cast on each valve or actuator with an arrow indicating the direction to open in the counter-clockwise direction. All gear and power actuators shall be equipped with position indicators. Where possible, manual actuators shall be located between 48 and 60 inches above the floor or the permanent working platform.

E. Functionality: Electric and pneumatic actuators shall be coordinated with power and instrumentation equipment indicated elsewhere in the Contract Documents.

2.2 MANUAL ACTUATORS

A. Unless otherwise indicated, all valves and gates shall be furnished with manual actuators as specified below:

1. Valves up to and including 4 inches in diameter shall have direct acting lever or handwheel actuators of the manufacturer's best standard design.

2. Larger valves and gates shall have gear-assisted manual actuators, with a maximum operating pull of 60 pounds on the rim of the handwheel.

a. Above ground valves 6-inches to 24-inches in diameter may have traveling nut actuators, worm-gear actuators, spur- or bevel-gear actuators, as appropriate for each valve.

b. Above ground valves 30-inches in diameter and greater and valves for pressures higher than 250 psi shall have totally enclosed worm-gear actuators.

c. Buried and submerged valves, gates, and other valves as indicated shall have totally enclosed worm-gear actuators, hermetically-sealed water-tight and grease-packed.

B. Buried Valves: Unless otherwise indicated, buried valves shall have extension stems to grade, with square nuts or floor stands, position indicators, and cast-iron or steel pipe extensions with valve boxes, covers, and operating keys. Where so indicated, buried valves shall be in cast-iron, concrete, or similar valve boxes with covers of ample size to allow operation of the valve actuators. Covers of valve boxes shall be permanently labeled as required by the local Utility Company or the Engineer. Wrench-nuts shall comply with AWWA C500 – Metal-Seated Gate Valves for Water Supply Service.

C. Chain Actuator: Manually-activated valves with the stem located more than 7-feet above the floor or operating level shall be furnished with chain drives consisting of sprocket-rim chain wheels, chain guides, and operating chains, and be provided by the valve Manufacturer. The wheel and guide shall be of ductile-iron, cast-iron, or steel, and furnish heavy-duty, Type 304 stainless steel operating chain looped to extend within 3-feet of the operating floor level. The valve stem of chain-actuated valves shall be extra strong to allow for the extra weight and chain pull. Hooks shall be provided for chain storage where chains interfere with pedestrian traffic.

D. Floor Boxes: Hot-dip galvanized cast-iron or steel floor boxes and covers to fit the slab thickness shall be provided for all operating nuts in or below concrete slabs. For operating nuts in the concrete slab, the cover shall be bronze-bushed.

E. Manual Worm-Gear Actuator: The actuator shall consist of a single or double reduction gear unit contained in a weather-proof cast-iron or steel body with cover and minimum 12-inch diameter handwheel. The actuator shall be capable of 90-degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The actuator shall consist of spur or helical gears and worm-gearing. The spur or helical gears shall be of hardened alloy steel and the worm-gear shall be alloy bronze. The worm-gear shaft and the handwheel shaft shall be of stainless steel. All gearing shall be accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Actuator output gear changes shall be mechanically possible by simply changing the exposed or helical gear set ratio without further disassembly of the actuator. All gearing shall be designed for a 100 percent overload.

2.3 ELECTRIC MOTOR ACTUATORS

A. Where electric motor actuators are indicated, an electric motor-actuated valve control unit shall be attached to the actuating mechanism housing by means of a flanged motor adaptor piece.

B. Design:

1. The actuators shall be suitable for use on a nominal 480 volt, 3 phase, 60Hz power supply and are to incorporate motor, integral reversing starter, local control facilities and terminals for remote control and indication connections housed within a self-contained, sealed enclosure.

2. Meet applicable AWWA requirements and meet the requirements set out in EN15714-2 and ISA SP96.02.

3. The actuator shall be sized to guarantee valve closure. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. For linear operating valves, the operating speed shall be such as to give valve closing and opening at approximately 10-12 inches per minute unless otherwise stated in the data sheet. For quarter turn valve types, the operating time will be a maximum of 60 seconds.

4. Handwheels for Manual Operation:

   a. Metallic with arrows to indicate "open" rotation; incapable of rotation during motor operation; unaffected by fused motor, being mechanically independent of the motor drive; maximum 80 pound pull on rim for manual operation. Actuators shall be fitted with 2-inch AWWA nut for portable operator. When in the manual operating mode, actuator to remain in this mode until motor is energized, at which time the actuator shall automatically return to electric operation.

5. Declutch Lever: Padlockable, capable of mechanically disengaging motor and related gearing positively when motor is de-energized and freeing handwheel for manual operation.

   a. Do not share any gearing between motor operation and handwheel operation.

   b. Design so that simultaneous manual and motor operation is impossible.

6. Motorized operators shall be provided with an integrally mounted communication module within the actuators, to allow non-intrusive set up, double sealed electrical housing and shall not require access after factory fitting. In order to maintain the integrity of the enclosure, setting of the torque levels, position limits and configuration of the indication contacts etc. shall be carried out without the removal of any actuator covers and without mains power over an Infra-red or *Bluetooth*® wireless interface. Sufficient commissioning tools shall be provided with the actuators and must meet the enclosure protection and certification levels of the actuators. Commissioning tools shall not form an integral part of the actuator and must be removable for secure storage. In addition, provision shall be made for the protection of configured actuator settings by a means independent of access to the commissioning tool. Provision shall be made to disable *Bluetooth*® communications or only allow a *Bluetooth*® connection initiated by an Infra-Red command for maximum security.

    a. Each operator shall have independent HAND-OFF-AUTO selector switch and OPEN-CLOSE control devices that are wired to the motor starter circuit and completely isolated and independent of the valve actuator remote control network.

    b. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel irrespective of the connection sequence of the power supply.

7. The complete motorized operator enclosure shall be:

    a. NEMA 4 and NEMA 6 submersible to IP68 (20 feet of head for 72 hours). Actuators shall be suitable for indoor and outdoor use. The actuator shall be capable of functioning in an ambient temperature ranging from -33°C (22°F) to 70°C (140°F), up to 100% relative humidity.

    b. Actuators for hazardous area applications shall meet the area classification, gas group and surface temperature requirements specified in data sheet.

    c. Equipped with a separately sealed (double “O” ring) terminal area, such that with the terminal cover removed the actuator’s internal components are protected from environmental moisture and dust during storage and “no-power” conditions, start-up and working life. Enclosure must allow for temporary site storage without the need for electrical supply connection.

    d. All external fasteners shall be stainless steel.

C. Actuator Gearing:

1. Meet applicable AWWA requirements.

2. Single reduction type with hardened alloy steel worm gear, and aluminum bronze worm gear set; self-locking to maintain gate position.

3. Power Gearing: Accurately cut to assure minimum backlash; anti-friction bearing with caged balls or rollers throughout.

4. Stem Nuts: High tensile aluminum bronze; accurately machined and mounted in heavy ball or roller bearings.

5. Actuator Gear Housing: Aluminum housing with a separate cast iron thrust base.

6. Lubrication: Rotating power train components immersed in oil with provisions for inspection and re-lubrication without disassembly.

   a. Lubricants: Suitable for ambient conditions of -20 degrees F to +150 degrees F.

   b. Provide seals on shafting. All seals, feed throughs, and bearings shall provide sealing such that the actuator can be mounted in any position with no leakage of oil. Secondary gearboxes shall be externally attached to the actuator to accommodate variations in output speeds, torques or operating times and for use with quarter-turn valves. These multi-turn and quarter-turn gearboxes are to use accurately cut gears suitable for motor drive.

D. Motors:

1. The motor shall an integral part of the actuator, designed specifically for valve actuator applications. It shall be a low inertia high torque design, class F insulated with a class B temperature rise giving a time rating of 15 minutes at 40°C (104°F) at an average load of at least 33% of maximum valve torque. Where the total cycle time (two complete strokes) is longer than 15 minutes then NEMA Class H motor for 30 minute duty rating is to be used, with a maximum continuous temperature rating of 125 degrees C rise over ambient Temperature shall be limited by 2 thermostats embedded in the motor end windings and integrated into its control. Type: Specifically designed for gate actuator service with high starting torque, low inertia, totally enclosed, non-ventilated construction.

2. Protection shall be provided for the motor as follows:

   a. Stall - the motor shall be de-energized within 8 seconds in the event of a stall when attempting to unseat a jammed valve.

   b. Over temperature - thermostat will cause tripping of the motor. Auto-reset on cooling.

   c. Single phasing - lost phase protection

   d. Direction – phase rotation correction

3. Motor Windings: Epoxy treated.

4. Size: Sufficient to provide the maximum torque required for valve opening/closing operation, with a safety factor of 1.5. Torque shall be based on the valve manufacture’s calculated torque required for opening/closing at full differential and maximum valve dynamic torque.

5. Voltage Tolerance: Capable of operating at within 10 percent of specified voltage.

6. Motor Starters:

   a. For Open-Close Service: Self-contained electromechanical reversing starter suitable for 60 starts/hr.

   b. For Modulating Service: Self-contained solid-state reversing starter suitable for 1,200 starts per hour. The hammer action will be replaced by a direct drive.

7. Accessories: Internal thermal contacts embedded in the motor windings for detecting motor overload and a ground lug.

8. Power Supply: As scheduled or as indicated.

9. Enclosures for Motors, Switches, and Other Electrical Compartments shall be:

   a. In Class 1, Division 1 or Division 2, classified areas or NEMA 7 and NEMA 6 submersible to IP68.

   b. In other locations: NEMA 4 and NEMA 6 submersible to IP68.

   c. Terminal compartment shall have three threaded cable entries as a minimum. Provide additional threaded entries if required.

E. Controls:

1. Coordinate requirements with P&IDs, electrical schematics, and Specification Section 40 61 96 – Control Strategies.

2. Voltage Transformer:

   a. As required to step down power supply to control voltage.

   b. Size voltage transformer to provide 24VDC or 120 VAC control power, for customer signals, indication and interlock relays as needed with 25 percent spare capacity or 15 VA, whichever is greater, for the multi-turn actuator.

3. Control Station:

   a. Integral with operator. Enclosures shall be:

      a) In Class 1, Division 1 or Division 2 classified areas: NEMA 7 and NEMA 6 submersible to IP68.

      b) In other locations: NEMA 4 and NEMA 6 submersible to IP68.

   b. Provided with Following Devices:

      a) HAND-OFF-AUTO selector switch, lockable in the OFF position.

      b) OPEN and CLOSE pushbuttons.

      c) OPEN and CLOSE indicating lights.

4. Torque Sensing:

   a. Torque and thrust loads in both closing and opening directions shall be limited by a torque sensing device.

   b. Torque setting: 40 percent to 100 percent rated torque, adjustable in 1% increments and indicated locally.

5. Electric Circuit Diagrams:

   a. Identical regardless of whether gates are to open or close on torque or position limit.

   b. Non-intrusive calibration-adjustment and interrogation of the actuator shall be accomplished without the removal of any of the actuator's covers. Non-intrusive calibration, adjustment & interrogation will be by means of a setting tool to provide speedy interrogation capabilities as well as security. The setting tool shall be in a non-intrusive intrinsically safe watertight casing. In addition, it shall be possible to use a PDA or laptop.

6. Valve Position/Actuator Status Indication:

   a. The actuator shall provide a local display of the position of the valve, even when the power supply is not present.

   b. In the event of a (main) power (supply) loss or failure, the position contacts shall continue to be able to supply remote position feedback and maintain interlock capabilities.

   c. Absolute position measurement should be incorporated within the actuator. The technology must be capable of reliably measuring position even in the case of a single fault. The design must be simple with the minimum number of moving parts (no more than 5). Technologies such as LEDs or potentiometers for position measurement are considered unreliable and therefore not preferred. The position of the actuator and valve shall be updated contemporaneously, even when the power supply is not present.

   d. Four contacts shall be provided which can be selected to indicate any position of the valve; Provision shall be made for the selection of a normally closed or open contact form. Contacts shall maintain and update position indication during handwheel operation when all external power to the actuator is isolated. The contacts shall be rated at 5 Amps, 250 VAC, 30 VDC. Provision shall be made in the design for an additional eight contacts having the same functionality. A configurable monitor relay shall be provided as standard, which can be used to indicate either Availability or Fault. The relay should be a spring return type with a Normally Open / Normally Closed contact pre-wired to the terminal bung.

   e. As an alternative to providing valve position, any of the above contacts shall be selectable to signal one of the following:

      a) Valve Opening or Closing.

b) Motor Tripped on Torque in Mid Travel.

c) Motor Stalled.

d) Actuator Being Operated by Handwheel.

f. For actuators in modulating service, provide a controller that will accept a 4-20 mA analog signal. Additionally, a 4-20 mA position transmitter shall be included to provide a valve position feedback. The controller shall compare the input signal with the feedback signal to produce an error signal. The controller shall cause the motor to move the valve or gate in a direction so as to reduce the magnitude of the error signal. The controller positioning accuracy shall be plus or minus 1.0 percent of travel or better. It shall be possible to adjust Dead Band (0 to 9.9 percent of travel) and a Motion Inhibit Timer (2 to 99 seconds), and select action upon loss of signal, open/close/stay put.

7. Integral Starter and Transformer

a. The reversing starter, control transformer and local controls shall be integral with the valve actuator, suitably housed to prevent breathing and condensation. The starter shall be suitable for 60 starts per hour and of rating appropriate to motor size. The controls supply transformer shall be fed from two of the incoming three phases and incorporate overload protection. It shall have the necessary tapping and be adequately rated to provide power for the following functions:

a) Energizing of the contactor Coils

b) 24VDC or 110V AC output for remote controls (maximum 5W/VA)

c) Supply for all internal electrical circuits

8. Local Position Indication:

a. The actuator display shall include a dedicated numeric/symbol digital position indicator displaying valve position from fully open to fully close in 0.1% increments. Valve closed and open positions shall be indicated by symbols showing valve position in relation to the pipework to ensure that valve status is clearly interpreted. With mains power connected, the display shall be backlit to enhance contrast at all ambient light levels and shall be legible from a distance of at least 5m (16ft).

b. Red, green, and yellow LEDs corresponding to open, closed and intermediate valve positions shall be included on the actuator display when power is switched on. The yellow LED should also be fully programmable for on/off, blinker and fault indication. The digital display shall be maintained and updated during handwheel operation when mains power to the actuator is isolated.

c. The actuator display shall include a fully configurable dot-matrix display element with a minimum pixel resolution of 168 x 132 to display operational, alarm, configuration and graphical datalogger information. The text display shall be selectable between English and other languages such as: Spanish, German, French, and Italian. Provision shall be made to upload a different language without removal of any covers or using specialized tools not provided as standard with the actuator Local Display: Large enough to be readable from a distance of six feet when the actuator is powered up. It shall be possible to rotate the display in 90 degree increments to compensate for the actuators installed position.

d. Each actuator shall include a Data Logger to provide diagnostic information for maintenance & preventative maintenance purposes, including torque curves for both open & close strokes. This information is to be accessed by means of a) the setting tool, b) PDA or c) laptop, and in a format that can be saved electronically or on paper and then viewed at a later date. The software to achieve this and any updates to the software are to be supplied at no extra cost to the end user. Datalogger graphical displays should as a minimum be able to display log and trend graphs on the local LCD for the following:

a) Torque versus Position

b) Number of Starts versus Position

c) Number of starts per hour

d) Dwell Time

e) Average temperature.

e. The main display shall be capable of indicating 4 different home-screens of the following configuration:

a) Isolation and status

b) Position and torque (analogue)

c) Position and torque (digital)

d) Position and demand (positioning).

F. Operation:

1. Controller System: Rated as follows:

a. Open-Close Service - 60 starts per hour (minimum).

b. Modulating Service - 1,200 starts per hour (minimum).

G. Manufacturers:

1. Intelligent electric actuators with torque output requirements of 750 ft-lbs. and less for butterfly valves and eccentric plug valves shall be quarter turn type. Acceptable manufactures include:

a. Rotork “IQT Series”

b. Limitorque “QX”

c. EIM “HQ Series”

2. Intelligent electric actuators for open-close service shall be multi-turn type. Acceptable manufacturers include:

a. Rotork “IQ Series”

b. Limitorque “MX”

c. EIM “TEC 2000”

3. Intelligent electric actuators for modulating service shall be as follows:

a. Rotork “IQ Series”

b. Limitorque “MX”

c. EIM “TEC 2000”

4. Intelligent actuators for explosion proof service shall be as follows:

a. Rotork “IQ Series”

b. Limitorque “MX”

c. EIM “TEC 2000”

PART 3 - EXECUTION

3.1 GENERAL

A. Field representatives of manufacturers of valves or gates with electric actuators shall adjust actuator controls and limit switches in the field for the required function.

B. All valve and gate actuators and accessories shall be installed in accordance with Section 40 05 51 - Valves, General. Actuators shall be located to be readily accessible for operation and maintenance, without obstructing walkways. Actuators shall not be mounted where shock or vibrations will impair their operation, nor shall the support systems be attached to handrails, process piping, or mechanical equipment.

3.2 SOURCE QUALITY CONTROL

A. Factory test each motorized operator assembly in accordance with AWWA C540, except as modified herein.

B. Demonstrate that the stroke time is within the specified range.

C. Verify limit switch and torque switch functions in both directions.

D. Provide individual factory test certificates for each motorized actuator at no additional cost. Record the following parameters as a minimum.

1. No load current.

2. Current at maximum torque setting.

3. Stall current.

4. Torque at maximum torque setting.

5. Stall torque.

6. Test voltage and frequency.

7. Flash test voltage.

8. Actuator output speed.

E. Record details of specification, such as gear ratios for both manual and automatic drive, closing direction, wiring diagram, and serial number on the test certificates.

F. Require the motorized actuator manufacturer to submit certified statements that proof-of-design tests were carried out per the “Valve Actuator” section of AWWA C540 and that all requirements were successfully met.

3.3 INSTALLATION

A. Install operators in accordance with manufacturer's instructions.

3.4 MANUFACTURER'S FIELD SERVICES

A. Coordinate field service work with Owner and Engineer prior to initiating such work.

B. Furnish a qualified Manufacturer’s Representative to provide manufacturer’s field services for inspection, testing, equipment startup, and operator training.

C. Manufacturer’s representative shall perform the following services as described below and as specified in Section 01 75 16 – Startup Procedures.

1. Installation Assistance:

a. Advise/observe the Contractor on the installation of motorized operators.

b. Check and verify that installation of the motorized operators is in accordance with manufacturer’s installation instructions.

c. Provide additional assistance as required.

2. Provide a 2-year warranty from date of substantial completion for the project.

3. Training: Provide a minimum of four (4) hours of training for the Owner's staff on the operation and maintenance of electric operated gates and valves.

3.5 COMMISSIONING KIT

A. Each actuator shall be supplied with a start-up kit comprising installation instruction manual, electrical wiring diagram and cover seals to make good any site losses during the commissioning period. In addition, sufficient actuator commissioning tools shall be supplied to enable actuator set up and adjustment during valve/actuator testing and site installation commissioning.

END OF SECTION 40 05 57

SECTION 40 05 62 - PLUG VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall furnish and place into satisfactory operating condition plug valves, where required, in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A. ASTM A 126 Gray Iron Castings for Valves

B. ASTM A 536 Ductile Iron Castings

1.3 SUBMITTALS

A. The Vendor shall furnish submittals in accordance with Section 01 30 00 – Vendor Submittals and Section 40 05 51 – Valves, General.

B. Vendor shall indicate actuator position for each valve in submittal. Valves installed in horizontal piping shall have the plug swing upward when opening, no exceptions.

PART 2 - PRODUCTS

2.1 ECCENTRIC PLUG VALVES (1/2 INCH TO 72-INCH)

A. Construction: Eccentric plug valves shall be of the non-lubricated, eccentric plug design with cast iron bodies conforming to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with ANSI 125 lb. flanged ends for valves 3-inch and larger, and screwed or flanged ends for smaller sizes.

1. The plugs and shafts shall be of cast iron or ductile iron conforming to ASTM A 536 - Ductile Iron Castings, and the plugs shall be lined with a resilient coating, best suited for the specific service.

2. The body shall be lined with a suitable elastomer, where required for a special service, or it shall be epoxy-lined.

3. The seats shall be of nickel or stainless steel welded to the body.

4. All top and bottom shaft bearings shall be of permanently lubricated stainless steel or Teflon coated stainless steel.

5. Grit seals of Teflon, Nylatron, or similar suitable material shall be at the top and bottom plug journals.

6. Valves shall have an unobstructed, full port of 100 percent of full pipe area.

7. All eccentric plug valves shall have a pressure rating of not less than 150 psi WOG, for bubble-tight shut-off in the standard flow direction, and 25 psi WOG in the reverse flow direction.

8. When equipped with worm gear actuator, the pressure rating shall be 150 psi WOG in both directions.

9. The stem seal shall consist of field adjustable packing, replaceable without removal of the actuator, or of self-adjusting U-cup packing.

2.2 ACTUATORS

A. Unless otherwise indicated, eccentric plug valves 3-inch and smaller shall have operating levers; larger valves shall have worm-gear actuators. Valve actuators shall be in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.

B. Vendor shall coordinate actuator position for ease of operation by Owner and to ensure plug shall swing upward when installed in horizontal piping.

