1.03 SPARE PARTS

A. Provide spare parts that are identical to and interchangeable with similar parts installed.

1.04 QUALITY ASSURANCE:

A. Permanently mark the capacity of the hoist and trolley on each hoist, in easy to read letters and in a prominent position.

B. Provide only safety type hooks.

C. Provide hoists so that hook can reach the floor at the lowest level of the lift.

D. Do not use hoists for construction purposes of any nature.

E. Hoists shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

F. Welding: In accordance with American Welding Society Code D1.1/1.3.

G. Provide shop tests as specified.

H. Services of Manufacturer's Representative as stated in Section 01445 and as specified herein.

I. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:
   1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.
   2. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection.
      a. 1 person-day.
   3. Functional Testing: Check alignment and perform a functional test. Tests to include all items specified.
      a. 1 person-day.
   4. Performance Testing: Field performance test equipment specified.
      a. 1 person-day.
   5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.
      a. 1/2 person-day.
   6. Credit to the Owner, all unused service person-days specified above, at the manufacturer’s published field service rate.
   7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

J. Manufacturer of hoisting equipment shall have a minimum of five (5) operating installations with hoists of the size specified and in the same service as specified operating for not less than five (5) years.

1.05 DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements specified in Section 01610.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Gantry Crane shall be Spanco, Inc. A-Series aluminum gantry crane or equal.

B. Bridge Crane shall be as supplied from Mass Crane and Hoist Company of Tyngsboro, MA or an approved equal.

2.02 GANTRY CRANE (1 required):

A. The Gantry Crane shall be classified as one complete and single "manufactured product" as it relates to Build America Buy America (BABA) Act compliance defined in Specification Section 00820G. The list of products below shall be considered "components" of this manufactured product as it relates to BABA compliance.

B. Portable, corrosion resistant, height and span adjustable gantry crane with swivel-lock casters.
1. Lift Capacity: 2,000 lbs.
2. Beam Span: Adjustable - 8 ft. max.
3. Height Under Beam: Adjustable - 6'-6" to 9'-0"

C. Fabricated from 6061-T6 aluminum sections with finished ends and surfaces designed with a factor of 15 percent of the rated capacity for hoist and trolly weight and 25 percent on the rated capacity for impact.

D. Gantry crane shall be designed for moderate usage (Class C Moderate Usage) as defined by CMAA 70.

E. System Components
1. I-Beam:
   a. Standard aluminum I-beam
   b. Brushed aluminum finish
   c. Adjustable span capabilities
2. A-Frame:
   a. Fabricated from high-strength tubing.
   b. Adjustable height accomplished using spring-loaded steel locking pins.
   c. Center tube adjusts in 6-inch increments.
   d. Brushed aluminum finish.
3. Casters:
   a. Four-position swivel-locking casters.
   b. Polyurethane wheels.

2.03 BRIDGE CRANE (1 REQUIRED)

A. The bridge crane shall be classified as one complete and single "manufactured product" as it relates to Build America Buy America (BABA) Act compliance defined in Specification Section 00820G. The list of products below shall be considered "components" of this manufactured product as it relates to BABA compliance.

B. This specification covers all labor, materials, equipment, and appurtenances required to furnish, provide installation and start-up assistance, training, and testing of a complete bridge crane, complete and operable, as described herein and as required by the Contract Documents.

C. The bridge crane shall be strucually supported in accordance with the plans. It shall be designed for the high lift pump room with an approximate area of 18' wide by 32' length. The bridge crane manufacturer shall furnish and install the following beams and associated components:

1. Three (3) header beams shall be sized and provided by the bridge crane manufacturer and run the width of the room. Header beams must be compatible and mounted to the bearing load plates detailed on the structural drawings.
2. Two (2) runway beams shall be sized and provided by the bridge crane manufacturer. Runway beams must be designed and provided by the bridge crane manufacturer to run the length of the room and be affixed to the header beams.
3. One (1) bridge beam shall be sized and provided by the bridge crane manufacturer. The bridge beam shall be designed to travel along the length of the runway beams and accommodate the hoist and associated equipment.
    a. Bridge beam shall be provided with rails, endtrucks, and end stops as needed for a complete design.
4. Motorized trollies shall be provided to move the hoist along the length of the bridge beam and the bridge bream along the length of the runway beams.
5. The bridge crane beams shall meet local and state structural and building code, and shall be designed and stamped by a registered Massachusetts structural engineer.