2.3 MANUFACTURERS, OR EQUAL

A. DeZurik Corporation

B. Clow Valve Company

C. Pratt Valve

D. Val-Matic

PART 3 - EXECUTION

3.1 INSTALLATION

A. Plug valves shall be installed in strict accordance with the manufacturer's published recommendations and the applicable provisions of Section 40 05 51 – Valves, General.

B. Unless otherwise directed, the following rules shall be observed for the installation of eccentric plug valves on sewage, sludge, or other liquid systems containing solids, silt, or fine sand:

1. The valves shall be positioned with the stem in the horizontal direction.

2. In horizontal pipelines, the plug shall swing upwards when opening, to permit flushing out of solids. Coordinate location of valve actuator so plug swings upward prior to ordering valves.

3. The orientation of the valve shall prevent the valve body from filling up with solids when closed; however, where the pressure differential through the valve exceeds 25 psi, the higher pressure for valves without worm gear, electric, or air operators shall be through the valve to force the plug against the seat.

4. Valves which may be closed for extended periods (stand-by, bypass, or drain lines) and valves with reversed flow (higher pressure on downstream side, forcing the plug away from its seat), shall be equipped with worm gear operators for all sizes.

5. For special applications or when in doubt, consult with the manufacturer prior to installation.

END OF SECTION 40 05 62

SECTION 40 05 63 - BALL VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall furnish and place ball valves into satisfactory operating condition, where required, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. The Vendor shall furnish submittals in accordance with Section 01 30 00 – Vendor Submittals and Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 STAINLESS STEEL BALL VALVES (4-INCH AND SMALLER)

A. Unless otherwise indicated, general purpose metal ball valves in sizes up to 4-inch shall have actuators in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.

B. Body: Ball valves up to 4-inch (incl.) in size shall have stainless steel 2-or 3-piece bodies with screwed ends for a pressure rating of not less than 600 psi WOG.

C. Balls: The balls shall be stainless steel, with standard port (single reduction) or full port openings.

D. Stems: The valve stems shall be of the blow-out proof design, stainless steel with reinforced Teflon seal.

E. Seats: The valve seats shall be of Teflon or Buna-N, for bi-directional service and easy replacement.

F. Manufacturers, or equal

1. Conbraco Industries, Inc. (Apollo)

2. ITT Engineered Valves

3. Neles-Jamesbury, Inc.

4. Watts Regulator

5. Worcester Controls

2.2 PLASTIC BALL VALVES

A. Plastic ball valves for corrosive fluids shall be made of polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), polypropylene (PP), or polyvinylidene fluoride (PVDF), as recommended by the Manufacturer for the specific application. Valves shall have manual actuators in accordance with Section 40 05 57 – Actuators for Process Valves and Gates, unless otherwise indicated.

B. Construction: Plastic ball valves shall have union ends or flanged ends to mate with ANSI B 16.5, class 150 flanges, for easy removal. The balls shall have full size ports and Teflon seats. Body seals, union o-ring seals, and stem seals shall be in accordance with the corrosion resistance requirements of respective valve manufacturer. External (without entering into the wetted area) seat packing adjustment is preferred. Metal reinforced stems to prevent accidental breakage are preferred. The valves shall be suitable for a maximum Working non-shock pressure of 150 psi at 73 degrees F for PVC and CPVC, with decreasing ratings for higher temperatures and other plastics.

C. Manufacturers, or equal

1. ASAHI-America
2. George Fischer, Inc.
3. Plast-O-Matic Valves, Inc.
4. Spears Mfg. Co.

PART 3 - EXECUTION

3.1 GENERAL

A. Valves shall be installed in accordance with Section 40 05 51 – Valves, General. Care shall be taken that valves in plastic lines are well supported at each end of the valve.

END OF SECTION 40 05 63

SECTION 40 05 64 - BUTTERFLY VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall furnish and place into satisfactory operating condition butterfly valves, where required, in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

1.	ANSI/AWWA C504	Rubber-Seated Butterfly Valves.
2.	ANSI/AWWA C540	Power Actuating Devices for Valves and Sluice Gates
3.	ANSI/AWWA C550	Protective Epoxy Interior Coatings for Valves and Hydrants
4.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
5.	ANSI B16.5	Pipe Flanges and Flanged Fittings
6.	ASTM A48	Specifications for Gray Iron Castings
7.	ASTM A126	Gray Iron Castings for Valves, Flanges and Pipe Fittings
8.	STM A276	Specifications for Stainless and Heat-Resisting Steel Bars and Shapes
9.	ASTM A436	Austenitic, Gray Iron Castings
10.	ASTM A536	Ductile Iron Castings
11.	MSS SP67	Butterfly Valves

1.3 SUBMITTALS

A. Provide shop drawings per Section 01 30 00 – Vendor Submittals and Section 40 05 51 – Valves, General including:

1. Complete Shop Drawings of butterfly valves and actuators.

2. Drawings showing valve port diameter complete with dimensions, part numbers and materials of construction.

3. Certification of proof-of-design test from the valve manufacturer.

4. If automatically actuated, provide actuator information in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.

5. For above grade installations, provide literature regarding valve position indicators and installation information to indicate if valves must be installed in the upright position. If valve must be installed in upright position, provide modified valve position indicator that can be seen from the floor when opening or closing the valve.

1.4 QUALITY ASSURANCE

A. Valves shall be subjected to performance, leakage, and hydrostatic test in accordance with procedures and acceptance criteria established by AWWA C504.

PART 2 - PRODUCTS

2.1 GENERAL

A. Butterfly valves shall comply with the requirements of Section 40 05 51 – Valves, General.

2.2 BUTTERFLY VALVES FOR GENERAL PURPOSE SERVICE

A. Butterfly valves shall be rubber seated butterfly valves that conform to AWWA C504, rated for water working pressures up to 150 psig, subject to the following requirements. Butterfly valves for general purpose service shall be rubber seated butterfly valves that conform to AWWA C504, rated for water working pressures up to 150 psig, subject to the following requirements. Valves shall be of the size and class indicated, suitable for bubble tight shut-off service as well as throttling service at rated pressure at ambient temperatures of 33 to 125 degrees F. Lug or wafer style valves shall have ANSI 125 lb flange bolt hole patterns.

B. Body: The valve body shall be of cast iron conforming to ASTM A126 - Specifications for Gray Iron Castings for Valves, Flanges and Pipe Fittings, Class B, with either wafer, lug, or flanged design, drilled to ANSI B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 125. The entire body shall be factory coated with an epoxy coating system in accordance with AWWA C550.

C. Disc: The disc shall be a ductile iron conforming to ASTM A536, with factory applied epoxy coating in accordance with AWWA C550. The disc shall have no holes drilled into it for securing the disc to the stem with pins, screws, or any other such hardware. If the disc design is such that securing hardware is required then the disc and securing hardware shall both be type 316 stainless steel.

D. Seat: The valve seat shall be Ethylene-Propylene-Diene Monomer (EPDM) or Buna N and shall be bonded or vulcanized to the valve body.

E. Stem: The valve stem shall be a Type 316 stainless steel ASTM A276, with keyed slots on the stem to make with receiving slots on the inner part of the disc requiring no disc screws or pins for connection of the tem to the disc. If connecting pins or screws are required for a particular manufacturer's design, then the disc as well as the connecting hardware shall be type 316 stainless steel.

F. Stem Bushing: The stem bushing shall be a non-corrosive, heavy duty acetal bushing.

G. Stem Seal: The stem shall be a double "U" cup seal or O-ring designed which is self-adjusting and provides positive sealing in both directions and is suitable for the service condition.

H. Flange / Style: Unless otherwise specified or noted on the drawings, the style of each butterfly valve shall be lug style. The Contractor shall not use any type of raised face type PVC flange on either side of any butterfly valve. Contractor shall be responsible to ensure that the selected butterfly valve will fully open and close without any physical interference at all.

I. Testing: Valves shall be factory leak tested in accordance with AWWA C504.

J. Manufacturers or equal:

1. DeZurik Water Controls
2. Henry Pratt Company
3. Bray
4. Val-matic

2.3 BUTTERFLY VALVES FOR AIR SERVICE

A. General: Butterfly valves for air service shall be specifically designed for this service and meet or exceed the design, strength, performance, and testing standards of AWWA C504. They shall be suitable for pressures from vacuum to 125 psi and temperatures from minus 40 degrees F to 300 degrees F.

B. Body: The valve body shall be of cast iron conforming to ASTM A126, Class B, with lug or flanged design as indicated, drilled to ANSI B16.1, Class 25, 125, 250, and 800, Class 125.

C. Disc: The disc shall be cast iron conforming to ASTM A126 with a nylon coating, bronze, or Type 316 stainless steel. The disc shall be designed with the air- profile or other suitable shape. Sprayed or plated disc edges are not acceptable.

D. Seat: The elastomer seat shall be in the body. It shall be field-replaceable without special tools. The seat material shall be Viton to provide a tight shut-off at the temperatures above.

E. Shaft: The valve shaft shall be of Type 316 or 304 stainless steel, with sufficient strength to allow for the increased torque for air service.

F. Bearings: Shaft bearings shall be of the self-lubricating corrosion resistant sleeve type.

G. Packing: The packing shall be of the adjustable or self-adjustable (a-ring) type, suitable for the temperature and service conditions.

H. Manufacturers, or Equal:

1. DeZurik water Controls

2. Henry Pratt Company

3. Bray

2.4 ACTUATORS

A. Manual Actuators: Actuators shall conform to Section 40 05 57 – Actuators for Process Valves and Gates and to ANSI / AWWA C540 - Power Actuating Devices for Valves and Sluice Gates, subject to the following requirements. Unless otherwise indicated, all manually-actuated butterfly valves of 6 inch diameter and larger shall be equipped with a handwheel and 2-inch square actuating nut and position indicator. Manual lever type actuators shall allow for positive throttling and have at minimum 10 stop positions from open to close for positive locking of the valve. The manual lever type actuators as well as handwheel actuators shall have an epoxy coating.

B. Electric Actuators: Provide electric actuators that meet the requirements of AWWA C 540 and are in accordance with Section 40 05 57 – Actuators for Process Valves and Gates. The maximum torque for the valve shall be input into the actuator program to be the maximum torque applied by the actuator.

2.5 PAINTING AND COATINGS

A. All valves inside of hydraulic structures shall be provided with a high build epoxy coating system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation, inspect interconnecting piping and end connections to ensure compatibility.

B. Prior to installation, inspect and verify condition of valve and appurtenances.

C. Ensure exposed piping is sufficiently supported to bear weight of valve when it is installed.

3.2 PRODUCT HANDLING

A. Protect valves and components against dirt and damage during shipment and storage.

B. Handle valves to prevent damage or contamination.

3.3 INSTALLATION

A. Install all valves in accordance with manufacturer’s recommendations and with Section 40 05 51 – Valves, General.

END OF SECTION 40 05 64

SECTION 40 05 65.23 – SWING CHECK VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall furnish and place into satisfactory operating condition swing check valves, where required, in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A.	ANSI/AWWA C 508	Swing-Check Valves for Waterworks Service, 2 in. through 24 in.
B.	ASTM A 126	Gray Iron Casting for Valves, Flanges, and Pipe Fittings
C.	ANSI/ASME B 16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 300
D.	ASTM B 584	Copper Alloy Sand Castings for General Applications
E.	ASTM B 584 or B 148	Aluminum-Bronze Castings, or of Buna-N
F.	ASTM B 763	Copper Alloy Sand Castings for Valve Application, or
G.	ANSI/ASME B1.20.1	Pipe Threads, General Purpose (inch)
H.	ASTM B 16	Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines.

1.3 SUBMITTALS

A. The Contractor shall furnish submittals in accordance with Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 SWING CHECK VALVES (3-INCH AND LARGER)

A. General: If not specified otherwise, swing check valves for water, sewage, sludge, and general service shall be of the outside lever and spring or weight type, in accordance with ANSI/AWWA C 508 - Swing-Check Valves for Waterworks Service, 2 in. through 24 in. NPS. Valves shall have full-opening passages, designed for a water-working pressure of 150 psi. They shall have a flanged cover piece to provide access to the disc.

B. Body: The valve body and cover shall be of ductile iron conforming to ASTM A 536 – Ductile Iron Castings for Valves, Flanges, and Pipe Fittings, with flanged ends conforming to ANSI/ASME B 16.1 - Ductile Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800, or mechanical joint ends, as indicated.

C. Disc: The valve disc shall be of ductile iron, or bronze conforming to ASTM B 584 - Copper Alloy Sand Castings for General Applications.

D. Seat and Rings: The valve seat and rings shall be of stainless steel T304 or T316 Type.

E. Lining & Coating: The valve shall be lined and coated with NSF 61 Fusion Bonded Epoxy.

F. Hinge Pin: The hinge pin shall be of bronze or stainless steel.

G. Manufacturers, or equal

1. Val-Matic, 7800LW Series
2. American Flow Control (Darling)
3. APCO (Valve and Primer Corp.)
4. Kennedy Valve
5. Mueller Company
6. Crane Valves and Fittings

2.2 SWING CHECK VALVES (2-1/2-INCH AND SMALLER)

A. Swing check valves for steam, water, oil, or gas in sizes 2-1/2 inch and smaller shall be suitable for a steam pressure of 150 psi and a cold-water pressure of 300 psi. They shall have screwed ends unless otherwise indicated, and screwed caps.

B. Body: The valve body and cap shall be of bronze conforming to ASTM B 763 - Copper Alloy Sand Castings for Valve Application, or ASTM B 584 with threaded ends conforming to ANSI/ASME B1.20.1 - Pipe Threads, General Purpose (inch).

C. Disc: Valves for steam service shall have bronze or brass discs conforming to ASTM B 16 - Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines, and for cold water, oil, and gas service replaceable composition discs.

D. Hinge Pin: The hinge pins shall be of bronze or stainless steel.

E. Manufacturers, or equal

1. Crane Company
2. Milwaukee Valve Company
3. Stockham Valves and Fittings
4. Wm. Powell Company

PART 3 - EXECUTION

3.1 GENERAL

A. Valves shall be installed in accordance with provisions of Section 40 05 51 – Valves, General.

END OF SECTION 40 05 65.23

SECTION 40 05 65.29 – DOUBLE-DISK CHECK VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall furnish and place into satisfactory operating condition check valves, where required, in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A.	ANSI/AWWA C 508	Swing-Check Valves for Waterworks Service, 2 in. through 24 in.
B.	ASTM A 126	Gray Iron Casting for Valves, Flanges, and Pipe Fittings
C.	ANSI/ASME B 16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 300
D.	ASTM B 584	Copper Alloy Sand Castings for General Applications
E.	ASTM B 584 or B 148	Aluminum-Bronze Castings, or of Buna-N
F.	ASTM B 763	Copper Alloy Sand Castings for Valve Application, or
G.	ANSI/ASME B1.20.1	Pipe Threads, General Purpose (inch)
H.	ASTM B 16	Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines.

1.3 SUBMITTALS

A. The Vendor shall furnish submittals in accordance with Section 01 30 00 – Vendor Submittals and Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 DOUBLE-DISK CHECK VALVES

A. Double-disk check valves for air and gas service and where indicated, shall be of the wafer-type designed to fit between ANSI B16.1 flanges for 125-lb rating. The check valve leaves shall be spring-loaded. Flow from one direction shall cause the valve to open, and upon valve shutoff, the spring shall shut the valve leaves before reverse flow starts, acting at a point of zero velocity, for non-slam closure. The spring-tension of each valve shall be designed for the individual operating condition.

B. Body: The valve body shall be of cast iron conforming to ASTM A 126 with integrally-cast seat, rated for minimum 150-lb working pressure at up to 250 degrees F.

C. Leaves: The leaves shall be of bronze, aluminum bronze, or ductile iron, revolving on stainless steel or monel hinge pins with retainers.

D. Seat: The valves shall have resilient seats for bubble-tight shut-off, suitable for temperatures up to 250 degrees F without sticking. The seats shall be Viton or other suitable material for the intended purpose. The seat rings shall be firmly attached a shoulder cast in the body or to the disc by compression-molding or similar acceptable method.

E. Springs: The springs shall be of Type 316 stainless steel or Inconel, as best suited for the service condition.

F. Manufacturers, or equal:

1. APCO (Valve and Primer Corporation)

2. Proquip International

3. VAL-MATIC (Valve and Manufacturing Corporation)

PART 3 - EXECUTION

3.1 GENERAL

A. Valves shall be installed in accordance with provisions of Section 40 05 51 – Valves, General.

END OF SECTION 40 05 65.29

SECTION 40 05 82 – SOLENOID VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide solenoid valves and appurtenances in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

1.	AWWA C511	Reduced-Pressure Principle Backflow Prevention Assembly
2.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
3.	C-510-97	Double Check Valve Backflow Prevention Assembly
4.	C-511-97	Reduced Pressure Principle Backflow Prevention Assembly
5.	NPFA 820	Standard for Fire Protection in Wastewater Treatment and Collection Facilities

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 30 00 – Vendor Submittals and Section 40 05 51 – Valves, General.

B. Technical Manual: Furnish operation and maintenance information in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

A. Comply with quality assurance requirements listed in Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 GENERAL

A. All valves specified in this Section shall meet the applicable requirements of Section 40 05 51 – Valves, General.

2.2 SOLENOID VALVES

A. All coil ratings shall be for continuous duty. For electrical characteristics see electrical drawings or specifications.

B. Explosion-proof valves shall be provided in Class 1, Division 1 areas as required under NPFA 820 guidelines.

C. Solenoid valves shall be of the size, type, and class indicated and shall be designed for not less than 150 psi water-working pressure. Valves for water, air, or gas service shall have stainless steel body with screwed ends, stainless steel trim and spring, Teflon or other resilient seals with material best suited for the temperature and fluid handled. Unless otherwise indicated, for chemicals and all corrosive fluids, solenoid valves with PVC, CPVC, polypropylene (PP), polyvinylidene fluoride (PVDF), or Teflon materials of construction, suitable for the specific application shall be provided. Enclosures shall be NEMA rated in accordance with the area designations.

D. Solenoid valves shall be pilot controlled and shall be water hammer free.

E. Solenoid valves shall fail in the closed position unless otherwise indicated on the project drawings.

F. Where solenoid valves are a part of a packaged equipment system, those solenoids valves shall be specified and provided by the equipment manufacturer.

G. Manufacturers, or Equal:

1. For general duty

    a. Automatic Switch Co. (ASCO), Model "RED HAT"

    b. Skinner Valve (Parker Hannifin Corporation)

    c. Magnatrol Valve Corporation

    d. J. D. Gould Co.

2. Metallic valves for corrosive fluids

    a. Valcor Engineering Corporation

3. Plastic valves for corrosive fluids

    a. GF Plastic Systems, Inc.

    b. Spears Mfg. Co.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Valves shall be installed in accordance with the manufacturer's printed recommendations, and with provisions of Section 40 05 51 – Valves, General.

B. After installation is complete, the solenoid valve shall be tested for proper operation.

END OF SECTION 40 05 82

SECTION 40 05 93 – COMMON MOTOR REQUIRMENTS FOR PROCESS EQUIPMENT

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Vendor shall provide electrical motors, accessories, and appurtenances complete and operable, in conformance with the individual driven equipment specifications and the Contract Documents.

B. The provisions in this Section apply to all low voltage AC squirrel cage induction motors except as indicated otherwise.

C. All motors shown on the Drawings or specified in other divisions of the Specifications shall in general, be furnished with the driven equipment and connected under Division 26 of the Specification.

D. If motors are specified in other divisions of the Specification, then in the event of conflicts, the more restrictive specification shall apply.

E. The Vendor shall select suitable electric motors for the equipment. The choice of motor manufacturer shall be subject to review by the Engineer. Such review will consider future availability of replacement parts and compatibility with driven equipment.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Motors shall be designed, built, and tested in accordance with the latest revision of the following standard documents. In the case of conflict between the requirements of this Section and those of the standard documents, the requirements of this Section shall prevail.

1.	NEMA MG 1	Motors and Generators
2.	ANSI/IEEE 112	Test Procedures for Polyphase Induction Motors and Generators
3.	UL l004	Motors, Electric

1.3 VENDOR SUBMITTALS

A. Refer to Section 01 30 00 – Vendor Submittals and individual equipment specification requirements.

B. Submit the motor manufacturer's certification of bearing life on motors where application conditions suggest significant belt drive or thrust loads.

C. A Motor Data form (sample Form follows section) shall be submitted for each and every motor furnished under this Contract.

D. Motor outline, dimensions, and weight.

E. Manufacturer's descriptive information relative to specified features.

F. Motor Performance Characteristics:

1. Guaranteed minimum efficiency at rated load at rated voltage.
2. Guaranteed minimum power factor at rated load at rated voltage.
3. Expected efficiency at 1/2, 3/4, and full load at rated voltage.
4. Expected power factor at 1/2, 3/4, and full load at rated voltage.
5. Motor no-load current at rated voltage.
6. Full load current at rated voltage.
7. Full load current at 110 percent voltage.
8. Starting current at rated voltage.
9. Full load speed.
10. Certified copy of test report for identical motor tested in accordance with NEMA MG 1-12.53a and IEEE Standard 112, Test Method B, showing full load efficiency and power factor not less than specified value. Motors not as specified will be rejected.

G. Vertical Motor Data:

1. Thrust bearing life
2. Type of thrust bearing lubrication.
3. Type of guide bearing lubrication.

H. Operation and Maintenance Manuals (provided before training of treatment plant staff), including:

1. Complete information for storage and installation.
2. Complete operating and maintenance instructions.
3. Bill of Materials.

1.4 EQUIPMENT GUARANTEE

A. Guarantees shall cover:

1. Faulty or inadequate design.
2. Improper assembly or erection.
3. Breakage, or other failure.
4. Defective workmanship or materials

1.5 FACTORY TESTS

A. Provide factory test and test reports as listed below for all polyphase motors. For motors 7 1/2 hp and above, provide test reports for the actual motor being supplied. For motors under 7 1/2 hp, test reports of an identical motor may be provided. Perform all tests in accordance with the Procedures for Polyphase Induction Motors and Generators No. 112A and NEMA MG 1.

B. Measurements of no-load current and speed at nominal voltage and frequency

1. Measurement of locked rotor current at rated frequency.

2. Results of high-potential test.

3. Determination of efficiency and power factor at ½ load, ¾ load, full-load, and service factor load.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide squirrel-cage induction motors unless otherwise noted.

B. Electric motors driving identical machines shall be identical.

C. Coordination: Provide motors especially suitable both electrically and mechanically to drive the loads specified. The speed, horsepower, torque base, bearing, shaft, insulation and enclosure shall be closely coordinated with this specification so as to provide a satisfactory, efficient drive without overloading, overheating, abnormal noise or vibration. The BHP required of the driven equipment under the most severe operating conditions for the equipment served shall not exceed the rated nameplate horsepower of the motor when operating at its rated service factor, nor shall it exceed the rated nameplate horsepower of the motor when operated at specified conditions at a service factor of 1.0. The "most severe operating conditions" shall include the full possible range of normal operating conditions but shall not include unusual conditions such as equipment failure.

D. Standards: All motors shall be in accordance with NEMA-MG 1 "T" Line, IEEE and ANSI latest revision insofar as they are applicable.

E. Service Conditions: Provide motors designed and built for long, trouble-free life in industrial service capable of operating successfully under the following application conditions:

1. 40°C maximum ambient temperature to -20 degrees Celsius minimum ambient temperature.

2. Altitude at the facility site shall be verified.

3. Voltage variations to + 10 percent of nameplate rating.

4. Frequency variations to + 5 percent of nameplate rating.

5. Multiple speed motors suitable for use with multiple speed starter furnished.

6. Inverter duty motors suitable for use with variable frequency drives, if furnished.

F. Operating Characteristics: All motors shall be rated for full-voltage starting, NEMA Design B, normal torque, normal starting current, unless otherwise required by the driven equipment or specified.

G. Installation Environment: Provide motors suitable for the environment in which they are to be installed. Where the installation environment is specified, provide motors suitable for the environment indicated and in conformance with the specification.

H. Exempt Motors: Motors for valve operators, submersible pumps, or motors which are integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven element, or part of domestic or commercial uses apparatus may be excepted from these specifications to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

2.2 ENCLOSURES

A. Horizontal: Dripproof NEMA Standard MG 1, unless otherwise specified. Provide screen over all air openings.

B. Vertical: Motors shall be weather protected Type 1 (WP-l) NEMA Standard MG 1, with inlet and outlet openings screened unless otherwise specified.

C. TEFC and TENV: Totally enclosed fan cooled (TEFC) where specified. Provide horizontal TEFC motors with condensate drain holes. Totally enclosed non- ventilated (TENV) may be substituted for TEFC at Contractor's option.

D. Cast iron or extruded aluminum or die cast aluminum stator frames and end shields, rigid construction.

E. Heavy fabricated steel, cast iron or aluminum frames for single phase motors.

2.3 ACCESSORY REQUIREMENTS

A. Motor Assembly: Provide NEMA conduit entrance box. Provide conduit entrance box size and drilling to conform to the conduit or wiring requirements indicated on the electrical drawings. Include motor leads and all accessory leads in a common conduit entrance box.

B. Motor Leads: Provide motor leads compatible with motor insulation systems, permanently identified.

C. Eyebolts: Provide drilling and tapping for eyebolts on all motors weighing more than 83 pounds.

D. Nameplates: Provide one or more engraved stainless-steel stamped metal nameplates with the information required by NEMA-MGI-IO.38 and the following additional information:

1. Maximum ambient temperature for which motor is rated.

2. Class of insulation.

3. Service factor.

4. Bearing number.

5. Motor connection diagram if more than three leads.

6. Power rating in KW if driven equipment ratings are given in metric units.

E. Oil Lubricated Polyphase Motors: Provide lubricating oil reservoirs and sight gauges.

F. Painting: As specified in Section 43 05 01 - Equipment General Provisions.

G. Provide motor grounding lug suitable to terminate ground wire, sized as indicated.

2.4 INSULATION CLASS

A. Provide NEMA Class B insulation for all polyphase squirrel-cage induction motors, unless otherwise specified.

1. Provide additional anti-abrasion protection for non-enclosed motors, per NEMA MGl-l.27.

2. Provide additional moisture protection for enclosed motors, per NEMA MGl-20.48a.

B. Class F insulation with additional nonhygroscopic moisture protection as specified in paragraph 2.03A above may be utilized at the Contractor's option, however, the temperature rise as measured by resistance when operating at rated service factor and load shall conform to the limiting observable temperatures in NEMA-MGl, for class of insulation used.

C. Class A insulating materials shall not be utilized except in single-phase fractional horsepower motors or used in dry locations, with a standard reduction in rated temperature rise.

D. Encapsulation: Where specified. Provide insulating resin encapsulation by a molded or equivalent process in which the resin completely surrounds the conductors in the slots and end turns, leaving no voids between the conductors or adjacent stator steel. Allowable temperature rise shall not exceed the limits of NEMA-MGl.

E. Motors to be operated from adjustable frequency drives shall be provided with insulation systems to withstand 1600-volt spikes, with dV/dt as defined in NEMA MG 1-31 and shall be labeled as “Inverter Duty”.

2.5 SERVICE FACTOR

A. Provide the service factor indicated, or NEMA standard for the specified insulation and enclosure, whichever is greater. Minimum service factor shall be 1.15.

2.6 NEMA TYPE

A. Provide motors in accordance with standard NEMA type classifications as specified. The use of industry standard subclassifications such as "mill and Chemical" motors and similar" standard" heavy-duty designs are encouraged where they meet or exceed the specified minimum requirements.

2.7 POWER RATINGS

A. Motor horsepower or kw ratings, if indicated in the detailed equipment specifications, are minimum size acceptable.

B. Ratings indicated on the electrical drawings are for guidance only and do not limit the equipment size.

C. Frame/hp relationships shall conform to the latest NEMA standards for "T" or "U" frames and all dimensions shall meet NEMA standards.

2.8 STANDARD RATED VOLTAGE PHASE AND FREQUENCY

A. Provide motors nameplate-rated for 60 Hertz power supply as follows unless otherwise specified or shown on the drawings:

1. Motor less than 1/6 hp, single-phase, 115 volts.

2. Motors 1/6 hp through 1 hp, single phase, 115/230 volts.

3. Motors 1 hp and greater, three phase, 460 volts.

4. Multi-speed motors may have single voltage rating if manufacturer's standard.

B. Conform to the specified service conditions and the equipment specifications without reduction in the service factor.

2.9 BEARINGS AND SHAFTS

A. Motors greater than 2 HP shall have bearings designed for 17,500 hours (belted) or 100,000 hours (coupled) L-10 life.

B. Fractional Horsepower: Motors with fractional horsepower through 2 HP shall be provided with Lubricated-for-Life ball bearings.

C. Horizontal Motors Over 2 HP: Motors larger than 2 HP shall be provided with relubricatable ball bearings. Lubrication shall be per manufacturer’s recommendation for smooth operation and long life of the bearings.

D. Vertical Motors Over 2 HP: Vertical motors larger than 2 HP shall be provided with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

E. Shafts: Shafts shall be in accordance with NEMA "T" or "TS" dimensions. Long shafts shall be suitable for belt, chain or gear drive within limits established by good industrial practice and documented by NEMA. Short shafts shall be used for direct connection. Vertical motors shall be the solid-shaft type except where application requires a hollow-shaft design.

F. Inverter Duty Motors: Motors to be used in VFD applications must have bearing protection from shaft currents. Provide AEGIS shaft grounding rings, ceramic bearings or equivalent means to prevent premature bearing failure due to shaft current discharge.

2.10 DUTY CYCLE

A. Provide motors rated for continuous duty unless otherwise specified. Short time rated motors may be provided where the application is well documented by NEMA, is usual industrial practice and the driven equipment and motor is a tested combination under the specified performance conditions.

2.11 LUBRICATION

A. Horizontal polyphase motors shall be grease lubricated. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent relubrication, but facilities shall be provided for adding new grease and draining out old grease without major motor disassembly. Motors 180T frame and smaller may utilize grease release fitting in lieu of grease drain plug. The bearing housing shall have long, tight, running fits or rotating seals to protect against the entrance of foreign matter into the bearings or leakage of grease out of the bearing cavity.

B. Vertical polyphase motor lubrication shall conform to the motor manufacturer's recommendations. Except as otherwise recommended, guide bearings shall be ball bearings, grease lubricated; thrust bearings shall be grease lubricated through frame 28OT, oil lubricated in larger frame sizes.

2.12 MOTOR THERMAL PROTECTION

A. Provide one heat-sensing detector per phase, embedded in the windings to provide even temperature protection on motors 75 hp or larger. Coordinate over-temperature protection system with motor starter overload relays.

B. Single Phase Motor: Single phase 120, 208, or 230-volt motor shall have integral thermal overload protection or shall be inherently current limited.

C. Thermostats: Winding thermostats shall be snap action, bi-metallic, temperature-actuated switch, and shall be factory mounted integral to the motors. Thermostats shall be provided with one normally closed contact. The thermostat switch point shall be precalibrated by the manufacturer.

2.13 HIGH EFFICIENCY MOTORS

A. All motors provided shall be high efficiency as specified below.

B. High efficiency motors shall have minimum and nominal efficiencies which meet or exceed the efficiencies specified below when tested in accordance with the latest version of IEEE Test Procedure 112A. Method B. using accuracy improvement by segregated loss determination including stray load loss improvement as specified in NEMA Standard MGl-12.S3A. latest revision. Minimum efficiencies shall be guaranteed in writing.

C. Single speed induction high efficiency motors, three-phase, NEMA Design B, 460V, continuous duty, 40°C ambient shall meet or exceed the efficiencies specified in the following table.

Energy Efficiency Horizontal					
		Percent Guaranteed Minimum Rated Load Efficiencies		Percent Guaranteed Minimum Rated Load Power Factor	
HP	Nominal Speed RPM	DP	TEFC	DP	TEFC
1	1,800	80.0	81.5	85.0	85.0
	1,200	78.5	79.3	74.0	74.0
1.5	3,600	79.3	81.5	86.0	86.0
	1,800	79.3	82.0	88.0	88.0
	1,200	82.5	84.0	69.5	69.5
2	3,600	82.0	84.0	88.0	88.0
	1,800	81.5	83.7	84.0	84.0
	1,200	85.5	85.5	69.0	69.0
	900	82.9	82.5	54.0	54.0
3	3,600	82.0	84.0	91.0	88.0
	1,800	84.8	86.5	79.0	79.5
	1,200	87.5	88.1	71.0	71.5
	900	84.1	82.9	62.0	62.5
5	3,600	84.8	86.5	87.0	91.5
	1,800	86.5	86.5	81.0	81.0
	1,200	87.5	88.1	75.5	75.5
	900	87.5	86.5	70.0	70.5
7.5	3,600	86.5	88.1	90.0	90.0
	1,800	89.3	89.5	86.5	86.5
	1,200	88.5	88.5	80.0	80.0
	900	87.5	86.5	72.0	72.0
10	3,600	89.3	89.5	90.0	90.0
	1,800	89.3	89.5	86.0	86.0
	1,200	89.5	89.5	80.5	81.0
	900	89.3	88.5	77.5	78.0

2.14 ACCEPTABLE MANUFACTURER

A. U.S. Motors

B. General Electric

C. Equal

PART 3 - EXECUTION

3.1 ERECTION

A. Motors shall be factory installed on common bases, stands, etc., with the driven equipment. Provide suitable couplings and guards between motor and driven equipment.

B. Align and connect to driven equipment.

C. Connect motors to power supply and controllers and verify correct rotation of equipment.

3.2 INSTALLATION CHECK

A. Provide services of an experienced, competent, and authorized representative of the manufacturer to visit site of work and inspect, check, adjust if necessary, and approve equipment installation for motors 25 hp and larger.

B. Assure that equipment manufacturer's representative is present when equipment is placed in operation.

C. Verify that equipment representative revisits jobsite as often as necessary until all trouble is corrected and equipment installation and operation are satisfactory, in the opinion of the Owner.

D. The Installing Contractor shall perform the following field checks:

1. Inspect each motor installation for any deviation from rated voltage, phase, or frequency and improper installation.

2. Visually check for proper phase and ground connections. Verify that multi-voltage motors are connected for proper voltage.

3. Check winding and bearing temperature detectors and space heaters for functional operation.

4. Test for proper rotation prior to connection to the driven equipment.

5. Test insulation (megger test) of all new and re-used motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

END OF SECTION 40 05 93

MOTOR DATA FORM

Equipment Name: _____ Equipment Number(s): _____

Site Location: _____

Nameplate Markings

Mfr: _____ Mfr Model: _____ Frame: _____ HP: _____

Volts: _____ Phase: _____ RPM: _____ Service Factor: _____

FLA: _____ LRA: _____ Freq: _____ Ambient Temp Rating: _____°C

Time Rating: _____ (NEMA MG-10.35) Design Letter _____ (NEMA MG-1.16)

KVA Code Letter: _____ Insulation Class: _____

The following information is required for high efficiency motors only:

A. Guaranteed minimum efficiency at full load at NEMA efficiency index:

_____
(NEMA MG1-12.53B)

B. Nameplate or nominal efficiency: _____

Data Not Necessarily Marked on Name Plate

Type of enclosure: _____ Enclosure Material: _____

Temp rise: _____ °C (NEMA MG1-12.41, 42)

Space heater included: _____ Yes _____ No;

If yes, _____ Watts _____ Volts

Type of Rotor winding over-temperature protection, if specified:

Use the space below to provide additional information on other motor modifications, if specified:

_____

_____

SECTION 40 61 96 - CONTROL STRATEGIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The following equipment is included in the control strategies. Refer to equipment specifications for control narratives

1. IFAS System
2. Upflow Sand Filtration
3. Sludge Dewatering System

1.2 ABBREVIATIONS

A. The following abbreviations are used in this Section:

F/R:	Forward or Reverse
HOR:	HAND/OFF/REMOTE
VFD:	Variable Frequency Drive
HOA:	Hand/Off/Auto
MOV:	Motor Operated Valve
LCP:	Local Control Panel
LCS:	Local Control Station
PLC:	Programmable Logic Controller

1.3 SUBMITTALS

A. Provide submittals in accordance with Sections 01 30 00 – Vendor Submittals.

B. Develop detailed loop descriptions based on the information in the Contract Documents.

1. For each control loop, provide a detailed functional description of the operation of the equipment, signals, and controls shown on the P&IDs:
    a. Include all functions depicted or described in the Contract Documents.
    b. Include the following within each loop description:
        a) All requirements specific to that loop.
        b) Common control requirements applicable to that loop.
        c) List of all ranges, setpoints, timers, values, counters, etc.

c. Where there are similar loops with identical control, only 1 loop description needs be developed, and the remaining loops may reference that loop description.

C. Loop description format:

1. Loop number and title.

2. References:

a. List P&IDs that are specifically referenced.

3. Abstract:

a. General description of how the loop works, what devices are involved, and how the process shall be controlled.

b. Process values, setpoints, and limits, including units and ranges:

1) Show span and range values for analog inputs and outputs, and operating point and dead band for discrete inputs.

4. Hardwired control:

a. Detailed description of the control functions at the local level.

b. Function of local operator interfaces.

c. Operation of hardwired field pilot controls:

1) Pushbuttons.

2) Selector switches.

3) Potentiometers.

4) Pilot lights, indicators, and other displays.

5. Hardwired interlocks:

a. Explanation of the operation of system interlocks and hardwired permissive conditions.

6. PLC control:

a. Detailed description of the control functions that are under control of the PLC.

b. Operator controls and automatic controls.

c. Setpoints, alarms, etc.:

1) Include units and ranges for analog values.

2) Include span and range for analog inputs and outputs.

3) Include operating point and dead band for discrete inputs, and identify conditions where contacts are open, and when they close.

d. Control sequences.

7. Software interlocks:

a. Operation of system software interlocks.

8. HMI/HIM control:

a. Detailed description of the operator controls.

9. SCADA control:

a. Detailed description of the operator controls.

b. Setpoints, alarms, etc.

10. Indicators and alarms:

a. List any indicators and alarms specific to the loop that are not covered in the common control strategies.

11. Failure modes:

a. List any failure modes specific to the loop that are not covered in the common control strategies.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 COMMON FUNCTIONS

A. Common functions that are generally applicable to all loops or to many similar loops are described under the heading "General Control Loop Functions." These functions are not repeated in the descriptions for each individual control strategy.

B. General Control Loop Functions: The following general control system functions shall be provided:

1. All analog and discrete inputs to the dialers shall be displayed. Both RUNNING and OFF input states shall be displayed.

2. All analog inputs shall have instrument failure alarms when the input is below 0 percent or above 100 percent for a tunable time initially set at 10 seconds.

3. All discrete FAIL inputs shall be alarmed for a tunable time initially set at 10 seconds. Other discrete inputs shall be alarmed as noted in the control strategy descriptions.

4. Operational Readiness Testing (ORT) should include all discrete and analog alarms as well as status alarms. This should also include all operations (e.g., lift station pump controls for lead, lag alarms, etc.). All alarm should be tested through voice or text notification as needed.

5. Where alarms are specified in the control strategy descriptions or on the Drawings, alarms shall be initiated from the applicable inputs. If discrete inputs are not available, the specified alarms shall be initiated from the applicable analog input; alarm set-points shall be operator adjustable.

6. All flow inputs and equipment run times shall be totalized and recorded. All totalized values shall be displayed. Runtime shall be displayed in tenths of an hour and be based on real-time accumulation.

7. When a level is less than 10 (e.g., ft, psi, mg/L, etc.) the precision shall be recorded in hundredths.

8. Displays shall be grouped functionally for ease of operation. Both analog and discrete functions associated with an item of equipment or a group of equipment shall be provided on the same display.

9. All PID control functions shall be provided with standard analog controller functions and operator interfaces including, but not limited to, the following:

    a. AUTO/MANUAL mode selection: In AUTO, the output of controller shall be based on the PID control calculation. In MANUAL, the output of the controller shall be constant, but operator adjustable. Transfer between operational modes shall be bumpless.

    b. OPERATOR/PROGRAM set point selection: In OPERATOR, the set point shall be operator adjustable from the equipment. In PROGRAM, the set point shall be adjusted by the associated PLC.

    c. Set point, process variable, and controller output shall be displayed.

    d. Provisions shall be included to prevent reset windup.

10. When equipment is tagged OUT OF SERVICE, by the operator all associated equipment shall have their alarms inhibited until the tagged equipment is re-tagged IN SERVICE.

11. Speed indications and speed control set-points shall be displayed in Hz.

12. Wherever two or more pieces of equipment are provided for the same functions, the equipment shall be alternated after each use.

13. All motorized equipment with status contact indication in SCADA shall have:

    a. Totalized elapsed time (non-resetting)

    b. Totalized elapsed time (24-hour). Midnight reset, store and log previous day.

14. All VFD controlled equipment shall be configured for Ethernet control and monitoring by the associated PLC. SCADA display shall include, but not be limited to, the following:

    a. VFD Running Status

    b. VFD Fault

    c. VFD Speed Output (%)

    d. VFD Speed Feedback (%)

    e. Motor KW

    f. Motor Amps

END OF SECTION 40 61 96

SECTION 40 67 00 - CONTROL PANELS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall provide control panels, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section apply to local panels provided in equipment systems specified in other sections unless indicated otherwise in those sections.

1.2 REFERENCE STANDARDS

A. ASTM A 283 Low and Intermediate Tensile Strength Carbon Steel Plates

B. UL 508A Industrial Control Panels

1.3 SUBMITTALS

A. Submittals shall be furnished in accordance with Sections 01 30 00 – Vendor Submittals.

B. Shop Drawings: The Contractor shall submit shop drawings for each panel and enclosure provided under Division 40. The shop drawings shall completely define and document the construction, finish, layout, power circuits, signal and safety grounding circuits, fuses, circuit breakers, signal circuits, internally mounted instrumentation, face plate mounted instrumentation components, internal panel arrangements, and external panel arrangements. The submittal shall include the following:

1. A complete index shall appear in the front of each bound volume. Drawings and data sheets associated with a panel shall be grouped together with the panels being indexed by systems or process areas. Panel tagging and nameplate nomenclature shall be consistent with the requirements of the Contract Documents.