D. The hoist system shall be provided to meet the following requirements:

1. Lift Capacity: 3-ton
2. Lifting Height: 12 feet
3. Lifting and lowering operations shall be motorized and controlled from pendant.
4. Certified and listed to UL 1340.
5. Hoist shall be equipped with a motorized trolley to move the hoist along the length of bridge beam.

E. The bridge crane hoist shall be provided with the following electrical and control attributes:

1. Control Panel shall be NEMA 4X stainless steel
2. Power Voltage: 460 VAC, 3 phase, 60 hertz
3. Amps: 15 amps maximum
4. Control pendant shall be provided to allow for operation of trolleys and hoist.
5. Bridge crane manufacturer shall provide one junction box located on the bridge crane beams for incoming electrical supply to be furnished and installed by the Electrical Contractor. All other conduits, wires, and cables between the junction box and crane components shall be provided by bridge crane manufacturer.

6. Accordian type festooning shall be utilized for all wiring suppled by bridge crane manufacturer.
7. Control panel shall contain single speed motor starters with motor protection overloads.
8. Limit switches and stops.
9. Control panel shall be furnished in accordance with Division 16 specifications.

2.04 SAFETY STOPS

A. Provide safety stops on all open ends of track (or where indicated) to prevent trolley from running off ends or damaging building. Provide stops with capability of withstanding impact imposed by motion of fully loaded hoist and trolley.

2.05 TRACK

A. Monorail Track: Standard beam of sizes indicated on structural drawings.

B. Erect track per CMAA tolerances with section ends machined fitted and spliced with web-type or other designed couplings to provide flush level connections. Maximum gap between adjacent ends not exceeding 1/16 inch (1.6 mm).

2.06 SHOP PAINTING

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with Section 09900.

B. Surface preparation, mixing and application and safety requirements shall be in accordance with the paint manufacturer’s printed instructions and as specified.

C. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

D. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install items in accordance with manufacturer's printed instructions and as indicated and specified.

B. Check horizontal and vertical alignment of track and rails.

C. Erect rack per CMAA tolerances with section ends machined fitted and spliced with web-type couplings to provide flush level connections. Maximum gap between adjacent ends not exceeding 1/16-inch.

D. Do not use cast fittings.

3.02 FIELD TESTING

A. Provide as specified herein. Perform all tests with instrumentation controls. Perform testing in accordance with OSHA 29 CFR 1910.179 and as specified herein.

B. After installation of hoist equipment, and after inspection, operation, testing and adjustment have been completed by manufacturer's field service technician, conduct test for each hoist in presence of the Engineer to determine its ability to operate at rated capacity under conditions specified and indicated. During tests, observe and record, capacity. Promptly correct or replace all equipment not conforming to the requirements of this section revealed by or noted during tests, at no additional cost to the Owner, and repeat tests until specified results are obtained. Contractor to provide all labor, weights and materials for conducting tests.

1. Running test shall consist of moving hoist and trolley through two complete cycles. The first cycle will be with no load. For the second cycle, the unit will be loaded with 100 percent of the specified load rating.
2. Test and simulate all locking and safety devices.

C. Make all adjustments to place equipment in specified working order at time of above tests.

D. After three (3) unsuccessful testing attempts, remove and replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated.

3.03 FIELD TOUCH-UP PAINTING

A. After installation and testing, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.04 CONTRACT CLOSEOUT

A. Provide in accordance with Section 01700.

END OF SECTION

INDEX

DIVISION 15 MECHANICAL

SECTION 15060

PIPE HANGERS AND SUPPORTS

(Part of Work of Section 15401 – PLUMBING FILED SUB-BIDS, Filed Sub-Bid Required)

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide pipe hangers and supports as required by the Contract Documents.
   1. In general provide all hanging and supporting devices for hanging or supporting piping systems throughout the Work.
   2. The contractor shall be responsible for providing all piping supports required to conform with the requirements of this Section whether or not indicated on the drawings.
      a. Additional supports may be required to be provided by the contractor to restrain pipe movement noted during systems operations.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 15100 Ductile Iron Pipe, Fittings and Appurtenances
   2. Section 15101 Grooved Piping Systems
   3. Section 15102 Copper Pipe, Fittings and Appurtenances
   4. Section 15104 Plastic Pipe and Fittings
   5. Section 15106 Stainless Steel Pipe and Fittings (Two and One Half-Inches and Smaller)
   6. Section 15107 Stainless Steel Pipe and Fittings (Three-Inches and Larger)
   7. Section 15400 Plumbing

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. Hangers and supports shall be of an approved standard design capable of supporting the load under all operating conditions.
   1. All hangers, supports, and appurtenance shall conform to the latest applicable requirements of ANSI 31.1.0.
   2. The minimum working factor of safety for all supporting equipment, with the exception of springs, shall be five times the ultimate tensile strength of the material, assuming 10-foot of waterfilled pipe being supported.

C. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment.
   1. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, submit certification stating that such requirements have been complied with.

D. Codes and Regulations:
   1. In addition to complying with the specified requirements, comply with pertinent regulations of governmental agencies having jurisdiction.
   2. In the event of conflict between or among specified requirements and pertinent regulations, the more stringent requirement shall govern.

E. The Contractor shall submit drawings and calculations stamped by a structural engineer registered in the State of Massachusetts detailing piping supports for all runs of piping that are not supported from the floor and are not specifically called out in the support/spacing schedules included herein.
   1. Pipe support drawings and calculations shall be included for, but not limited to, Prefiltered Water (PFW), piping prior to and between tanks associated with MIEX, MIEX Effluent (ME), Filter Backwash Supply (BWS), Air Scour (AS), Spent Backwash Water (SBW), Filtered Water (FLT), PFAS Treated Water (TW), and Finished Water (FW), and any other piping mounted on the walls or ceilings.

F. Coordinate the work of this Section with the work of other Sections.

1.04 SUBMITTALS

A. Comply with the pertinent provisions of Section 01300.

B. Product Data:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer’s specifications and other data needed to prove compliance with the specified requirements.
   3. Shop drawings and other data as required to indicate method of installing the pipe hangers and supports, except where such details are fully shown on the Drawings.

1.05 PRODUCT HANDLING

A. Handle in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL

A. All of the equipment specified herein is intended to support the various types of pipe and piping systems.
   1. The details shown on the drawings are intended to indicate the generally desired methods of support under normal conditions.
   2. It shall be the responsibility of the Contractor to develop final details and any details associated with special conditions not already covered to meet the system conditions specified in the piping specifications.

B. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, fittings, and other pipe appurtenances and to support and secure the pipe in the intended position and alignment.

1. All supports shall be designed to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe and personnel contact.
2. Any structural steel members required to brace any piping from excessive dislocation shall conform to the applicable requirements of Section 05500 and shall be furnished and installed under this section.

C. Hangers and supports shall be spaced in accordance with ANSI B31.1 except that the maximum unsupported span shall not exceed 10 feet unless otherwise specified herein.

D. Where flexible couplings are required at equipment, tanks, etc. the opposite to the piece of equipment, tank, etc. shall be rigidly supported.

E. All pipe and appurtenances connected to the equipment shall be supported in a manner to prevent any strain from being imposed on the equipment or piping system.

F. All rods, clamps, hangers, inserts, anchor bolts, brackets, and components for interior pipe supports shall be furnished with hot dipped galvanized finish, except where field welding is required, or as indicated herein.
1. Interior clamps on plastic pipe shall be plastic coated.
2. Supports for copper pipe shall be copper plated or shall have a 1/16-inch plastic coating.
3. Supports for chemical feed piping shall be stainless steel or fiberglass, with the material being selected so that it is compatible with the chemicals being transported in the piping system being supported.
4. All rods, clamps, hangers, inserts, anchor bolts, brackets, and components for exterior pipe, submerged pipe and pipe within outdoor structures shall be Type 316 Stainless Steel.

G. Supports shall be sufficiently close together such that the sag of the pipe is within limits that will permit drainage and avoid excessive bending stresses from concentrated load between supports.

H. All uninsulated non-metallic piping shall be protected from local stress concentration at each support point.
1. Protection shall be provided by galvanized steel protection shields or other method as approved by the Engineer.
2. Where pipes are bottom supported, 180 degrees arc shields shall be furnished.
3. Where 360 degree arc support is required, such as U-bolts, protection shields shall be provided for the entire pipe circumference.
4. Protection shields shall have an 18 gauge minimum thickness, not be less than 12-inch in length and be securely fastened to pipe with stainless steel or galvanized metal straps not less than 1/2-inch wide.

I. All insulated pipe shall be furnished with a rigid foam insulating saddle at each pipe support location.
1. Provide galvanized protection shields as specified above at each location.

J. Where pipe hangers and supports come in contact with copper piping, provide protection from galvanic corrosion by: wrapping pipe with 1/16-inch thick neoprene sheet material and galvanized protection shield; thermoplastic sleeve-type isolators; or copper plated or PVC coated hangers and supports.