2. Scaled physical arrangement drawings drawn to scale that define and quantify the physical groupings comprising control panel sections, auxiliary panels, subpanels, and racks. Cutout locations with nameplate identifications shall be shown.

3. Front of panel layouts for all control panels.

4. Schematic/elementary diagrams shall depict all control devices and circuits and their functions.

5. Interconnection diagrams shall locate and identify all external connections between the control panel/control panel devices and associated equipment. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all panel ingress and egress points.

6. A bill of material that enumerates all devices associated with the control panel.

PART 2 - PRODUCTS

2.1 GENERAL

A. Environmental Suitability: Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided, as indicated, in order to maintain all instrumentation devices within 20 percent of the minimums and maximums of their rated environmental operating ranges. The Contractor shall provide all power wiring for these devices. Instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

B. The control panel shall be the source of power for any 120 VAC solenoid valves interconnected with the control panel. Equipment associated with the control panel shall be ready for service after connection of conductors to equipment, controls, and control panel.

C. Instrument power circuits shall be fed from the associated PLC panel.

D. Control panels shall not contain any voltages greater than 120VAC.

E. Unless indicated otherwise, control panels shall be housed in NEMA rated enclosures in accordance with Section 26 05 00 – Electrical, General. Panels shall be either freestanding, pedestal-mounted or equipment skid-mounted, as indicated. Internal control components shall be mounted on an internal back-panel or side-panel as required.

F. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks. Each control panel shall be provided with identified terminal strips for the connection of all external conductors. The Contractor shall provide sufficient terminal blocks to connect 25 percent additional conductors for future use.

G. Motor starters, where required, shall be in accordance with the specifications. Each motor starter shall be provided with contact closures for motor overload, local indication, and remote alarm. Discrete outputs from the control panel shall be provided by electrically isolated interposing relay contacts. Analog inputs and outputs leaving the envelope of the building shall be isolated 4-20 mA, 2-wire signals with power supply. All analog inputs and outputs shall be individually fused.

H. Control panel mounted devices shall be mounted a minimum of 3 feet above finished floor elevation.

2.2 CONTROL PANELS

A. Each PLC and remote I/O system and corresponding housing, including I/O modules, power supply modules, communication interface devices, and peripheral equipment shall be mounted inside a NEMA enclosure in accordance with Section 26 05 00 – Electrical, General. I/O wiring from the field to the remote I/O system shall be terminated on terminal blocks in the lower portion of the enclosure.

B. Materials: Panels shall be made of Grade 304 stainless steel. Panel section faces shall be No. 10 gauge minimum thickness for free standing panels and No. 14 gauge minimum thickness for wall mounted or pedestal mounted panels. Materials shall be selected for levelness and smoothness.

1. Relay rack high density type panels shall utilize standard relay racks with No. 14 gauge steel frame and supports.

2. Structural shapes and strap steel shall comply with ASTM A 283 - Low and Intermediate Tensile Strength Carbon Steel Plates, Grade C.

3. Bolting Material: Commercial quality carbon steel bolts, nuts, and washers shall be 1/2-inch diameter with UNC threads. Carriage bolts shall be used for attaching end plates. All other bolts shall be hex end machine bolts. Nuts shall be hot pressed hex, American Standard, heavy. Standard wrought washers shall be used for foundation bolts and attachments to building structures. Other bolted joints shall have SAE standard lock washers.

4. Enclosures shall be NEMA Type 3R if located in the Process Room and NEMA Type 12 if located in the electrical room.

C. Construction: Dimensions shall be in accordance with vendor's requirements. Elevations and horizontal spacing shall be subject to Engineer's approval.

D. Fabrication: End plates, top plates, and top closure panels (to hung ceiling) shall be provided when required by the material requisition. End plates, top plates, and top closure panels shall be removable with countersunk bolts to match panels. Top closure panels shall be furnished in lengths which match the widths of standard panels, except that one top closure panel may extend across two 4-foot 6-inch wide or five 2-foot wide standard panels. The vertical joints of these panels shall align with the vertical joints of the standard panels.

1. End closure or rear closure doors shall be provided where required. Such doors shall be flush fitting, gasketed, and be of the hinged lift-off type with lockable door handles. A common key shall be provided for all doors on one panel assembly. Removable access panels shall be provided with dished handle fasteners. Screwdriver 1/4 turn or Dzus type fasteners are not acceptable.

2. The flanged edges of all panels shall be straight and smooth. Corners shall be welded and ground smooth.

3. The face of the panel shall be true and level after angling.

4. All panel cutouts and holes may be cut or drilled by any standard method that does not cause deformation. Burrs shall be ground smooth.

5. Adjacent panels shall assemble with races flush. Gaps or cracks shall not be visible from the front of the assembled instrument board.

6. Stiffeners shall be welded to the back of panels, as required to prevent panel deformation due to the weight of face mounted instruments.

7. Panels shall be self-supporting as defined below.

E. Framework and Supports: The rear of each panel section shall have a steel framework assembled to it for supporting conduit, wireways, switches, piping, and instrument accessory Items such as relay or terminal enclosures, transducers, pressure switches, valves, and air relays.

1. The main framework shall be constructed of standard structural shapes. Special shapes such as "Unistrut" may be used for secondary supports. Framework must neither interfere with instrument connections nor interfere with access needed for maintenance or adjustments.

2. Steel framework shall extend 2-feet 4-inches back from the panel face or as indicated in the material requisition. Where indicated, individual adjustable leg supports shall be provided at the back of the framework so that the entire panel is self-supporting.

F. Preparation of Panel Surface: The following requirements apply to the front and rear face of the panel, both sides and the edges of all flanges, and the periphery of all holes or cutouts.

1. High spots, burrs, and rough spots shall be ground smooth.

2. The surfaces shall be sanded or sandblasted to a smooth, clean, bright finish.

3. All traces of oil shall be removed with a solvent.

4. The first coat of primer shall be applied immediately.

G. Instrument Finishing: The final coats applied to painted surface of instrument cases, doors, or bezels which are visible from the front of panels shall be manufacturer's standard unless otherwise indicated. Black Japan or "crinkle" finishes on instrument cases are not acceptable.

H. Mounting of Instruments: The panel vendor shall provide cutouts, and shall mount all instrument items indicated to be panel mounted, including any instruments indicated to be furnished by other vendors but installed in the panel.

1. The panel vendor shall also mount behind the panels other instrument accessory items as required for functionality as indicated.

2. Equipment mounted at the rear of panel shall be installed to allow for commissioning adjustments, servicing requirements, and cover removal.

3. Spare space shall be kept clear of wiring, etc., to give maximum space for future additions.

I. Panel Components:

1. Terminal Blocks.

a. Terminal blocks for power distribution and digital signals shall comply with the following requirements

a) Terminal blocks shall be UL rated for 600V, 30A minimum.

b) Terminal blocks shall have a compression-style screw clamp connection.

c) Terminal blocks shall be capable of accepting #12 AWG wire.

d) Terminal blocks directly associated with digital I/O signals shall be two-tier with pre-manufactured jumper bars for distribution of common signals.

b. Terminal blocks for analog signals shall comply with the following requirements:

a) Terminal blocks shall be UL rated for 300V, 20A minimum.

b) Terminal blocks shall have a compression-style screw clamp connection.

c) Terminal blocks shall be capable of accepting #16 AWG wire.

d) Terminal blocks shall be three-tier sensor blocks for termination of signal positive, negative, and shield with pre-manufactured jumper bars for distribution of common signals.

c. Fuse blocks shall comply with the following requirements:

a) Fuse blocks shall be UL rated for 600V, 10A minimum.

b) Fuse blocks shall incorporate a hinged lever that accepts 5x20 mm fuses.

c) Fuse blocks shall have a compression-style screw clamp connection.

d) Fuse blocks shall be capable of accepting #12 AWG wire.

e) Fuse blocks shall contain blown-fuse indication through the use of a neon lamp or an LED.

d. All terminal blocks and fuse blocks shall be designed for DIN rail mounting. Extra deep 15 mm DIN rail shall be used.

e. Contractor shall provide terminal block end sections and end stops as necessary for a complete installation.

f. Terminal blocks and fuse blocks shall be provided with pre-printed snap-on label strips. Stick-on labeling is not acceptable. Labeling shall be consistent with Contractor's control panel drawings. Contractor shall clearly label all terminal blocks in every control panel; unlabeled terminal blocks are not acceptable.

g. Terminal blocks and fuse blocks shall be ABB, Allen-Bradley, or approved equal.

2. Instrument Power: All instruments requiring power that are wired to a PLC shall also have power supplied from the same PLC control panel. All instrument power sources shall be individually fused.

3. Signal surge suppressors. Signal surge suppressors shall be provided for all analog signals leaving the envelope of the building.

a. Signal surge suppressors shall be Phoenix Contact TT-2-PE-24DC or equal.

4. Control Relays. Control relays shall comply with the following requirements:

a. Relays shall be plug-in style with a DIN-rail mountable base.

b. Relays shall have on/off indication.

c. General purpose control relays shall have 24VDC or 120VAC coil as required for application. Relay contacts shall be rated 10 Amp at 120VAC or 125VDC. Contractor shall be responsible for quantity of contacts as required for application. New general purpose control relays shall be Allen Bradley 700-HA series or equal.

d. Digital output interposing relays shall be terminal block style. Allen Bradley 700-HL series or equal.

5. Intrinsically Safe Barriers. Relays shall be solid-state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe use in hazardous areas. Relays shall be located in non-hazardous areas. Relays shall be manufactured by GEMS, MTL, R.Stahl, Inc., or Turck.

6. Circuit Breakers. Circuit breakers for use in control panels shall be rated for 600V service.

a. Control panel circuit breakers shall be DIN-rail mounted.

b. Control panel circuit breakers shall be Allen-Bradley, Square D, or approved equal.

7. Surge Suppression. PLC control panels shall incorporate a transient-voltage surge suppressor on the incoming line. Surge suppressors shall be properly sized by the Contractor based upon the maximum current draw of the control panel.

    a. Surge suppressors shall be Innovative Technology, Leviton, or equal.

8. DC Power Supplies. PLC control panels shall be provided with a redundant DC power supply system containing two identical 24VDC power supplies and a redundancy module to regulate loading.

    a. DC Power Supplies shall be redundant. A redundancy module shall be used to regulate loading.

    b. Size DC power supplies based upon the actual 24V load. Power supplies shall not be loaded more than 50% of rated capacity.

    c. DC power supply systems shall be Sola HD SDN Series, ABB CP Series, or equal.

9. Digital Panel Indicators. Digital indicators shall be designed for semi-flush mounting in a panel. The indicator shall be a 3 1/2 digit LED, LCD, or gas discharge type display, with digits at least 0.5 inch high. The indicator shall be easily read at a distance of 10 feet in varying control room lighting environments. Operating temperature range shall be 32°F to 140°F. Accuracy shall be ±0.1 percent. The indicator shall be scaled in engineering units, with the units engraved on the display face or on the associated nameplate. The indicator shall have a selectable decimal point and shall provide over-range indication. Digital indicators shall be manufactured by Invensys/Eurotherm/Action Instruments, Newport Electronics, Precision Digital Corporation, or Red Lion Controls.

10. Selector Switches. Selector switches shall be 30.5-mm, heavy-duty, oil-tight type with gloved-hand or wing lever operators. Position legends shall be engraved on the switch faceplate. Switches for electric circuits shall have silver butting or sliding contacts, rated 10 amperes continuous at 120 V ac. Contact configuration shall be as indicated on the Drawings or for the application. Switches used in electronic signal circuits shall have contacts suitable for that duty. Switches shall be Eaton/Cutler-Hammer "10250T", General Electric "CR104P", or Allen Bradley “800T”.

11. Indicating Lights. Indicating lights shall be 30.5-mm, heavy-duty, oil-tight type, with full voltage LED lamps. Legends shall be engraved on the lens or on a legend faceplate. Lights shall be push-to-test type. Indicating lights shall be Eaton/Cutler Hammer "10250T", General Electric "CR104P", or Allen Bradley “800T”.

12. Pushbuttons. Push buttons shall be 30.5-mm, heavy-duty, oil-tight type. Legends shall be engraved on the push-button faceplate. Contacts shall be rated 10 amperes continuous at 120 V ac. Push buttons shall be Eaton/Cutler-Hammer "10250T", General Electric "CR104P", or Allen Bradley “800T”.

13. Alarm Horns. Horns shall be high-decibel, panel-mount, vibrating type designed for heavy-duty use. Horn volume shall be field-adjustable from 78 to 103 dB at 10 feet. Horns shall operate at 120 volts ac. Horns shall be weatherproof NEMA Type 4X. Horns shall be panel front mounted and shall be supplied with gasket. Horns shall be Edwards Signals "870P Series."Horns shall be supplied with a field mounted enclosure. Horns shall be Edwards Signals "876 series."

J. Electrical Requirements:

1. All conduit, wireways, switches, wire, and electrical fittings for 120 volt circuits to instruments and other electrical devices as required for a complete and operable installation.

2. Conduit, wireways, junction boxes and fittings shall be provided for signal wire, thermocouple, or resistance thermometer lead wire. Conduit or wireway runs shall include those required between temperature sensors and temperature transmitters and between the thermocouple wireway or junction box and instruments.

3. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. Wiring shall be identified with stamped tubular wire end markers.

4. PLC control panels shall be provided with a 15 amp, 120 volt, service outlet circuit within the back-of-panel area.

5. PLC control panels shall be provided with fluorescent light and door activated switch.

6. Wall mounted or pedestal mounted panels shall be so sized as to adequately - dissipate heat generated by equipment mounted in or on the panel.

7. Control panels mounted outside shall be provided with thermostatically controlled heaters that maintain inside temperature above 40 degrees F.

8. Wiring Methods: Wiring methods and materials for all panels shall be in accordance with the NEC requirements for General Purpose (no open wiring) unless otherwise indicated. Control Panels shall be UL508A listed Control Panels.

9. Signal and Control Circuit Wiring: Wire type and sizes: Conductor shall be flexible stranded copper machine tool wire, UL listed Type MTW, and shall be rated 600 volts. Wires, including shielded cables, shall be No. 16 AWG minimum.

   a. Wire Insulation Colors: Ungrounded control circuit conductors operating at the supply voltage shall have a black insulation. Grounded circuit conductors shall have white insulation. Insulation for ungrounded AC control circuit conductors operating at less than the supply voltage shall be red. Wires energized by a voltage source external to the control panel shall have yellow insulation. Insulation for ungrounded DC conductors shall be blue. Insulation for grounded DC conductors shall be white with blue stripe. Twisted pair wiring shall be positive (+) black and negative(-) white/clear.

b. Wire Marking: Wire numbers shall be marked using white numbered wire markers made from plastic-coated cloth, Brady Type B 500 or equal, or shall be heat shrink plastic.

c. Flexible conduit is not acceptable except when specifically approved by the Engineer in writing. Conduit fittings shall be Crouse Hinds cast fittings or equal.

d. Splicing of wires will only be allowed in junction boxes. Splices shall be either soldered or pressure crimped type.

e. For case grounding, panels shall be provided with a 1/4-inch by 1-inch copper ground bus complete with soderless connector for one No.4 AWG bare stranded copper cable. The copper cable shall be provided by the Contractor and be connected to a system ground loop.

10. Power Supply: Unless otherwise indicated control panel primary power supplies shall be 120 volt, 60 Hz circuits. 24VDC subsystems shall be provided for PLC control panels.

K. Labor and Workmanship: Panels shall be fabricated, piped, and wired by fully qualified workmen who are properly trained, experienced, and supervised.

L. At a minimum, control panels shall be constructed in a UL shop and contain UL labels prior to shipment.

2.3 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Provide and install UPS(s) to power all PLC hardware furnished under this Specification.

B. The UPS shall receive a 120 VAC, 60 HZ power input, and generate a 120 VAC, 60 HZ output signal which is protected from incoming spikes, sags, noise, brownouts, and power outages.

1. The UPS shall incorporate a transformer, a battery pack, a battery charger, an inverter, and a microprocessor based controller to provide continuous, on-line, computer grade uninterruptible power. Lighting and surge protection shall meet ANSI/IEEE c62.41 categories A and B. The UPS shall be U.L. listed. Spike attenuation shall be 2000 to 1. The output neutral shall be bonded to ground. Noise isolation shall be 120 Db common-mode, 60 Db normal mode. Output voltage regulation shall be + 3% with less than 5% total harmonic distortion. UPS efficiency shall be at least 85%. The UPS shall be rated for ambient temperatures from 32 degrees F to 104 degrees F and relative humidity from 0 to 95%

2. Each UPS shall maintain power to all of its connected loads, including non-constant loads such as alarms and printers, for a minimum of 15 minutes with a 50% growth factor over the connected load. The equipment submittal shall include sizing calculations which support the model and size selected. The UPS shall be supplied with a low output voltage cutoff to prevent damage to loads when the battery power is exhausted.

C. The equipment shall include sizing calculation which support the unit selected being able to power all its connected loads for the indicated time period with a 50% growth factor.

D. The uninterruptible power supply shall be Eaton Ferrups UPS series, Liebert, IPM or equal.

2.4 SPARE PARTS AND SPECIAL TOOLS

A. Control panel spare parts selected by the Engineer and special tools shall be furnished by the Vendor.

PART 3 - EXECUTION

3.1 LISTING AND INSTALLATION

A. Control panels shall be installed in accordance with the applicable specifications.

B. Control Panels shall be fabricated in accordance with UL 508A, and shall be UL Listed Industrial Control Panels.

3.2 EQUIPMENT DELIVERY

A. Panels shall be crated for shipment using a heavy framework and skids. Panel sections shall be cushioned to protect the finish of the instruments and panel during shipment. Instruments which are shipped with the panel shall further have suitable shipping stops and cushioning material installed to protect parts which could be damaged due to mechanical shock. Each separate panel unit shall be provided with removable lifting lugs to facilitate handling.

B. Shipments by air ride van unless otherwise indicated. Control panel testing and inspection, if required, shall be performed prior to shipping.

3.3 CONTROL PANEL SIGNAL AND CONTROL CIRCUIT WIRING

A. Wiring Installation: Wires shall be run in plastic wireways except (1) field wiring, (2) wiring between mating blocks in adjacent sections, (3) wiring from components on a swing out panel to components on a part of the fixed structure, and (4) wiring to panel mounted components. Wiring run from components on a swing out panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals.

B. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and be secured to the inside face of the panel using adhesive mounts.

C. Wiring to rear terminals on panel-mount instruments shall be in plastic wireways secured to horizontal brackets above or below the instruments in about the same plane as the rear of the instruments.

D. Shop Drawings shall show conformance to the above wiring installation requirements.

E. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on Shop Drawings. These numbers shall be marked on conductors at every terminal.

3.4 CALIBRATION, TESTING, AND INSTRUCTION

A. Calibration, testing, and instruction shall be performed.

B. Inspection and Approval: Panel fabricator shall conduct the following tests before shipment.

1. Alarm circuits rung out to determine their operability.

2. Electrical circuits checked for continuity and where applicable, operability.

3. Any other test required to place the panel in an operating condition.

C. It shall be the responsibility of the Contractor to furnish all necessary testing devices and sufficient manpower to perform the tests required by the Engineer.

D. Factory Acceptance Testing: PLC control panels shall be factory tested as required by Division 40 specifications.

E. Field Testing: Each control panel shall be tested again for functional operation in the field after the connection of external conductors and prior to equipment startup.

END OF SECTION 40 67 00

SECTION 40 71 76 - INSERTION-TYPE AIR FLOW METER

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall provide insertion-type flowmeters capable of measuring direct mass, volumetric, or velocity flow measurement. The flow measuring system must be in accordance with the Contract Documents. The transmitter and sensor will be remote design with appropriate length of interconnecting cable. Communications between the transmitter and receiving devices will be accomplished through dual analog outputs available on the transmitter.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 30 00 – Vendor Submittals.

1.3 QUALITY ASSURANCE

A. The insertion element shall be stainless steel and the electronics must be housed in a NEMA 4X (IP66) rated enclosure. The flowmeter must come with a one-year unconditional warranty from the date of substantial completion.

PART 2 - PRODUCTS

2.1 FLOWMETER

A. All meters shall be capable of operating at an ambient temperature ranging from 0 to 140 degrees F.

B. Temperature Compensation: 0 to 250 degree F

C. Media Compatibility: Air, compressed air, and Nitrogen

D. Pipe/Line Size Compatibility: 2 to 24 inches

E. Instrument Range: .75 to 400 SFPS

F. Flow Element Installation: Insertion

G. Flow Element Type: Thermal Dispersion using constant current measurement principle

H. Flow Element Construction: 316 stainless steel

I. Transmitter Enclosure: NEMA 4X aluminum with epoxy coating.

J. Transmitter Output Signal: 4-20mA or 0-10VDC, user assignable to flow rate and/or temperature.

K. Input Power: 18-36VDC or 85-265VAC

L. Digital Display: +/-9999 Counts LED, 0.45" H characters, user scalable flow rate units or 0-100%.

M. Manufacturers, or equal:

1. FCI ST50 Series Flowmeters

2. Equal must be approved during bidding process.

2.2 FLOW CONDITIONERS

A. A flow conditioning panel shall be applied with flow meters with inadequate straight-run conditions to ensure flow meter accuracy and repeatability.