K. Pipe supports shall be provided as follows:
   1. Support spacing for steel and stainless steel piping two inch and smaller in diameter and copper tubing shall not exceed five feet.
   2. Supports for multiple PVC plastic piping shall be continuous wherever possible.
      a. Individually supported PVC pipes shall be supported as recommended by the manufacturer except that support-spacing shall not exceed three feet.
      b. Multiple, suspended, horizontal plastic PVC pipe runs, where possible, shall be supported by ladder type cable trays such as the Electray Ladder by Husky/Burndy, the Globetray by the Metal Products Division of United States Gypsum, or approved equal.
         i. Ladder shall be hot dipped galvanized, stainless steel, or fiberglass construction, but shall be resistant to any chemical being transported within the piping system.
         ii. Rung spacing shall be 12-inch.
         iii. Tray width shall be approximately 6-inch for single rungs and 12-inch for double runs.
         iv. Ladder type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc. required for a complete support system.
         v. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners equal to Globe Model M-CAC; Husky/Burndy Model SCR; or approved equal.
         vi. Spacing between clamps shall not exceed 9-feet.
         vii. The cable trays shall provide continuous support along the length of the pipe.
         viii. Individual clamps, hangers, and supports in contact with plastic PVC pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.
   3. Pipe supports shall not induce point loadings but shall distribute pipe loads evenly along the pipe circumference.
   4. Supports shall be provided at changes in direction and elsewhere as shown in the drawings or specified herein.
      a. No piping shall be supported from other piping unless specifically directed or authorized by the Engineer.
   5. Pipe supports shall be provided to minimize lateral forces through valves, both sides of a split type couplings, and sleeve type couplings, and to minimize all pipe forces on pump housings.
      a. Pump housings shall not be utilized to support connecting pipes.
   6. Effects of thermal expansion and contraction of the pipe shall be accounted for in the pipe support selection and installation.

L. Unless otherwise specified herein, pipe hangers and supports shall be as manufactured by Grinnell Co. Providence R.I.; Carpenter and Patterson, Inc Woburn MA; or approved equal.
   1. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered as proprietary in this specification.
   2. Any item comparable in type, style, quality, design, and performance, shall be considered as equal.

M. Any required pipe supports for which the supports specified in this section are not applicable shall be fabricated or constructed from standard structural steel shapes,

concrete, and anchor hardware similar to items previously specified herein and shall be subject to the approval of the Engineer.

N. Anchor bolts shall be equal to Kwik-Bolt as manufactured by the McCullock Industries Minneapolis MN; or approved equal.
   1. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of 1-inch behind the steel reinforcement.

2.02 SINGLE AND MULTIPLE PIPE SUPPORTS

A. Single pipes located in a horizontal plane close to the floor shall be supported by one of the methods specified herein or as shown on the drawings.

B. Pipes 3-inch in diameter and larger shall be supported by adjustable stanchions constructed of galvanized steel, stainless steel, or fiberglass, and shall be resistant to any chemical being transported within the piping.
   1. Stanchions shall provide at least 4-inch adjustment and be flange mounted to floor.

C. Pipes less than 3-inch in diameter shall be held in positions by supports fabricated from galvanized steel, stainless steel, or fiberglass C channel, welded post base similar to Unistrut figure P2072A with pipe clamps.
   1. Where required to assure adequate support, fabricate supports using two vertical members and post bases connected together by horizontal member of sufficient load capacity to support pipe.
   2. Wherever possible, supports shall be fastened to nearby walls or other structural members to provide horizontal rigidity.
   3. More than one pipe may be supported from a common fabricated support.
   4. All supports unless specified otherwise for plastic or copper piping shall be galvanized, stainless steel, or fiberglass, and shall be resistant to any chemical transported within the piping.

D. Where shown on the drawings, pipe shall be supported using concrete anchor posts.
   1. Pipe shall be securely fastened to concrete anchor posts using suitable metal straps as required and approved by the Engineer.

2.03 WALL SUPPORTED PIPES

A. Single or multiple pipes located adjacent to walls, columns or other structural members, whenever deemed necessary, shall be supported using galvanized steel, stainless steel, or fiberglass wall brackets similar to Carpenter and Patterson Figures 69-78, 84, or 134; or C channel with fiberglass, stainless steel, or galvanized steel brackets similar to Unistrut pipe clamps. All support system materials shall be compatible with any chemicals transported within the piping being supported.
   1. All members shall be securely fastened to wall, column, etc. using double expansion shield or other method as approved by the Engineer.
   2. Additional wall bearing plates shall be provided where required.
   3. Steel support materials are not acceptable if steel is not compatible with chemicals used.