B. A flow conditioner pressure drop calculation for the design flow rates shall be provided. Excessive pressure drop across the conditioner is unacceptable.

C. The air flow meter manufacturer shall provide a flow conditioner with each flow meter that is approved for use by their company. The flow meter shall be factory calibrated for use with the flow conditioner provided. Flow conditioner and meter shall be calibrated as single system on an NIST traceable calibration stand and shall be from the same manufacturer. A NIST calibration certificate shall be provided.

D. Flow conditioners shall be flanged or shall mount between flanges and be constructed of 316 stainless steel. Conditioners that mount inside of piping or are welded to piping shall not be acceptable.

E. Manufacturers, or approved equal:

1. FCI Vortab VIP insertion panel

2. Equal must be approved during bidding process.

PART 3 - EXECUTION

3.1 GENERAL

A. Insertion-type air flow meter shall be mounted in accordance with manufacturer instructions.

B. Final acceptance of the equipment is contingent on satisfactory operation after installation.

C. Flowmeters shall be calibrated in accordance with the Manufacturer's recommendations and Section 40 79 23 – Testing, Calibration, and Commissioning.

3.2 INSTALLATION

A. The meters shall be installed in easily accessible locations for ease of reading and maintenance. Where possible, all meters shall be installed in such a way to provide the manufacturer's recommended straight approach and straight piping downstream.

B. Install flow conditioner in the location required by the flow meter manufacturer to maintain the flow meter factory-calibration.

3.3 TESTING

A. Equipment shall be prepared for operational use in accordance with manufacturer's instructions, including bench test and calibration, where required.

B. Each item shall be subjected to an operating test over the total range of capability of the equipment.

3.4 MANUFACTURERS SERVICE REPRESENTATIVE

A. Erection and Startup Assistance: During erection and startup of the flow meters, the Vendor shall provide all necessary assistance from an experienced factory service representative to ensure a correct and first-class installation.

B. Instruction of Owner's Personnel: After completion of the installation and during startup of the plant, the Vendor shall instruct the Owner's personnel in the proper operation, maintenance and repair of all metering equipment.

END OF SECTION 40 71 76

SECTION 40 72 00 - LEVEL MEASURING SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall provide level sensing equipment in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 30 00 – Vendor Submittals.

1.3 QUALITY ASSURANCE

A. Calibration: All level sensing equipment shall be shipped to the project site factory calibrated and accompanied with certificate of such.

B. Warranty: All sensors shall be provided with manufacturer's standard one-year product warranty.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE PRESSURE SENSOR

A. Submersible pressure sensors shall consist of a transducer, transmitter/receiver, and control relays. The pressure sensing unit shall consist of a top half of a 316 stainless steel seal with a welded 316 stainless steel diaphragm. The liquid level shall be obtained by converting pressure sensed across a diaphragm-protected transducer element. A microprocessor shall amplify and convert the signal into a digital representation from pressure to a liquid level surface reading. An output is produced when manually determined trip values are exceeded. The microprocessor-based electronics shall enable user selection of range, span, setpoints, time delay, units of distance, and selectable failsafe mode. Relay setpoints shall be adjustable over the entire span without the use of reference targets. Automatic temperature compensation circuitry shall be incorporated.

1. Diaphragm: The diaphragm shall be glycerin-filled and be welded 316 stainless steel with a 0.13 cubic inch displacement.

2. Material: All wetted parts, including standoff ring, spacers, nuts and bolts shall be of 316 Stainless steel. The body shall be made of 300 stainless steel and shall be explosion-proof design. Cable shall be polyurethane-jacketed, and 40-ft shall be provided as standard.

3. Signal Output: A 4-20 MADC using 2-wire twisted pair grounded shield cable. FM and CSA explosion-proof and intrinsically safe with a response time less than 5 ms.

4. Accuracy: the pressure sensing transducer shall have a static accuracy of 0.25% FSO BFSL and a 1-year stability accuracy of 0.20% FSO.

5. Remote mounted units shall be provided with connecting cable provided by the manufacturer of the switches. Input power shall be 120 VAC.

6. Switches shall be SPBT with a minimum rating of 10 Amps at 120 V AC.

7. Repeatability shall be 0.1-inch or less with a response time of less than one second and an accuracy of plus or minus 0.25 percent of full scale.

B. Manufacturers, or equal

1. Blue Ribbon, Model BC001Birdcage TM

2. WIKA, LS-10 LevelGuard

3. Equal must be approved during bidding process.

2.2 NON-INTRUSIVE ULTRASONIC LEVEL SENSORS

A. Non-intrusive ultrasonic level sensors shall consist of a transducer, transmitter/receiver, and control relays. The sonic level switch transmitter shall generate pulses that are directed to the liquid level. The returning echo/signal shall be detected by the receiver. A microprocessor shall amplify and convert the signal into a digital representation of the distance from the reflecting surface. An output is produced when manually determined trip values are exceeded. The microprocessor-based electronics shall enable user selection of range, span, setpoints, time delay, units of distance, and selectable failsafe mode. Relay setpoints shall be adjustable over the entire span without the use of reference targets. Automatic temperature compensation circuitry shall be incorporated.

1. The transducer housing shall be PVC with corrosion resistant sensor element.

2. Remote mounted units shall be provided with connecting cable provided by the manufacturer of the switches. Input power shall be 120 V AC.

3. Switches shall be SPBT with a minimum rating of 10 Amps at 120 V AC.

4. Repeatability shall be 0.1-inch or less with a response time of less than one second and an accuracy of plus or minus 0.25 percent of full scale.

B. Manufacturer, or equal

1. SIEMENS HydroRanger 200

2. Equal must be approved during bidding process.

2.3 FLOAT SWITCHES

A. Float switch shall be a non-floating (tilting switch action only) SPDT submersible switch. The switch shall be intrinsically safe with a zener barrier between the switch contacts and the power source. The switch shall be sealed in a polypropylene housing with a submersible cable sealed in the float switch body. The switch shall be supplied with a cable with adequate length to reach the barrier location without splicing the cable.

PART 3 - EXECUTION

3.1 GENERAL

A. Final acceptance of the equipment is contingent on satisfactory operation after installation.

B. Level measuring systems shall be calibrated in accordance with the Manufacturer's recommendations and Section 40 79 23 – Testing, Calibration, and Commissioning.

3.2 INSTALLATION

A. The level measuring systems shall be installed in easily accessible locations for ease of reading and maintenance.

3.3 TESTING

A. Each item shall be subjected to an operating test over the total range of capability of the equipment.

3.4 MANUFACTURERS SERVICE REPRESENTATIVE

A. Erection and Startup Assistance: During erection and startup of the level measuring systems, the Vendor shall provide all necessary assistance from an experienced factory service representative to ensure a correct and first-class installation.

B. Instruction of Owner's Personnel: After completion of the installation and during startup of the plant, the Vendor shall instruct the Owner's personnel in the proper operation, maintenance, and repair of the equipment.

END OF SECTION 40 72 00

SECTION 40 73 00 - PRESSURE MEASURING AND DETECTION SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall provide pressure measuring systems in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Shop Drawings and Technical Manual shall be submitted in conformance with the requirements of Section 01 30 00 – Vendor Submittals.

1.3 QUALITY ASSURANCE

A. Warranty: All pressure measuring, and detection systems shall be provided with manufacturer's standard one-year warranty.

PART 2 - PRODUCTS

2.1 GENERAL

A. Pressure gauges shall be provided on suction and discharge connections to pumps; discharge connections from blowers and compressors; and each side of pressure reducing valves. Vacuum gauges shall be provided for vacuum pumps. In all locations (such as certain pump suction connections) where pressures may vary below and above atmospheric head, compound gauges shall be installed.

B. Diaphragm Seals: Pressure sensing devices shall be equipped with diaphragm seals, or equal protective pressure or vacuum sensing devices as per standard details shown on the drawings. Diaphragm seals shall be provided for all gauges, pressure transmitters, or pressure switches where fluid has medium solids (i.e., nonpotable or plant effluent), contains chemicals, is of a corrosive nature, or high temperature which could affect the accuracy of the pressure sensing device. Materials shall be suitable for the intended application.

C. Annular Seals: Gauges and pressure sensing devices shall be provided with a flanged annular seal for all high solids (raw sewage, scum, and sludge) applications, including clarifier scum and sludge, waste activated sludge, and return activated sludge.

2.2 PRESSURE AND VACUUM GAUGES

A. Gauges shall be industrial quality type with Type 304 or 316 stainless steel movement and stainless steel or alloy case. Unless otherwise shown or specified, gauges shall have a 4½-inch dial, ¼-inch threaded connection, a Type 304 or 316 stainless steel snubber adapter, and shut-off valve. Gauges shall be calibrated to read in applicable units, with an accuracy of ± 1 percent, to 150 percent of the working pressure or vacuum of the pipe or vessel to which they are connected. Gauges for pumps shall read in feet of water and all gauges for air piping shall read in psi. All gauges shall be vibration and shock resistant.

B. Approved manufacturers, or equal, as approved by Engineer

1. Ashcroft
2. Foxboro
3. Rosemont

2.3 DIFFERENTIAL AND GAUGE PRESSURE TRANSMITTERS

A. Electronic differential transmitters shall consist of a capsule assembly, bottom works, vent plug, drain plug, cover flange, process connector and connection, amplifier unit, integral indicator, terminal box with cover, block and bleed valves, and conduit connections. Pressure applied to the unit shall be transmitted by a sealed fill fluid to both sides of a sensing diaphragm. The sensing diaphragm and the sensor body shall function as the moving and fixed electrodes, respectively, of a differential capacitor. As the applied pressure causes the diaphragm to move, the capacitance of the cell shall change.

B. Performance Requirements: The amplifier unit shall convert the change in capacitance to a 4 - 20 mA DC signal, 2 wire type, with an allowable loop load of no less than 600 ohms. Static pressure rating shall be a minimum of 500 psig. The maximum overrange pressure limit shall be a minimum of 150 percent of the range. Span shall be adjustable over a minimum of 5:1 range. External adjustments shall include zero and span. Output signal damping shall be provided as an internal adjustment.

1. Equipment shall be suitable for an ambient operating range of minus 40 degree F to plus 212 degrees F.
2. The integral indicator shall be calibrated in process units.
3. Power supply shall be 24 VDC.
4. Accuracy, including linearity and repeatability, shall be a plus or minus 0.2 percent of span.
5. Differential pressure transmitters used for flow service shall include square root extraction to produce an output signal linearly proportional to flow.

C. Wetted parts, including block and bleed valve parts, shall be constructed of Type 316 stainless steel.

D. Approved manufacturers, or equal, as approved by Engineer

1. With local indicator and controller:

    a. Foxboro

    b. Rosemount

    c. Yokogawa

2. Without local indicator and controller:

    a. Noshok

    b. SICK

2.4 ADJUSTABLE PRESSURE SWITCH

A. Adjustable pressure switches shall be diaphragm-actuated, dual adjustment pressure switches with SPDT contacts rated for a minimum of 5 Amps at 120 V AC. The dead band shall be adjustable up to 60 percent of full scale. Set points shall fall between 20 and 80 percent of the adjustable range. The diaphragm shall be Buna-N, and the lower housing shall be brass with a 1/4-inch bottom sensing connection, unless otherwise indicated.

B. Approved manufacturers, or equal, as approved by Engineer

1. United Electric

2. Ashcroft

2.5 DIAPHRAGM SEALS

A. Diaphragm seals shall consist of bottom housing, lower ring, diaphragm capsule, fill screw, flushing connection, and a top housing.

1. The diaphragm seal shall have a removable bottom housing to permit servicing.

2. The diaphragm seal shall be factory assembled to the corresponding pressure instrument and be factory-filled. The assembly shall be shipped with a tag reading "Do not disassemble for installation”.

3. Exposed surfaces housings shall be constructed of Type 316 stainless steel.

4. The diaphragm seal shall attach to the inlet connection of a pressure instrument to isolate its measuring element from the process fluid. The space between the diaphragm and the pressure element shall be completely filled with a suitable liquid. Displacement of the liquid fill in the pressure element through the movement of the diaphragm shall transmit process pressure changes directly to a gauge, transmitter, switch, or other pressure instrument.

B. Materials of Diaphragm: Seals shall be of Type 304 or 316 stainless steel with stainless steel diaphragm for pressure over 15 psi and elastomer diaphragm for pressure of 15 psi and less. Type 316 stainless steel nuts and bolts, fill connection and valved flush port size ¼-inch NPT capable of disassembly without loss of filler fluid.

C. Approved manufacturers, or equal, as approved by Engineer

a. Ashcroft Model 101

b. U.S. Gauge (Ametek) SG

c. Marshalltown Series 225-01

2. Snubber Manufacturers, or equal

a. Cajon Company

b. Weksler Instruments, Corp.

2.6 ANNULAR SEALS FOR PRESSURE MEASURING SYSTEMS

A. Annular seals shall consist of a bolt-through Isolator Ring and Type 304 or 316 stainless steel calibration/evacuation accessory. Any required instrument manifolds shall be Type 316 stainless steel, minimum size of ½" with NPT connection of size required for pressure sensing device. Pressure transmitters, switches and gauges shall be shipped to annular seal manufacturer for factory assembly, evacuation and calibration.

B. Isolator ring shall include a valve and/or quick release device to allow instruments to be removed while the piping is in service and to prevent loss of fill fluid.

C. Materials of Diaphragm: Seals shall be of Type 304 or 316 Stainless Steel for center section and end plates with Neoprene or EPDM diaphragm. Fill fluid shall be Silicone Fluid.

D. Approved manufacturers, or equal, as approved by Engineer

a. Onyx Valve

b. Ashcroft

PART 3 - EXECUTION

A. Pressure measuring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested.

END OF SECTION 40 73 00

SECTION 40 74 00 - TEMPERATURE MEASURING SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall provide temperature-measuring systems in accordance with the Contract Documents.

1.2 SUBMITTALS

A. The Vendor shall submit manufacturer's information for Engineer review in accordance with Section 01 30 00 – Vendor Submittals.

1.3 QUALITY ASSURANCE

A. Warranty: All temperature measuring systems shall be provided with manufacturer's standard one-year product warranty.

PART 2 - PRODUCTS

2.1 TEMPERATURE MEASURING SYSTEMS

A. Insertion type resistance temperature detectors (RTDs) shall be 100 ohms nominal at 0 degree C, tip-sensitive, 3 wire platinum in 1/4-inch Type 316 stainless steel sheath with watertight potting. Time constant in agitated water shall not exceed 6.0 seconds. RTD shall comply with International Practical Temperature Scale (IPTS) 68 standards. Accuracy shall be plus or minus 0.1 degree C. Temperature transmitters shall be 2 wire devices with continuously adjustable span and zero adjustments, integral direct reading indicator, solid state circuitry, and a 4 - 20 mA DC output linearly proportional to the indicated temperature span. Where indicated with thermowells, RTDs shall be provided with 316 stainless steel thermowell, spring-loading device, extensions, union coupler, and explosion-proof aluminum connection head. Union shall extend out beyond the pipe lagging. Surface type RTDs shall be a 100 ohm nominal at 0 degree C, 3 wire platinum element in a flexible watertight case for strapping to a pipe surface.

B. Temperature transmitters shall be 2 wire devices with continuously adjustable span and zero adjustments, integral direct reading indicator, solid state circuitry, and a 4 - 20 mA DC output linearly proportional to the indicated temperature span.

C. Where indicated with thermowells, RTDs shall be provided with 316 stainless steel thermowell, spring-loading device, extensions, union coupler, and explosion-proof aluminum connection head. Union shall extend out beyond the pipe lagging.

D. Surface type RTDs shall be a 100 ohm nominal at 0 degree C, 3 wire platinum element in a flexible watertight case for strapping to a pipe surface.

E. Resistance temperature detector assemblies shall be Rosemount Series 78, Moore Industries Ready to Install, or equal. Transmitter shall be Rosemount Model 3144/644, Moore Industries Ready to Install RTI2, or equal.

F. Resistance temperature for room detection shall be Versis Industries TE Series wall temperature sensor or equal.

2.2 BIMETALLIC TEMPERATURE DETECTION SWITCHES

A. Temperature switches shall be bimetallic type with 3/4-inch NPT thermowell process connection per applicable piping code. Switches shall have SPOT -contacts and be provided with an adjustable setpoint.

B. Bimetallic temperature detection switches shall be Mercoid Series FM-437 (water and oil service), Honeywell, or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Temperature measuring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested.

END OF SECTION – 40 74 00

SECTION 40 75 43 – DISSOLVED OXYGEN MEASURING SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Vendor shall provide dissolved oxygen (D.O.) measuring equipment in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 30 00 – Vendor Submittals.

1.3 QUALITY ASSURANCE

A. Calibration: All D.O. measuring equipment shall be shipped to the project site factory calibrated and accompanied with certificate of such.

B. Warranty: A written Manufacturer's warranty shall be provided for the equipment specified in this Section. The warranty shall be for a minimum period of one (1) year from the date of Substantial Completion equipment. The Vendor shall repair or replace all defects of materials or workmanship in the equipment.

PART 2 - PRODUCTS

2.1 DISSOLVED OXYGEN MEASURING SYSTEM

1. The dissolved oxygen (D.O.) monitoring system shall consist of a sensor, analyzer, and auxiliary equipment to facilitate mounting the D.O. monitoring system.

2. The system shall output a signal proportional to the dissolved oxygen level and the measured temperature. The analyzer shall meet NEMA 4X/IP66 requirements and shall be supplied with sufficient cable to connect the probes to the transmitter/indicators (22.9 feet minimum). The system shall be able to display the following parameters at a minimum:

    a. Dissolved Oxygen Concentration

    b. Temperature

    c. Relay Status

    d. Selected Salinity at Calibration

    e. Selected Value for Alarm Relays (High and Low Dissolved Oxygen)

    f. Error Pending and Error Log

    g. The system shall be able to perform automatic calibration of the dissolved oxygen monitoring system. The Power supply shall be 115 VAC, +10%, -15%.

3. The wetted probe shall sense the dissolved oxygen concentration via a luminescent sensor. The signal from the sensor shall be tied to the interface unit that will send all pertinent data to the PLC via ethernet cable. The dissolved oxygen transmitter shall be utilized for monitoring the dissolved oxygen concentration in the tank.

4. The measuring principle shall be based on luminescent material that is sensitive to oxygen.

5. Sensor replacement shall not require factory service personnel to be present. Calibration shall be accomplished in free air and will not require special chemical baths.

6. The interface unit shall be housed in a NEMA 4X/IP66 metal enclosure with a corrosion-resistant finish. The panel must be complete with terminal strips and wire ducts (if needed).

7. The interface unit shall be capable of managing a minimum of six (6) inputs.

8. Operation Characteristics:

    a. The dissolved oxygen probe shall be a continuous-reading probe that utilizes luminescent sensor technology.

    b. The probe will not require calibration more frequently than once every six months.

    c. The probe material shall be formed either Noryl® and 316 Stainless Steel or 316Ti, POM, and PVC. All parts of the probe shall be corrosion resistant and fully immersible.

    d. The sensor material shall be either poly butyl methacrylate or PMMA, PVC and silicone.

    e. The measurement range shall be 0.00 to 20.00 mg/L dissolved oxygen with an accuracy of ±0.2 ppm.

    f. The operation of the analyzers shall not be affected by H_2S, pH, K^{+1}, Na^{+1}, Mg^{+2}, Ca^{+2}, NH_4^{+1}, Al^{+3}, Pb^{+2}, Cd^{+2}, Zn^{+2}, $Cr_{(total)}$, Fe^{+2}, Fe^{+3}, Mn^{+2}, Cu^{+2}, Ni^{+2}, Co^{+2}, CN^{-1}, NO_3^{-1}, SO_4^{-2}, S^{-2}, $PO_4^{+}3$, Cl^{-1}, anion-active tensides, crude oils, or Cl_2.

    g. The sensor shall be supplied with a microprocessor-based analyzer. The analyzer shall contain a digital display with menu-driven software, two analog 4-20 mA outputs and 3 unpowered SPDT form ‘C’ alarm contacts. The controller shall be enclosed in a corrosion resistant IP66 enclosure.

    h. The probe shall provide electrolyte-free operation without the requirements of sample conditioning.

    i. The probe shall be furnished with a mounting kit.

    j. The temperature range is 0 to 50°C.

    k. The temperature accuracy is ± 0.2°C.

9. The dissolved oxygen sensor shall be suitable for submerged or flow through installation.

10. Spare Parts

    a. Supplier shall provide a minimum of one (1) spare DO probe for shelf stock.

    b. Supplier shall provide a minimum of one (1) spare interface unit (transmitter) for shelf stock.

11. Manufacturer of D.O. sensors and analyzers, or equal

    a. Hach LDO2 transmitter (Part No. 9020000) with Hach SC1000 controller (Part No. LXV402.99.12002) and Hach Sunroof and Mounting Hardware for SC1000 Controller (Part No. LZX957).

    b. YSI Optical DO with System 2020 3G – 20 Channel Terminal/Controller, IQ Sun Shield, and Rail Mounting Kit.

    c. Equal must be approved during bidding process

PART 3 - EXECUTION

3.1 SERVICE REPRESENTATIVE

A. Erection and Startup Assistance: During erection and startup, the Vendor shall obtain all necessary assistance from an experienced factory service representative to ensure a correct and first-class installation, in accordance with the manufacturer's instructions.

B. Instruction of Owner's Personnel: After completion of the installation and during startup of the plant, the Vendor shall instruct the Owner's personnel in the proper operation, maintenance, and repair of all equipment.

END OF SECTION 40 75 43

SECTION 40 79 23 – TESTING, CALIBRATION, AND COMMISSIONING

PART 1 - GENERAL

1.1 GENERAL PROCEDURES FOR INSPECTION, TEST, AND INSTRUMENT CALIBRATION

A. Each instrument shall be checked against the latest version of the design documents for tagging, manufacturer, model number, range, action, etc., before functional testing or calibration.

B. Any air system, permanent or temporary, used for energizing instrumentation shall be dry and clean at all times, and be blown down thoroughly before use. Any connection between the air supply system shall be via proper filter and regulator.

C. Plastic sealing plugs shall be used for all pneumatic connections and tubing except during test and immediately before final connection in the field.

D. Care shall be observed when connecting electric power supplies to the instrumentation. Insure correct voltage and frequency on AC power supplies. Insure correct voltage, polarity, and superimposed ripple on DC power supplies. Ensure correct polarity of the supply and proper grounding before connecting instruments.

E. The Vendor shall satisfy the requirement that the installation, calibration, and checkout of the instruments meet the requirements of the project specifications.

F. The calibration procedures for verifying instrument precision should conform to accepted practices as outlined in ASTM, ASHRAE, ISA, etc. specifications.

G. Copies of the manufacturer's installation and calibration instructions shall be provided to the calibration technicians prior to the commencement of calibration.

1.2 INSTRUMENT QUALITY LEVELS AND METEROLOGY

A. Instrumentation supplied for the calibrating sensing instruments for facility control system shall include documentation concerning the calibration method and traceability to the National Institute for Standards and Testing (NIST).

B. Process instrumentation shall be field checked for accuracy before installation even if the instruments have been calibrated by the manufacturer's metrology facilities.

PART 2 - PRODUCTS

2.1 CALIBRATION AND TEST EQUIPMENT

A. All calibration and test equipment shall be in proper working order and calibrated using traceable standards and equipment set by the NIST. Certificates of traceability shall be kept on file in the field calibration office or field project office. Copies of the traceability documents shall be included with the submittal of the calibration forms.

B. All calibration and test equipment shall carry a documented current calibration sticker reflecting the date of the last calibration and the name or initials of the technician who performed the calibration. A current calibration will be performed before the equipment is shipped to the site. The calibration equipment shall be shipped directly from the calibrating authority to the site, in packaging provided by the calibrating authority. A current calibration will be performed for all calibration or test equipment every 180 days or within the normal calibration interval, whichever is less.

C. Any field instruments calibrated with test equipment whose calibration has expired will be rejected and will be required to be recalibrated.

D. All calibration and test equipment shall be of a higher accuracy than the instrument being calibrated.

E. The Vendor shall supply calibration and test equipment of sufficient quantity, quality, and type to calibrate the instruments and sensors used in the installation.

2.2 BENCH TEST AND CALIBRATION FORMS AND METHODOLOGY

A. Calibration forms and calibration procedures for each instrument type shall be generated by the Vendor and approved by the Owner or his representative before proceeding with any calibrations. The manufacturer's procedures or the Owner's existing procedures shall form the basis for the calibration procedure.

B. The following format shall be used for instrument calibration form:

1. A separate calibration form shall be generated for similar types of instruments that have different accuracy and tolerance requirements.

2. The form shall contain as found and as calibrated data areas. The form shall contain areas for the calibrating and test instruments manufacture, serial number, and date of calibration.

3. The forms shall be filled out and signed in black ink.

4. Those instruments that can shall be calibrated on the bench under controlled conditions. Care shall be taken with those instruments that must be calibrated in the field to approximate the conditions of the bench test.

PART 3 - EXECUTION

3.1 GENERAL

A. The Vendor shall calibrate all instrumentation in an environment suitable to quality testing procedures. High accuracy comparative instruments or mechanisms shall be the standard against which instrument calibration is tested.

B. Verify that all process and test instruments have been calibrated and traceable to the NIST or other appropriate reference standards. Verify that a calibration sticker has been affixed to the instrument and that each instrument is within its calibration period at the time that the calibration is performed.

C. Each instrument shall be calibrated as per Owner approved calibration procedures and forms.

D. Each instrument shall have a calibration sheet completely filled out with all pertinent data related to the calibration and system. These calibration sheets shall be organized in a binder by system and turned over to the Owner at the completion of the project.

E. Instruments shall have a calibration sticker placed on the instrument. The sticker shall not be placed until the instrument has successfully completed the calibration procedure and the associated calibration form has been filled out and signed. The sticker shall bear the date of calibration and expiration and initials of the technician certifying calibration.

END OF SECTION 40 79 23

SECTION 43 05 01 – EQUIPMENT, GENERAL PROVISIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish each piece of equipment complete with its base, drives, shafting, couplings, controls, guards, and other appurtenances which are specified or are required for proper and safe operation.

B. Furnish any special tools or equipment required for proper operation maintenance, testing, or adjusting.

1.2 REFERENCE STANDARDS

A. Equipment shall be in accordance with the following standards, as applicable and as indicated in each equipment specification:

1.	AFBMA	Anti-Friction Bearing Manufacturers Association, Inc.
2.	ASTM	American Society for Testing and Materials
3.	ANSI	American National Standards Institute
4.	ASME	American Society of Mechanical Engineers
5.	AWWA	American Water Works Association
6.	ASHREA	American Society of Heating, Refrigerating, and Air Conditioning Engineers
7.	AWS	American Welding Society
8.	NFPA	National Fire Protection Association
9.	NEMA	National Electrical Manufacturers Association
10.	OSHA	General Industry Safety Orders

B. The following standards are referenced in this and other sections:

1.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800
2.	ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy and other Special Alloys
3.	ANSI B46.1	Surface Texture

4.	ANSI S12.6	Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors
5.	ASME B1.20.1	General Purpose Pipe Threads (Inch)
6.	ASME B31.1	Power Piping
7.	AWWA C206	Field Welding of Steel Water Pipe
8.	AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144-inches (100 mm through 3,600 mm)
9.	AWWA D100	Welded Steel Tanks for Water Storage
10.	ASTM A48	Gray Iron Castings
11.	ASTM A108	Steel Bars, Carbon, Cold-Finished, Standard Quality
12.	ASME B17.1	Keys and Keyseats
13.	ASME B106.1M	Design of Transmission Shafting

1.3 SUBMITTALS

A. Submittals shall be made in accordance with Section 01 30 00 – Vendor Submittals and the specific equipment specifications sections.

B. Shop Drawings: Furnish complete drawings and technical information for equipment, piping, valves, electrical and controls. Where indicated or required by the Engineer, Shop Drawings shall include clear, concise calculations showing equipment anchorage forces and the capacities of the anchorage elements.

C. Spare Parts List: The Vendor shall obtain from the manufacturer and submit at the same time as Shop Drawings a list of suggested spare parts for each piece of equipment. Vendor shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.

D. Operation and Maintenance Manual: Provide technical operation and maintenance manuals in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 ADAPTATION OF EQUIPMENT

A. The Vendor shall furnish equipment readily adaptable for installation and operation. Equipment furnished shall be compatible with all other equipment furnished under the Contract.

B. The Vendor shall assume full responsibility for all modifications of mechanical and electrical controls, equipment, wiring, piping, as required to accomplish function intended by the Contract Documents.

1.5 QUALITY ASSURANCE

A. Guarantees: Unless otherwise accepted herein, guarantee all equipment and its install required. Guarantees shall cover the following: (1) Faulty or inadequate design; (2) Improper assembly or erection; (3) Leakage, breakage, or other failure; and (4) Defective workmanship or materials.

B. Inspection, Start-up and Field Adjustment: The Vendor shall demonstrate that all equipment meets the specified performance requirements. Vendor shall provide the services of an experienced, competent, and authorized service representative of the manufacturer of each item of major equipment who shall visit the site of Work to perform the following tasks:

1. Assist the Installation Contractor in the installation of the equipment.

2. To inspect, check, adjust if necessary and approve the equipment installation.

3. To start-up and field-test the equipment for proper operation, efficiency, and capacity.

4. To perform necessary field adjustments, including programming services for set point adjustment, during the test period until the equipment installation and operation are satisfactory to the Engineer.

5. To instruct the Owner's personnel in the operation and maintenance of the equipment. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.

C. Quality and Tolerances: Tolerances and clearances shall be as shown on the Shop Drawings and shall be closely adhered to.

D. Machine Finish: The type of finish shall be the most suitable for the application and shall be shown in micro-inches in accordance with ANSI B46.1

PART 2 - PRODUCTS

2.1 GENERAL

A. Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damages and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weather-tight storage facilities prior to installation. For extended storage period, plastic equipment wrappers shall be avoided to prevent accumulation of condensate in gears and bearings. Equipment delivered to the Site with rust or corroded parts shall be rejected. If equipment develops defects during storage, it shall be disassembled, cleaned and recoated to restore it to original condition.

B. Identification Equipment Items: At the time of shipping, each item of equipment shall have a legible identifying mark corresponding to the equipment number in the Contract Documents for the particular item.

C. Protective Coating: Equipment shall be painted or coated in accordance with manufacturer recommendations. Non-ferrous metal and corrosive-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly and shipping.

D. Controls: Equipment and system controls shall be in accordance with the Contract Documents.

E. All flanges on equipment and appurtenances provided under this Section shall conform to ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise shown. All pipe threads shall be in accordance with ANSI/ASME B1.20.1.

F. Nameplates: Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate date describing the machine performance ratings.

G. Tools: The Vendor shall furnish one complete set of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of the equipment. Tools shall be of best quality hardened steel forgoing with bright finish. Wrench heads shall have work faces dressed to fit nuts. Tools shall be suitable for professional work and manufactured by Snap On, Crescent, Stanley, or equal. The set of tools shall be neatly mounted in a labeled toolbox of suitable design provided with a hinged cover.

H. Lubricants: Vendor shall lubricate all equipment prior to initial testing of the equipment. After successful initial testing, final testing, and satisfactory completion of startup testing as specified in Section 01 75 16 – Startup Procedures, the Vendor shall conduct one complete lubricant change on all equipment. In addition, the Vendor shall be responsible for the proper disposal of all used lubricants. The Owner will then be responsible for subsequent lubricant changes.

2.2 NOISE REQUIREMENTS

A. Noise Level: When in operation, no single piece of equipment shall exceed the OSHA noise level requirement of 105 dBA for one-hour exposure per day.

2.3 VIBRATION LIMITATIONS

A. Vibration frequencies shall span the range from 5.0 to 5,000 Hz. Where specified, measurements shall be obtained while the installed equipment is operating within the specified speed range.

B. Centrifugal Machines with Sleeve Bearings: Unless otherwise specified, centrifugal machines with sleeve bearing shafts shall not exhibit unfiltered RMS readings for vibration displacement in excess of the following:

Shaft speed range range, rpm	Displacement peak to peak, mils
Up to 900	3.5
901-1800	3.0
1801-3000	2.5
3001-4500	2.0
Above 4500	1.6

Displacement measurements shall be taken radially on the shaft at two points at each bearing. Measuring points shall be 90 degrees apart.

C. Centrifugal Machines with Antifriction Bearings: Unless otherwise specified, centrifugal machines with antifriction bearing shafts shall not exhibit unfiltered RMS readings for vibration velocity in excess of 0.12 inches per second. Velocity measurements shall be taken on one point of each bearing housing.

D. Positive Displacement Machines: Unless otherwise specified, positive displacement machines of the rotary, reciprocating and controlled volume types shall operate without any lateral or torsional vibration characteristics that may accelerate wear of the equipment. The Vendor shall provide manufacturer's certification that the manufacturer has inspected the machine under operating conditions and found it to comply with the manufacturer’s requirements.

E. Vibration Isolators: Air compressors, blowers, engines, and inline fans shall be provided with restrained spring-type vibration isolators or pads per manufacturer's written recommendations. Vibration isolations shall be provided with seismic restraint.

2.4 CRITICAL SPEED REQUIREMENTS

A. Unless otherwise specified, rotating mechanical equipment shall not exhibit critical speeds within the specified range of operating speeds and impeller blade pass frequencies. Critical speeds for equipment with rigid rotor systems shall be at least 20 percent greater than maximum operating speed and maximum impeller blade pass frequency, whichever is greater. Critical speeds for equipment with flexible shaft-rotor systems shall be at least 15 percent below minimum operating speed and 20 percent above maximum operating speed and blade pass frequency.

2.5 DRIVE TRAINS AND SERVICE FACTORS

A. Drive Trains and Service Factors: Service factors shall be applied in the selection or design of mechanical power transmission components. All components of drive train assemblies between the prime mover and the driven equipment shall be designed and rated to deliver the maximum peak or starting torque, speed, and horsepower. All of the applicable service factors shall be considered, such as mechanical (type of prime mover), load class, start frequency, ventilation, ambient temperature, and fan factors. Drive train components include couplings, shafts, gears, and gear drives, drive chains, sprockets, and V-belt drives. Unless otherwise indicated, the following load classification shall apply in determining service factors:

Type of Equipment	Service Factor	Load Classification
Centrifugal Fans	1.0	Uniform
Pumps		
Centrifugal or Rotary	1.0	Uniform
Reciprocating	1.8	Moderate Shock
Cranes or Hoists	1.25	Moderate Shock

B. Mechanical Service Factors

	Mechanical Service Factors
Uniform	1.25
Moderate Shock	1.50
Heavy Shock	2.0

C. For thermal rating adjustments such as start frequency, ambient temperature, and hourly duty cycle factor, ventilation factor, and fan factor, refer to gear manufacturer sizing information.

D. For service factors of electric motor, see Section 40 05 93 – Common Motor Requirements for Process Equipment.

E. Where load classifications are not indicated, service factors based on AGMA 514.02 shall be used for standard load classification and for flexible couplings.

2.6 SHAFTING

A. Shafting shall be continuous between bearings and shall be sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. Shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.

B. Design Criteria: All shafts shall be designed to carry the steady state and transient loads suitable for unlimited number of load applications, in accordance with ASME B 106.1 M - Design of Transmission Shafting. Where shafts are subjected to fatigue stresses, such as frequent start and stop cycles, the mean stress shall be determined by using the modified Goodman Diagram. The maximum torsional stress shall not exceed the endurance limit of the shaft after application of the factor of safety of 2 in the endurance limit and the stress concentration factor of the fillets in the shaft and keyway. Stress concentration factor shall be in accordance with ASME Standard B17.1 - Keys and KeySeats.

C. Materials: Shafting materials shall be appropriate for the type of service and torque transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as indicated unless furnished as part of an equipment assembly.

1. Low carbon cold-rolled steel shafting shall conform to ASTM A 108, Grade 1018.

2. Medium carbon cold-rolled shafting shall conform to ASTM A 108, Grade 1045.

3. Other grades of carbon steel alloys shall be suitable for service and load.

4. Corrosion-resistant shafting shall be stainless steel or Monel, whichever is most suitable for the intended service.

D. Differential Settlement: Where differential settlement between the driver and the driven equipment may occur, a shaft of sufficient length with sets of universal type couplings shall be provided.

2.7 BEARINGS

A. Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA).

B. To assure satisfactory bearing application, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and lubrication shall be considered in bearing selection.

C. All re-lubricatable type bearings shall be equipped with a hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.

D. All lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to insure maximum bearing life and best performance.

E. Anti-Friction Type Bearing Life: Except where otherwise indicated, bearings shall have a minimum L-10 life expectancy of 10 years or 20,000 hours, whichever occurs first. Where so indicated, bearings shall have a minimum rated L-10 life expectancy corresponding to the type of service, as follows:

Type of service	Design Life, years	L-10 Design Life, hours
	(Whichever comes first)	
8-hour shift	10	20,000
16-hour shift	10	40,000
Continuous	10	60,000

F. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as indicated or as recommended in the published standards of the manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.

G. Sleeve Type Bearings: Sleeve-type bearings shall have a steel, cast iron or ductile iron housing and Babbitt or bronze liner. Bearing housing shall be bolted and doweled to the lower casing half. These housings shall be provided with cast iron caps bolted in place and the bearing end caps shall be bored to receive the bearing shells. Sleeve bearings shall be designed on the basis of the maximum allowable load permitted by the bearing manufacturer. If the sleeve bearing is connected to an equipment shaft with a coupling, the coupling transmitted thrust will be assumed to be the maximum motor or equipment thrust. Lubricant, lubrication system, and cooling system shall be as recommended by the bearing manufacturer.

H. Plate Thrust Bearings: Thrust bearings shall be the Kingsbury Type, designed and manufactured to maintain the shaft in the fixed axial position without undue heating or the necessity of adjustment or attention. Bearings shall be oil lubricated to suit the manufacturer's standard method of lubrication for the specific bearing. If bearing cooling is required, manufacturer shall provide necessary piping, filters, and valves.

2.8 ELECTRIC MOTORS

A. All motors shall comply with requirements listed in Section 40 05 93 – Common Motor Requirements for Process Equipment. All variable frequency drive (VFD) controlled motors shall comply with NEMA MG-1 Design “B” requirements.

2.9 SPARE PARTS

A. Spare parts, where specified, shall be provided in clearly labeled boxes. Labels shall display “City of Aberdeen WWTP”, the major piece of equipment to which the part belongs, the part name, and the manufacturer's part number.

PART 3 - EXECUTION

3.1 PROTECTION

A. Box, crate, or otherwise completely enclose and protect all equipment during shipment, handling, and off-site storage. Responsibility for storage on the job site will be assigned to the Installation Contractor.

3.2 INSTALLATION

A. Equipment shall be installed in accordance with the manufacturer’s written recommendations. The Vendor shall select or recommend the size and type of coupling required to suit each specific application; installation shall be per equipment manufacturer's printed recommendations. All insulating connections shall be installed in accordance with the manufacturer's printed instructions.

B. Alignment: Equipment shall be field tested to verify proper alignment.

3.3 SERVICES OF MANUFACTURER

A. Inspection, Startup, and Field Adjustment: Where required by individual sections, an authorized, experienced, and competent service representative of the manufacturer shall visit the Site for the number of days indicated in those sections to witness or perform the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.

1. Installation of equipment

2. Inspection, checking, and adjusting the equipment and approving its installation

3. Startup and field testing for proper operation, efficiency, and capacity

4. Performing field adjustments during the test period to ensure that the equipment installation and operation comply with requirements

B. Instruction of the Owner's Personnel: Where required by the individual equipment sections, an authorized training representative of the manufacturer shall visit the Site for the number of days indicated in those sections to instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.

1. The representative shall have at least two years’ experience in training. A resume of the representative shall be submitted.

2. Proposed training material and a detailed outline of each lesson shall be submitted for review. Review comments from the Engineer shall be incorporated into the material.

3. The training materials shall remain with the trainees after the session. The Vendor shall videotape the training for later use by the Owner's personnel.

3.4 PACKAGED EQUIPMENT

A. When any system is furnished as pre-packaged equipment, the Vendor shall coordinate all necessary space and structural requirements, clearances, utility connections, signals, and outputs with Installation Contractor to avoid later change orders.

B. If the packaged system has any additional features (as safety interlocks, etc.) other than required by the Contract Documents, the Vendor shall coordinate such features with the Engineer and provide all material and labor necessary for a complete installation as required by the manufacturer.

3.5 FIELD TESTS

A. Where indicated by the individual equipment sections, equipment shall be field-tested after installation to demonstrate satisfactory operation without excessive noise, vibration, or overheating of bearings or motor.

B. The following field testing shall be conducted:

1. Start, check, and operate the equipment over its entire operating range. Vibration level shall be within the amplitude limits as indicated or as recommended by the reference applicable Standards.

2. Obtain, record and provide to Engineer concurrent readings of motor voltage, amperage, capacity, vibration, and bearing temperatures for each piece of major equipment.

C. The Engineer shall witness field testing. The Installation Contractor shall notify the Engineer of the test schedule seven days in advance.

D. In the event that any equipment fails to meet the test requirements, the equipment shall be modified and re-tested until it complies with the specified operating criteria.

END OF SECTION 43 05 01

SECTION 43 05 50 - EQUIPMENT MOUNTING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section specifies mounts, supports, and the anchorage for equipment and accessories.

1.2 REFERENCE STANDARDS

A. Federal Specifications

1.	MIL-A-907E	Anti-seize Thread Compound, High Temperature

B. Commercial Standards

1.	ASTM A 48	Gray Iron Castings
2.	ASTM A 193	Alloy Steel and Stainless Steel Building Materials for High Temperature Service
3.	ASTM A 194	Carbon and Allow Steel Nuts for Bolts for High Pressure and High Temperature Service
4.	ASTM A 307	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
5.	ASTM A 325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

1.3 SUBMITTALS

A. Calculations and shop drawings shall be submitted for all of the work required above in accordance with Section 01 30 00 – Vendor Submittals. Anchor bolt and expansion bolt submittals shall be in accordance with requirements specified herein. All calculations must be made and signed by a civil or structural engineer currently registered in the State of Idaho.