B. Pipe shall be attached to supports using methods hereinbefore specified to meet the intent of this specification.

C. All supports shall be galvanized, stainless steel, or fiberglass, unless otherwise noted.

2.04 VERTICAL PIPE SUPPORTS

A. Where vertical pipes are not supported by a Unistrut system as specified above, they shall be supported in one of the following methods.
   1. For pipes 1/4-inch to 2-inch in diameter, an extension hanger ring shall be provided with an extensions rod and hangers flange.
      a. The rod diameter shall be as recommended by the manufacturer for the type of pipe supported.
      b. The hanger ring shall be galvanized steel, stainless steel, or fiberglass depending on the supported pipe.
      c. The hanger ring shall be equal to Carpenter & Patterson Figure 81 or 81 ct.
      d. The anchor flange shall be galvanized steel, stainless steel, or fiberglass similar to Carpenter and Patterson 85, depending on chemical resistance to the fluid being transported in the piping being supported.
   2. For pipes equal to or greater than 1/2-inch in diameter, extended pipe clamps similar to Carpenter and Patterson figure 26 may be used, and shall be galvanized steel, stainless steel, or fiberglass to be resistant to the fluid being transported within the piping.
      a. The hanger shall be attached to concrete structures using double expansion shields, or to steel support members using welding lugs similar to Carpenter and Patterson figure 220.
   3. Pipe riser clamps shall be used to support all vertical pipes extending through floor slabs.
      1. Riser clamps shall be galvanized steel, stainless steel, or fiberglass similar to Carpenter and Patterson figure 126.
      2. Copper clad or PVC coated clamps shall be used on copper pipes.
      3. Insulation shall be removed from insulated pipes prior to installing riser clamps.
   4. Unless otherwise specified, shown, or specifically approved by the Engineer, vertical runs exceeding twelve (12) feet shall be supported by approved pipe collars, clamps, brackets or wall rests at all points required insure a rigid installation.

PART 3 EXECUTION

3.01 DELIVERY AND STORAGE

A. All supports and hangers shall be crated, delivered and uncrated so as to protect against any damage.

B. All parts shall be properly protected so that no damage or deterioration shall occur during a prolonged delay from the time of shipment until installation is completed.

C. Finished iron or steel surfaces not galvanized or painted shall be properly protected to prevent rust and corrosion.

3.02 INSTALLATION

A. All pipes, horizontal and vertical, requiring rigid support shall be supported from the building structure by approved methods.

1. Supports shall be provided at changes in direction and elsewhere as shown in the drawings and specified herein.
2. No piping shall be supported from metal stairs, ladders and walkways unless specifically directed or authorized by the Engineer.

B. All pipe supports shall be designed with liberal strength and stiffness to support the respective pipes under the maximum combination of peak loading conditions to include pipe weight, liquid weight, liquid movement, and pressure forces, thermal expansion and contraction, vibrations, and all probable externally applied forces.
1. Prior to installation, all pipe supports shall be approved by the Engineer.

C. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split type couplings and sleeve type couplings, and to minimize all pipe forces on pump housings.
1. Pump housing shall not be utilized to support connecting pipes.

D. Inserts for pipe hangers and supports shall be installed on forms before concrete is placed.
1. Before setting these items, all drawings and figures shall be checked which have a direct bearing on the pipe location.
2. Responsibility for the proper location of pipe supports is included under this section.

E. Continuous metal inserts shall be embedded flush with the concrete surface.

3.03 TESTING

A. All pipe support systems shall be tested for compliance with the specifications.
1. After installation, each pipe support system shall be tested in conjunction with the respective piping pressure tests.
2. If any part of the pipe support system proves to be defective or inadequate, it shall be repaired or augmented under this section to the satisfaction of the Engineer.

END OF SECTION

SECTION 15075

MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide pipe markers, valve tags, equipment tags, and stencil legends as required by the Contract Documents.
   1. In general provide valve tags and pipe markers on all interior piping and valves and stencil legends on all floor hatches.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 07720 Roof Hatches
   2. Section 08306 Access Doors
   3. Section 15100 Ductile Iron Pipe, Fittings and Appurtenances
   4. Section 15101 Grooved Piping Systems
   5. Section 15102 Copper Pipe, Fittings and Appurtenances
   6. Section 15104 Plastic Pipe and Fittings
   7. Section 15106 Stainless Steel Pipe and Fittings Two and One Half Inches and Smaller
   8. Section 15107 Stainless Steel Pipe and Fittings Three-Inches and Larger
   9. Section 15108 Tubing, Hose, Fittings, and Appurtenances
   10. Section 15110 Valves and Appurtenances

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. The specifications are based on identification products manufactured by MSI Marking Services, Wilmington, DE.
   1. Products of equal quality by Seton Identification Products, Branford, CT, or EMEDCO, Buffalo, NY may be considered.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 45 calendar days after the Contractor has received the Owner's Notice To Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
   3. Valve tag schedule.