1.4 QUALITY ASSURANCE

A. Equipment anchorage calculations shall be provided by the Vendor according to manufacturer's recommendation, 2018 International Building Code and industry standards requirements, unless otherwise specified. All elements required to resist the calculated forces described herein or required by the equipment manufacturer shall be provided by the Vendor. The Installation Contractor shall furnish the anchoring hardware in accordance with the Vendor’s calculations.

PART 2 - PRODUCTS

2.1 GENERAL

A. Equipment mountings shall be as shown. All equipment located in floor slabs shall be mounted on concrete pads. Where a steel or cast base is shown or specified between the equipment and the concrete pedestal, it shall be hot-dip galvanized after fabrication.

B. For belt driven equipment shown as in-line and piggyback, the base shall be, rectangular and the motor shall always be behind and above the driven equipment and never over the driven equipment unless approved by the Engineer. Motor mounting hardware for any belt driven configuration shall allow for belt tension adjustment.

2.2 EQUIPMENT SUPPORTS AND FOUNDATIONS

A. Steel Bases: Structural steel bases shall be rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases, which may be "T" or "L"- shaped where shown. Pump bases for split case pump shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the base. Beam depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Grout holes shall be provided for the bases of all equipment where vibration isolation is not specified. Where vibration isolation is required, height saving brackets shall be employed in all mounting locations to provide a base clearance of one (1) inch.

2.3 CONNECTIONS

A. All pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment by Installation Contractor.

B. Flanges and Pipe Threads: All flanges on equipment and appurtenances provided under this Section shall conform to ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise shown. All pipe threads shall be in accordance with ANSI/ASME B1.20.1.

C. Unless otherwise indicated, equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greater of that noted in the general structural notes or as required by the governing building code, or 10 percent of gravity. Submitted design calculations for equipment supports shall bear the signature and seal of an engineer registered in the state wherein the project is to be built, unless otherwise indicated.

D. Couplings: Mechanical couplings shall be provided between the driver and the driven equipment. Flexible couplings shall be provided between the driver the driven equipment to accommodate sight angular misalignment, parallel misalignment, end float, and to cushion shock loads.

1. Unless otherwise indicated or recommended by the equipment manufacturer, coupling type shall be furnished with the respective equipment as follows:

Equipment Type	Coupling Type
Horizontal and end suction pumps	Gear or flexible spring
Vertical non-clog pumps, closed coupled	Flexible disk pack
Single stage centrifugal blowers	Flexible disk pack
Air compressors	Gear or flexible pack

2. Each coupling size shall be determined based on the rated horsepower of the motor, speed of the shaft, and the load classification service factor. The Contractor shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.

3. Taper-Lock or equal bushing may be used to provide for easy installation and removal of shafts of various diameters.

2.4 ANCHOR BOLTS

A. The Installation Contractor shall be responsible in providing anchor bolts for all equipment supplied to this project.

B. Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 25 percent, up to a limiting maximum oversizing of 1/4 inch. Minimum anchor bolt diameter shall be 1/2 inch. Anchor bolts shall be furnished with leveling nuts, the faces of which shall be tightened against flat surfaces as shown to not less than 10 percent of the bolt's safe tensile stress.

C. Tapered washers shall be provided where mating surface is not square with the nut.

D. Bolts, anchor bolts, nuts, and washers shall be Type 316 stainless steel, Class 1, conforming to ASTM A193 for bolts and to ASTM A194 for nuts. All threads on stainless steel bolts shall be protected with an antiseize lubricant suitable for submerged stainless steel bolts, to meet government specification MIL-A-907E. Buried bolts in poorly drained soil shall be coated the same as the buried pipe.

1. Antiseize lubricant shall be "PURE WHITE" by Anti-Seize Technology, Franklin Park, IL, 60131, AS-470 by Dixon Ticonderoga Company, Lakehurst, NJ, 08733, or equal.

E. Bolt Requirements: The bolt and nut material shall be free-cutting steel. The nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. All bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.

F. Bolts and nuts shall be installed with washers fabricated of material matching the base material of bolts, except that hardened washers for high strength bolts shall conform to the requirements of the AISC Specification. Lock washers fabricated of material matching the bolts shall be installed where indicated.

G. The length of each bolt shall be such that after the joint is made up, the bolt extends through the entire nut, but in no case more than 1/2-inch beyond the nut.

H. Adhesive Anchors: Unless otherwise indicated, all drilled, concrete or masonry anchors shall be adhesive anchors. No substitutions will be considered unless accompanied with ICBO report verifying strength and material equivalency.

1. Adhesive anchors are required for drilled anchors for indoor installations, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring reinforcing bars. Threaded rod shall be stainless steel Type 316. Epoxy adhesive shall be Hilti HIT RE 500 V3.

2. Unless otherwise indicated, glass capsule, polyester resin adhesive anchors will be permitted in locations not included above and shall be Hilti HVA or Cobra Anchors. Threaded rod shall be galvanized steel.

I. Expanding-Type Anchors: Expanding-type anchors if indicated or permitted, shall be galvanized steel expansion type ITW Ramset/Redhead "Trubolt" anchors; Hilti "Kwik-Bolt;" or equal. Lead caulking anchors will not be permitted. Size shall be as indicated. Embedment depth shall be as the manufacturer recommends for the load to be supported. Expansion type anchors which are to be embedded in grout may be steel. Non-embedded buried or submerged anchors shall be stainless steel.

J. Overhead Applications: Use Hilti HDA undercut anchors.

K. Miscellaneous Bolts and Nuts: ASTM A307

L. High Strength Bolts and Nuts: ASTM F3125 Grade A325

M. Concrete Anchors: Use cast in anchor bolts where required. Provide attachment to concrete with concrete anchors where shown on the drawings conforming to the following types. Use only type of concrete anchor shown on the drawings.

1. Expansion Anchors: Expansion anchors shall be wedge-type with a single piece three section wedge to anchor the stud in the hole. The stud nut and wedge shall be ANSI 304 stainless steel.

2. Adhesive Anchors: Adhesive anchors shall be an all thread rod with a nut. The all thread rod and nut shall be ANSI 304 stainless steel. The rod shall be anchored in the hole using a premeasured adhesive capsule consisting of vinyl urethane methacrylate adhesive.

3. Undercut Anchors: Undercut anchors shall be an undercut style with a brazed tungsten carbide edge on the undercutting end to perform the self-cutting undercut as the anchor is installed. The anchor shall cut and undercut bearing area of at least 2.5 times the nominal anchor bolt size. The anchor stud shall be ANSI 316 stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Each piece of equipment shall be anchored to resist a minimum lateral force required by the code, the manufacturer of the equipment or a lateral seismic force of 40 percent of the operating weight of the equipment, whichever is greater. This force shall be considered acting at the center of gravity of the piece under consideration. No equipment shall be anchored to vertical structural elements without written approval of the Engineer.

B. Equipment which is not vibration isolated shall be anchored directly to the, supporting floor system. In addition to the anchorage, all such equipment shall be internally designed so that all static and moving parts are anchored to the supporting framework to resist the imposed seismic force. All forces must be transmitted to the base in order to be anchored as required. Vibration isolated equipment shall be specially designed to meet these same requirements.

C. All piping, accessories, and appurtenances furnished with equipment shall be anchored to resist a lateral seismic force of 40 percent of its operating weight without excessive deflection. This force shall be considered acting at the center of gravity of the piece under consideration.

END OF SECTION 43 05 50

SECTION 43 05 60 – PROCESS EQUIPMENT TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Testing of mechanical equipment and systems.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. S1.4 Specification for Sound Level Meters.

B. Hydraulic Institute (HI).

1.3 SUBMITTALS

A. Schedule of factory tests and field tests as specified in Section 01 75 16 – Startup Procedures and this Section.

B. Test instrumentation calibration data.

C. Start-up plan as specified in Section 01 75 16 – Startup Procedures.

D. Test plan specified in this section.

E. Test result reports.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 QUALITY CONTROL TESTING AND REPORTING

A. Scheduling and notification:

1. Witnessed source quality control tests: Schedule test date and notify Engineer at least 30 days prior to start of test.

2. Field quality control tests: Schedule test date and notify Engineer at least 7 days prior to start of test.

B. Testing levels:

1. Test equipment based on test levels specified in the equipment section of this Project.

2. Requirements for Test Levels 1 to 4 are defined below.

3. Test levels apply for both Source (Factory) Quality Control Tests and Field Quality Control Tests as specified in the equipment sections of this Project.

4. If testing is not specified in the equipment section, provide Level 1 testing.

5. Requirements of Section 01 75 16 – Startup Procedures apply to Test Levels.

C. Witnessing: Source Quality Control Tests not witnessed unless specified otherwise in the equipment section or Section 01 75 16 – Startup Procedures; Field Quality Control Tests shall be witnessed.

D. Instrumentation: Provide necessary test instrumentation which has been calibrated within 1 year from date of test to recognized test standards traceable to the National Institute of Standards and Technology, Washington, D.C. or approved source. Properly calibrated field instrumentation permanently installed as a part of the Work may be utilized for Field Quality Control Tests.

E. Temporary facilities and labor: Provide necessary fluids, utilities, temporary piping, temporary supports, temporary access platforms or access means and other temporary facilities and labor necessary to safely operate the equipment and accomplish the specified testing. With Owner's permission, some utilities may be provided by fully tested permanently installed utilities that are part of the Work.

F. Test fluids:

1. Factory tests: Use water or air as appropriate at ambient conditions unless specified otherwise in the equipment section.

2. Field tests: Use specified process fluid at available conditions.

G. Pressure testing: Hydrostatically pressure test pressure containing parts in the factory at the appropriate standard or code required level above the equipment component specified design pressure or operating pressure, whichever is higher. Submit pressure test reports before shipping.

H. Test measurement and result accuracy:

1. Use test instruments with accuracies as recommended in the appropriate referenced standards. When no accuracy is recommended in the referenced standard, use 1 percent or better accuracy test instruments. Improved (lower error tolerance) accuracies specified elsewhere prevail over this general requirement.

2. Do not adjust results of tests for instrumentation accuracy. Measured values and values directly calculated from measured values shall be the basis for comparing actual equipment performance to specified requirements.

I. Field testing:

1. Submit test plan as specified in Section 01 75 16 – Startup Procedures and this section. Indicate test start time and duration, equipment to be tested, other equipment involved or required; temporary facilities required, number and skill or trade of personnel involved; safety issues and planned safety contingencies; anticipated effect on Owner's existing equipment and other information relevant to the test. Provide locations of all instruments to be used for testing. Provide calibration records for all instrumentation.

2. Perform general start-up and testing procedures as specified in Section 01 75 16 – Startup Procedures.

3. Prior to testing, verify equipment protective devices and safety devices have been installed, calibrated, and tested.

J. Reports: Submit reports for source and field-testing. Submit Source Quality Control Test result reports before shipping equipment to the field. Report features:

1. Report results in a bound document in generally accepted engineering format with title page, written summary of results compared to specified requirements, and appropriate curves or plots of significant variables in English units.

2. Include appendix with a copy of raw, unmodified test data sheets indicating test value, date and time of reading, and initials of person taking the data.

3. Include appendix with sample calculations for adjustments to raw test data and for calculated results.

4. Include appendix with the make, model, and last calibration date of instrumentation used for test measurements.

5. Include in body of report a drawing or sketch of the test system layout showing location and orientation of the test instruments relative to the tested equipment features.

3.2 EQUIPMENT TESTING, GENERAL

A. Tests for pumps, all levels of testing:

1. Test in accordance with applicable HI Standards in addition to the requirements in this and other sections.

2. Test tolerances: In accordance with appropriate HI Standards, except the following modified tolerances apply:

a. From 0 to plus 5 percent of head at the specified flows.

b. From 0 to plus 5 percent of flow at the rated design point head.

c. No negative tolerance for the efficiency at the specified flows.

d. No positive tolerance for vibration limits. Vibration limits and test methods in HI Standards do not apply, use limits and methods specified in this or other sections of the Specifications.

B. Tests for drivers: Test motors as specified in Section 40 05 93 Common Motor Requirements for Process Equipment. Test other drivers as specified in the driver equipment section.

3.3 REQUIREMENTS FOR VIBRATION TESTING

A. Definitions:

1. Peak-to-peak displacement: The root mean squared average of the peak-to-peak displacement multiplied by the square root of 2.

2. Peak velocity: The root mean squared average of the peak velocity multiplied by the square root of 2.

3. Peak acceleration: The root mean squared average of the peak acceleration multiplied by the square root of 2.

4. High frequency enveloping: A process to extract very low amplitude time domain signals associated with impact or impulse events such as bearing or gear tooth defects and display them in a frequency spectrum of acceleration versus frequency.

a. Manufacturers: One of the following or equal:

1) Rockwell Automation, Entek Group, "Spike Energy" analysis.

2) CSI, "PeakVue."

5. Low speed equipment: Equipment or components of equipment rotating at less than 600 revolutions per minute.

6. High speed equipment: Equipment and equipment components operating at or above 600 revolutions per minute.

B. Vibration instrumentation requirements:

1. Analyzers: Use digital type analyzers or data collectors with anti-aliasing filter, 12 bit A/D converter, fast fourier transform circuitry, phase measurement capability, time wave form data storage, high frequency enveloping capabilities, 35 frequency ranges from 21 to 1,500,000 cycles per minute, adjustable fast fourier transform resolution from 400 to 6,400 lines, storage for up to one hundred 3,200 line frequency spectra, RS232C data output port, circuitry for integration of acceleration data to velocity or double integration to displacement.

a. Manufacturers: One of the following or equal:

1) Entek-IRD, Division of Rockwell Automation, Enpac 1200 with applicable data analysis software or Entek Model 838 analyzer with built in printer.

2) Computational Systems Inc., (CSI) Division of Emerson Electric, Model 2120A, Data Collector/analyzer with applicable analysis software.

2. Analyzer settings:

   a. Units: English, inches/second, mils, and gravitational forces.

   b. Fast fourier transform lines: Most equipment 1,600 minimum; for motors, enough lines as required to distinguish motor current frequencies from rotational frequencies, use 3,200 lines for motors with a nominal speed of 3,600 revolutions per minute; 3,200 lines minimum for High Frequency Enveloping; 1,600 lines minimum for low speed equipment.

   c. Sample averages: Four (4) minimum.

   d. Maximum frequency (Fmax): 40 times rotational frequency for rolling element bearings, 10 times rotational frequency for sleeve bearings.

   e. Amplitude range: Auto select but full scale not more than twice the acceptance criteria or the highest peak, whichever is lower.

   f. Fast fourier transform windowing: Hanning Window.

   g. High pass filter: Minus 3 dB at 120 cycles per minute for high speed equipment. Minus 3 dB at 21 cycles per minute for low speed equipment.

3. Accelerometers:

   a. For low speed equipment: Low frequency, shear mode accelerometer, 500 millivolts per gravitational force sensitivity, 10 gravitational force range, plus/minus 5 percent frequency response from 0.5 hertz to 850 hertz, magnetic mount.

      1) Manufacturers: One of the following or equal:

      2) Wilcoxon Research, Model 797L.

      3) PCB, Model 393C.

   b. For high speed equipment: General purpose accelerometer, 100 millivolts per gravitational force sensitivity, 50 gravitational force range, plus/minus 3dB frequency response range from 2 hertz to 12,000 hertz when stud mounted, with magnetic mount holder.

      1) Manufacturers: One of the following or equal:

      2) Wilcoxon Research, Model 793.

      3) Entek-IRD Model 943.

C. Accelerometer mounting:

1. Use magnetic mounting or stud mounting.

2. Mount on bearing housing in location with best available direct path to bearing and shaft vibration.

3. Remove paint and mount transducer on flat metal surface or epoxy mount for High Frequency Enveloping measurements.

D. Vibration testing results presentation:

1. Provide equipment drawing with location and orientation of measurement points indicated.

2. For each vibration measurement take and include appropriate data on equipment operating conditions at the time vibration data is taken; for pumps, compressors, and blowers record suction pressure, discharge pressure, and flow.

3. When Vibration Spectra Data required:

a. Plot peak vibration velocity versus frequency in cycles per minute.

b. Label plots showing actual shaft or part rotation frequency, bearing inner and outer race ball pass frequencies, gear mesh frequencies and relevant equipment excitation frequencies on the plot; label probable cause of vibration peaks whether in excess of specification limits or not.

c. Label plots with equipment identification and operating conditions such as tag number, capacity, pressure, driver horsepower, and point of vibration measurement.

d. Plot motor spectra on a log amplitude scale versus frequency.

4. For low speed equipment, plot peak vibration displacement versus frequency as well as velocity versus frequency.

5. Provide name of manufacturer and model number of the vibration instrumentation used, including analyzer and accelerometer used together with mounting type.

3.4 TESTING LEVELS

A. Level 1 Quality Control Tests:

1. Level 1 General Equipment Performance Test:

a. For equipment, operate, rotate, or otherwise functionally test for 15 minutes minimum after components reach normal operating temperatures.

b. Operate at rated design load conditions.

c. Confirm that equipment is properly assembled, equipment moves or rotates in the proper direction, shafting, drive elements and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.

2. Level 1 Pump Performance Test:

a. Measure flow and head while operating at or near the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.

b. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in 40 05 93 Common Motor Requirements for Process Equipment or the applicable equipment section. Use actual driver for field tests.

c. Record measured flow, suction pressure, discharge pressure, and make observations on bearing temperatures and noise levels.

3. Level 1 Vibration Test:

a. Test requirement:

1) Measure filtered vibration spectra versus frequency in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component.

2) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.

b. Equipment operating condition: Test at specified maximum speed.

4. Level 1 Noise Test:

a. Measure unfiltered overall A-weighted sound pressure level in dBA at 3 feet horizontally from the surface of the equipment and at a mid-point of the equipment height.

B. Level 2 Quality Control Tests:

1. Level 2 General Performance Test:

a. For equipment, operate, rotate, or otherwise functionally test for at least 2 hours after components reach normal operating temperatures.

b. Operate at rated design load conditions.

c. Confirm that equipment is properly assembled, equipment moves or rotates in the proper direction, shafting, drive elements and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.

2. Level 2 Pump Performance Test:

a. Test 2 hours minimum for flow and head at the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.

b. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in 40 05 93 Common Motor Requirements for Process Equipment. Use actual driver for field tests.

c. Test for flow and head at 2 additional conditions; 1 at 25 percent below the rated flow and 1 at 10 percent above the rated flow.

d. Record measured flow, suction pressure, discharge pressure, and observations on bearing temperatures and noise levels at each condition.

3. Level 2 Vibration Test:

a. Test requirement:

1) Measure filtered vibration spectra versus frequency and measure vibration phase in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component; measure actual rotational speeds for each vibration spectra measured using photometric or other tachometer input connected directly to the vibration data collector.

2) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.

b. Equipment operating condition: Repeat test requirements at design specified maximum speed and at minimum speed for variable speed equipment.

c. Natural frequency test of field installed equipment:

1) Excite the installed equipment and support system in 3 perpendicular planes, use same planes as operating vibration measurement planes, and determine the as-installed natural resonant frequency of the driven equipment, the driver, gears and supports.

2) Perform test at each bearing housing, at each support pedestal, and for pumps on the suction and discharge piping.

3) Perform with equipment and attached piping full of intended service or process fluid.

4. Level 2 Noise Test:

a. Measure filtered A-weighted overall sound pressure level in dBA for each of 8 octave band mid-points beginning at 63 hertz measured at 3 feet horizontally from the surface of the equipment at mid-point height of the noise source.

C. Level 3 Quality Control Tests:

1. Level 3 General Equipment Performance Tests:

a. For equipment, operate, rotate, or otherwise functionally test for at least 4 hours after components reach normal operating temperatures.

b. Confirm that equipment is properly assembled, equipment rotates in the proper direction, shafting and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual noise, vibration or temperatures are observed.

c. Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure and temperature readings using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.

d. Bearing temperatures: During maximum speed or capacity performance testing, measure and record the exterior surface temperature of each bearing versus time.

2. Level 3 Pump Performance Test:

a. Test 4 hours minimum for flow and head at or near the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.

b. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in 40 05 93 Common Motor Requirements for Process Equipment. Use actual driver for field tests.

c. Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 15 minutes; for factory testing, test at other speeds may be omitted if test driver at reduced speeds is used for rated condition testing.

d. Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices are not required by the equipment section) and record observations on noise levels.

3. Level 3 Vibration Test:

a. Requirements: Same as Level 2 vibration test except data taken at each operating condition tested and with additional requirements below.

b. Perform High Frequency Enveloping Analysis for gears and bearings.

1) Measure bearing element vibration directly on each bearing cap in a location close as possible to the bearing load zone that provides a smooth surface and direct path to the bearing to detect bearing defects.

2) Report results in units of acceleration versus frequency in cycles per minute.

c. Perform Time Wave Form analysis for gears, low speed equipment and reciprocating equipment; plot true peak amplitude velocity and displacement versus time and label the period between peaks with the likely cause of the periodic peaks (relate the period to a cause).

d. Plot vibration spectra on 3 different plots; peak displacement versus frequency, peak acceleration versus frequency and peak velocity versus frequency.

4. Level 3 Noise Test: Measure filtered, un-weighted overall sound pressure level in dB at 3 feet horizontally from the surface of the equipment at mid-point height and at 4 locations approximately 90 degrees apart in plan view; report results for each of 8 octave band mid-points beginning at 63 hertz.

D. Level 4 Quality Control Tests:

1. Level 4 General Equipment Performance Test:

a. For equipment, operate, rotate, or otherwise functionally test for at least 8 hours after components reach normal operating temperatures.

b. Operate at rated design load conditions for1/2 the specified time; operate at each of any other specified conditions for a proportionate share of the remaining test time.

c. Confirm that equipment is properly assembled, equipment rotates in the proper direction, shafting and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual noise, vibration or temperatures are observed.

d. Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure and temperature readings using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.

e. Bearing temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.

2. Level 4 Pump Performance Test:

a. Test 8 hours minimum for flow and head; begin tests at or near the rated condition; for factory and field-testing, test with furnished motor at full speed.

b. Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 20 minutes or longer as necessary to measure required performance, vibration and noise data at each test condition.

c. Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices not required by the equipment section) and record observations on noise levels.

d. Bearing temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.

e. Perform efficiency and/or Net Positive Suction Head Required (NPSHr) and/or priming time tests when specified in the equipment section in accordance with the appropriate HI standard and as follows:

1) Perform NPSHr testing at maximum rated design speed, head and flow with test fluids at ambient conditions; at maximum rated speed, test at 15 percent above rated design flow, and 25 percent below rated design flow.

2) Perform efficiency testing with test fluids at maximum rated speed.

3) Perform priming time testing with test fluids at maximum rated speed.

3. Level 4 Vibration Test: Same as Level 3 vibration test.

4. Level 4 Noise Test: Same as Level 3 Noise Test except with data taken at each operating condition tested.

3.5 SOURCE QUALITY CONTROL

A. Test equipment as specified for each type of test at the test levels specified in equipment sections. Prepare and submit test reports as specified.

B. Inspection and balancing:

1. Statically and dynamically balance each of the individual rotating parts as required to achieve the required field vibration limits. Statically and dynamically balance the completed equipment rotating assembly and drive shaft components.

2. Furnish copies of material and component inspection reports including balancing reports for equipment system components and for the completed rotating assembly.

C. Critical speed of rotating equipment: Satisfy the following:

1. The first lateral and torsional critical speed of all constant, variable, and 2-speed driven equipment that is considered rigid such as horizontal pumps, all non-clog pumps, blowers, air compressors, and engines shall be at least 25 percent above the equipment's maximum operating speed.

2. The first lateral and torsional critical speed of all constant, variable, and 2-speed driven equipment that is considered flexible or flexibly mounted such as vertical pumps (vertical in-line and vertical non-clog pumps excluded) and fans shall at least 25 percent below the equipment's lowest operating speed.

3. The second lateral and torsional critical speed of all constant, variable, and 2-speed equipment that is considered flexible or flexibly mounted shall be at least 25 percent above the maximum operating speed.

3.6 FIELD QUALITY CONTROL

A. Test equipment as specified for each type of test at the test levels specified in equipment sections. Prepare and submit test reports as specified. Comply with latest version of applicable standards.

B. For variable speed equipment, conduct test to establish performance over the entire speed range and at the average operating condition. Establish performance curves for:

1. The speed corresponding to the rated maximum capacity.

2. The speed corresponding to the minimum capacity.

3. The speed corresponding to the average operating conditions.

3.7 VIBRATION ACCEPTANCE CRITERIA

A. Testing of rotating mechanical equipment: Tests are to be performed by an experienced, factory trained, and independent authorized vibration analysis expert.

B. Vibration displacement limits: Unless otherwise specified, equipment operating at speeds 600 revolutions per minute or less is not to exhibit unfiltered readings in excess of following:

Operating Speed (revolutions per minute)	Unfiltered (Overall) Peak-to-Peak Amplitude (mils)
	All Rotating Equipment
0 - 300	6.5
301 - 600	4.5
Note: For all equipment, axial shaft displacements not to exceed 50 percent of the maximum radial shaft displacements shown in the table relative to the casing.	

C. Vibration velocity limits: Unless otherwise specified, equipment operating at speeds greater than 600 revolutions per minute is not to exceed the following peak velocity limits:

Item	Unfiltered Overall Limit (inches per second)	Any Filtered Peak Limit (inches per second)
Non-Clog Solids Handling Centrifugal Pumps	0.35	0.25
Horizontal and Vertical In-Line Centrifugal Pumps (other than Non-Clog type)	0.18 (Input BHP 25 or less)	0.14 (Input BHP 25 or less)
	0.22 (Input BHP more than 25 but less than 100)	0.18 (Input BHP more than 25 but less than 100)
	0.25 (Input BHP 100 or more)	0.20 (Input BHP 100 or more)
Vertical Turbine, Mixed Flow, and Propeller Pumps	0.31 (Input BHP 100 or less)	0.22
	0.35 (Input BHP 125 or more)	0.25
Vertical Turbine, Mixed Flow, and Propeller Short Set Pumps	0.28 (Input BHP 100 or less)	0.21
	0.33 (Input BHP 125 or more)	0.24
Motors	See Applicable Motor Specification	
Gear Reducers, Radial	Not to exceed AGMA 6000-A88 limits	
Other Reducers, Axial	0.10	0.10
Centrifugal Fans and Blowers	0.15	0.10
Other Equipment, Radial	0.16	0.10
Other Equipment, Axial	0.10	0.10

D. Equipment operation: Measurements are to be obtained with equipment installed and operating within capacity ranges specified and without duplicate equipment running.

E. Additional criteria:

1. No narrow band spectral vibration amplitude components, whether sub-rotational, higher harmonic, or synchronous multiple of running speed, are to exceed 40 percent of synchronous vibration amplitude component without manufacturer's detailed verification of origin and ultimate effect of such excitation.

2. The presence of discernable vibration amplitude peaks in Test Level 2 or 3 vibration spectra at bearing inner or outer race frequencies shall be cause for rejection of the equipment.

3. For motors, the following shall be cause for rejection:

a. Stator eccentricity evidenced by a spectral peak at 2 times electrical line frequency that are more than 40 percent of the peak at rotational frequency.

b. Rotor eccentricity evidenced by a spectral peak at 2 times electrical line frequency with spectra side bands at the pole pass frequency around the 2 times line frequency peak.

c. Other rotor problems evidenced by pole pass frequency side bands around operating speed harmonic peaks or 2 times line frequency side bands around rotor bar pass frequency or around 2 times the rotor bar pass frequency.

d. Phasing problems evidenced by 1/3-line frequency side band spectral peaks around the 2 times electrical line frequency peak.

4. The presence of peaks in a High Frequency Enveloping spectra plot corresponding to bearing, gear or motor rotor bar frequencies or harmonics of these frequencies shall be cause for rejection of the equipment; since inadequate lubrication of some equipment may be a cause of these peaks, lubrication shall be checked, corrected as necessary and the high frequency envelope analysis repeated.

3.8 NOISE REQUIREMENTS AND CONTROL

A. Make measurements in relation to reference pressure of 0.0002 microbar.

B. Make measurements of emitted noise levels on sound level meter meeting or exceeding ANSI S1.4, Type II.

C. Set sound level meter to slow response.

D. Unless otherwise specified, maximum free field noise level not to exceed 85 dBA measured as sound pressure level at 3 feet from the equipment.

3.9 FUNCTIONAL AND OPERATIONAL TESTING OF EQUIPMENT

A. Functional testing as specified in Section 01 75 16 – Startup Procedures and this Section.

B. General checkout: Prior to operating equipment, inspect, test, and check supporting systems, including but not limited to power systems, control systems, piping systems, lubrication systems, and safety systems.

1. Test and calibrate instrumentation and electrical devices as recommended by manufacturer.

2. As a minimum for control systems associated with the equipment, perform the following:

a. Individual Loop Tests: Test from field device to intermediate terminations to controller and back to controlled element.

b. End-to-end test: Simulate input at field device and observe control system response at the final field control element.

3. Prior to testing, provide signed and dated certificates of calibration for test instrumentation and equipment.

C. Operation of related existing equipment: Owner will operate related existing equipment or facilities necessary to accomplish the testing.

D. Acceptable tests: Demonstrate the equipment performance meets the requirements of this Section and the equipment section; when the equipment fails to meet the specified requirements, perform additional more detailed testing to determine the cause, correct, repair, or replace the causative components and repeat the testing that revealed the deficiency.

E. Operational testing: As specified in Section 01 75 16 – Startup Procedures, and individual equipment specifications.

END OF SECTION 43 05 60

SECTION 46 61 27 – UPFLOW MOVING BED FILTER

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Vendor shall furnish and place into satisfactory operating condition a complete filtration system as specified herein. Filters shall be provided with all required equipment, and filtration media. Filters shall be modular and will be installed in concrete basins. The Installation Contractor shall install all structures including any required wall thimbles and external piping.

B. The Vendor shall size the filter equipment to meet the performance specifications below. The filter systems shall be designed so that the peak flow can be treated with one unit offline.

C. Air compressor: Vendor shall provide a compressed air system sized to deliver sufficient air to each airlift for backwashing, as well as any ancillary air requirements for the system, including pneumatic actuation of valves. The compressed air system shall include a dual air compressor with reservoir, air dryer, compressed air control panel, air panels for the control of air to the air lifts, and valves. The Installation Contractor shall install the air system and provide and install the interconnecting piping.

D. Vendor can provide more than one proposal (for different configurations or materials) at the time of bid.

E. The Installation Contractor shall provide two chemical dosing systems with associated mixing and flocculation – an alum system for phosphorus coagulation, and a caustic soda system for pH adjustment (downstream of the filters). Where necessary, a polymer dosing system shall also be provided by the contractor. The chemical, mixing and flocculation systems shall meet the Filter Vendor's requirements subject to the Engineer's approval.

1.2 DESIGN REQUIREMENTS

A. Influent Design Criteria: Clarified secondary effluent will be provided to the sand filter system with the following flow and water quality:

1.	Average Daily Flow:	0.36 MGD
2.	Max Month Flow:	0.50 MGD
3.	Peak Day Flow:	0.67 MGD
4.	Peak Hour Flow:	1.73 MGD
5.	Max Total Suspended Solids (from clarifier effluent):	30 mg/L
6.	Total Phosphorus:	2 mg/L*

*Note that chemical dosing upstream of the clarifiers will be provided to meet the influent concentration noted above to the sand filters.

B. Effluent Design Criteria: The sand filter vendor shall meet the following effluent water quality:

1.	Total Suspended Solids:	5 mg/L
2.	Total Phosphorus:	0.29 mg/L

C. The maximum allowable hydraulic loading shall not exceed 5 gpm/ft^2 at the peak hour flow with one unit offline.

D. The headloss through the filter shall not exceed 48" (as measured from the influent to the filter module to the crest of the effluent weir).

1.3 SUBMITTALS

A. See Section 01 30 00 – Vendor Submittals, for submittal procedures.

B. The Vendor shall submit a copy of the equipment specification section with all addenda and all referenced specification sections. Each paragraph shall be check-marked to indicate specification compliance or marked to indicate deviations from the specification requirements. Check marks shall indicate complete compliance with the paragraph requirements. Deviations from the specification shall be indicated by underlining the deviation and marking the paragraph or line with a number or letter. The remainder of the paragraph not marked as a deviation shall indicate compliance with the requirements of the paragraph. The manufacturer shall prepare a detailed justification for each deviation. Failure to include the required specification sections and justification for deviations will indicate non-compliance and shall be rejected without further consideration.

C. Submit to the Engineer for review, filtration calculation, headloss calculations, air flow requirements, complete drawings showing installation details, materials of construction, arrangement details, loadings, elevations, and all items furnished under this Section.

D. Complete instructions on installation of the equipment, air compressor, air lift system, controls, and filter media.

E. Design calculation for anchor bolts. Design calculations shall include dead, live, and dynamic loadings for normal and seismic conditions (see Drawings for seismic design standards). Design calculations shall be stamped by a professional engineer registered in the State of Idaho.

F. Start-up instructions.

G. Operation and Maintenance Data: Submit operation and maintenance data and equipment parts list in manual in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

A. To ensure that all the equipment required for the installation of the filter modules and air supply is properly coordinated and will function as a unit in accordance with the intent of these Specifications, the Vendor shall provide all the equipment specified under this Section.

B. Qualification of Filter Manufacturer: The filter Manufacturer shall have a minimum of 10 years' experience in the manufacture of this type of filter equipment and shall have completed at least 10 successful installations of the same type proposed.

1.5 WARRANTY AND GUARANTEE

A. A written manufacturer warranty shall be provided. The warranty shall be for a minimum period of one (1) year from the date of Substantial Completion. Manufacturer shall repair or replace all defects of materials or workmanship in the equipment during the warranty period. Corrections shall be completed within five (5) days after notification.

B. Written Guarantee: The Vendor shall guarantee that the filter system shall meet the required effluent limits. The coagulant dosing system will be supplied by the Installation Contractor. If, during the one-year guarantee period, the filter system fails or does not meet any of the specified requirements or test criteria herein, the Vendor shall correct such deficiencies as may be necessary to meet these requirements and criteria at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Parkson

B. Nexom

C. WesTech

D. Or approved equal

2.2 GENERAL

A. All structural steel shall conform to "Standard Specifications for Structural Steel of the A.S.T.M."

B. An effluent weir shall be provided to control the water level over the media.

C. All equipment shall be designed for continuous, twenty-four hour operation, and all parts of the mechanism shall be amply proportioned for all stresses, which may occur during fabrication, erection, and operation.

D. All anchor bolts shall be Type 316 stainless steel and shall be sized by the Vendor. The Installation Contractor shall provide and install the anchor bolts in accordance with the Vendor instructions.

E. All filter wetted parts shall be 304 or 316 stainless steel, FRP, or PVC. No carbon steel shall be allowed in the filters. All stainless steel shall be passivated.

2.3 UPFLOW MOVING BED FILTER

A. Materials of Construction

1.	Basin	Concrete, FRP, or 304 SS
2.	Filtrate trough (if applicable)	FRP or 304 SS
3.	Bottom hopper cones	FRP or 304 SS
4.	Feed distribution radials	FRP or 304 SS
5.	Reject compartment	FRP or Injection Molded Plastic
6.	Washer rings	PVC or Injection Molded Plastic
7.	Reject weirs	FRP or Injection Molded Plastic
8.	Distribution cones	FRP of 304 SS
9.	Airlift pipes	HDPE or PVC
10.	Airlift housing	FRP or 304 SS
11.	Airlift panel	304 SS
12.	Nuts, bolts, fasteners	304 SS
13.	Anchor bolts	304 SS

B. FILTER TANK

1. Each filter shall be self-contained in an open-top concrete tank sized by Vendor. Vendor shall produce dimensioned layout drawings of the filters with all sections needed to estimate concrete volumes, if applicable.

C. AIRLIFT

1. The sand cleaning system shall be capable of continuous or intermittent backwashing and internally redistributing the granular media to the top of the sand bed an average of 4-8 times per 24 hours. The airlift shall be supplied with an external air feed line to supply the pressurized air to the injection point. The feed line shall be protected from the abrasive movement of the media both inside the airlift and outside within the filter bed.

D. COUNTER-CURRENT WASHBOX

1. The filter system shall be furnished with a washbox assembly of fiberglass or injection molded plastic construction with an adjustable weir. The cross-sectional area of the counter-current washbox shall be sized to assure sufficient velocity of up-flowing water to transport separated solids into the wash chamber and over the reject weir and ultimately out through the reject line. The washbox geometry shall be optimized for separation of solids rejected from the filter media.

E. FILTER MEDIA

1. The filter media shall be furnished by the Filter Manufacturer and shall be of high quality silica sand in accordance with the American Water Works Association Standard for Filter Materials AWWA/ANSI B-100 (latest edition). The Filter manufacturer shall deliver the sand to the Site, and the Installation Contractor shall install the filter media per the Filter Manufacturer's instructions.

F. FEED CHAMBER

1. Each filter shall be furnished with a central feed chamber designed to distribute the influent water directly into the media. The feed chamber shall have capacity to distribute the influent at least 60" below the top of the media. The feed chamber shall have a central protector tube to house, support and protect the airlift feed pump and compressed air feed line from damage due to abrasion. This central protector tube shall extend from the top of the filter bed down through the feed chamber to the recessed chamber in the lower cone. The feed chamber shall also incorporate support devices to the side wall, if applicable. The feed chamber shall be permanently attached and centered on the lower end to ensure that the system remains properly located at all times. The feed chamber shall be constructed of fiberglass or 304 SS.

G. HEAD LOSS INSTRUMENTATION

1. The Head Loss Indicator Gauge shall be coupled directly to the influent feed channel of the filter and extend above the top of the filter cell. The Head Loss Indicator Gauge shall be marked with an easily readable clear rule indicating the differential pressure (ΔP).

2. Head Loss shall also be monitored with a pressure transmitter directly to the influent feed of the filter system. Transmitter signal shall land in the Air Control Panel and the signal made available to the plant PLC (by Installation Contractor).

H. AIR CONTROL PANEL WITH AIR BURST SYSTEM

1. The filter system shall be furnished with a NEMA 4X operators control panel equipped with manufacturer's standard equipment, including airflow regulation, flow monitoring/control valves, normal operation and adjustable duration airbursting (where applicable) solenoids and all other controls necessary for operation of the filter's airlift. A signal from the plant SCADA system shall be received to operate the system.

2. All analog and digital signals from flow or level instrumentation in the Air Control Panel shall be available to the plant PLC via terminal contacts.

3. Where filter cells are intended to be operated in a lead/lag type configuration, the Vendor shall provide a control narrative for system integration through the plant PLC. Solenoid valves shall be included in the Vendor's scope, as well as sufficient instrument air in the air compressor system, to operate Installation Contractor-supplied pneumatic control valves to each filter cell.

I. AIR SYSTEM

1. The Filter Manufacturer shall furnish an air compressor unit to pressurize the pneumatic system. The duplex air compressor unit shall be provided with two each, two-stage compressor pumps. The air tank shall be an ASME Code receiver rated at a minimum of 200 psig. The system shall be complete with two (2), 460 V/3P/60 Hz powered, 2-stage compressor pumps; air cooled aftercooler; loadless starting; low oil shutdown switch; pressure gauge; safety valve; intake air filter; pressure switch; manual and automatic receiver blowdown and shut off valves; vibration pads for mounting; and complete startup kits. The Vendor shall size the air compressor.

2. A refrigerated-type air dryer shall be provided and sized by Vendor. Power shall be 115V/1P/60 Hz. The air dryer shall be provided with a pre-filter.

3. The Vendor shall provide a duplex alternating control panel. The panel shall include motor starter for the two compressor motors and thermal overloads. Circuit protection and disconnects shall be by others. Motor starter shall meet the requirements of Section 26 29 13.13 – Across-the-Line Motor Controllers.

J. SPARE PARTS

1. Filter Equipment: The Filter Manufacturer shall provide the following spare parts for the airlift pumps and control panel (one each):

a. Spare airlift

b. Regulator - air control panel.

c. Air flow indicator and control valve - air control panel.

d. Air filter element – air control panel.

e. One intake air filter and one oil change for the air compressor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: The Installation Contractor shall install structures, filter equipment, filter media, piping and valves in conformance with the Manufacturer's recommendations.

B. The Installation Contractor shall provide and install the chemical feed system including pumps, valves, piping, and controls.

3.2 TESTING AND CORRECTION OF DEFICIENCIES

A. General

1. All testing shall be performed under the supervision of the Filter Manufacturer's representative as specified. The Installation Contractor shall conduct all specified tests and shall furnish all power, material, instrumentation, equipment, personnel, etc., for conducting tests as specified herein.

2. The Vendor shall submit three copies of full and complete test reports for all tests, describing the units tested; the type of test; test set-ups, and procedures and instrumentation; and test flow rates, pressures, levels and all other data and results as required to demonstrate that all items tested meet specified requirements.

B. Start-Up

1. Equipment Testing

a. The Filter Manufacturer's representative shall check and verify that installation of the filter modules is in accordance with Drawings, Specifications, and Filter Manufacturer's installation instructions.

b. The Filter Manufacturer's representative shall adjust all reject weir plates and air rates to each airlift.

c. The Filter Manufacturer's representative shall instruct plant personnel on operation and maintenance of the filter system.

d. The Filter Manufacturer shall include two (2) trips to the site, each one (1) day to advise the Installation Contractor on the installation of the filter equipment and to inspect and approve the installation.

e. The Filter manufacturer shall include two (2) trips to the site for four (4) days to start-up the filter system and to train the operators.

C. Testing

1. Process System Testing

a. The Installation Contractor and Filter Manufacturer shall test the blower/air compressor system for correct operation and certify that the backwash system is operating in conformance with these Specifications.

2. 7-Day Test

a. The Owner shall collect inlet and outlet samples (composite) on seven consecutive days and analyze them for total suspended solids (TSS) and total phosphorus (TP) at the Owner’s expense. If the outlet concentration averages are less than or equal to the performance requirements, then the filter system shall have passed the initial seven-day test. The Installation

Contractor and Filter Manufacturer shall make the necessary adjustments to the filter system and conduct additional seven-day tests at no cost to the Owner until the system passes.

3.3 OPERATOR TRAINING

A. A trained factory representative shall provide a minimum of 4 hours of operation and maintenance training to the Owner's personnel. The Installation Contractor shall video the training session and provide a copy on DVD to the Owner.

END OF SECTION 46 61 27