1.05 PRODUCT HANDLING

A Comply with manufacturer's requirements.

PART 2 PRODUCTS

2.01 PIPE MARKERS

A. Pipe markers shall be MS-900 Self Adhesive Pipe Markers (customized if required) as manufactured by MSI, Wilmington, DE or an approved equal from the above stated manufacturer's.
   1. Shall meet ANSI A.13.1 standards for print size, color and background color.
   2. Printed on premium-quality, fade resistant, outdoor grade vinyl with durable, indoor/outdoor adhesive
   3. Marker legends not "In-Stock" shall be custom printed.

B. MS-900 Flow Directional Arrow Tape shall be as manufactured by MSI, Wilmington, DE or an approved equal from the above stated manufacturer's.
   1. Shall satisfy ASME A13.1 requirement to show flow direction
   2. Designed for both indoor and outdoor applications.
   3. For pipe up to three (3) inch, use two (2) inch width.
   4. For pipes four (4) inches and up, use four (4) inch width.

2.02 VALVE TAGS

A. Brass Valve Tags: shall be as manufactured by as manufactured by MSI, Wilmington, DE or an approved equal from the above stated manufacturer's.
   1. Material: .19 gauge brass,
   2. Size: Two (2) inches in diameter,
   3. Characters,
      a. Stamped and black-filled with 1/4-inch service indicators on the top line and 1/2-inch numbers below.
      b. Tags to be customized if necessary.
      c. Number sequence shall be in accordance with the valve numbers on the Contract Documents, in accordance with valve numbers by the system vendor if not identified on the Contract Drawings, or continuous from 001 thru 999 if not identified on the Contract Drawings or by the system vendor.

B. Valve tag fasteners: Shall be Brass Jack Chain.
   1. Adjustable open and close links,
   2. Solid brass,
   3. Approximately 25 links per foot.

2.03 STENCILS

A. Stencil letters and spacing for other than piping identification, shall comply with ASME 13.1
   1. Character height shall be 3 1/2-inches.

2.04 EQUIPMENT TAGS

A. Engraved laminated equipment tags, minimum 3/4-inch high with 3/8-inch engraved letters, shall be provided for all equipment as manufactured by MSI, Wilmington, DE or approved equal from the above stated manufacturers.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section shall be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install the work of this Section in strict accordance with the manufacturer's recommendations as approved by the Engineer, using only the approved mounting materials.

B. Install a valve tag or equipment tag on every interior valve and equipment.
1. Letter abbreviations and numbers shall be per submitted and approved valve schedule and equipment numbering per Contract Drawings.
2. Affix valve tag or equipment tag so that it does not interfere with the operation of the valve or equipment.
3. Do not affix valve tag to valve handle.

C. Install pipe identification on all interior piping. Markers shall identify service (fluid name) and flow direction.
1. Install in clear view and align with axis of piping.
2. Locate identification at:
   a. Every ten (10) feet,
   b. All risers and drops,
   c. Each side of structure penetrations,
   d. Each change in direction.
3. Piping shall be identified in accordance with the following schedule:

Piping	Color Scheme	Markings
Prefiltered Water (PFW)	Aqua	Black
MIEX Effluent (ME)	Aqua	Black
Filtered (FLT) (Post-Greensand)	Light Blue	Black
Treated Water (TW) (Post-PFAS)	Light Blue	Black
Finished or Potable Water	Dark Blue	White
Supernatant Return (SR)	Aqua	Black
Filter-To-Waste (FTW)	Light Brown	Black
Filter Backwash Supply (BWS)	Light Brown	Black
Spent Backwash Water (SBW)	Dark Brown	White
Residuals (Sludge)	Dark Brown	White
Polyaluminum Chloride (PACl)	Orange	Black
Sodium Hydroxide (NaOH)	Yellow w/ Green Band	Orange

Sodium Hypochlorite (NaOCl)	Yellow	Black
Fluorosilicic Acid (Fluoride)	Light Blue w/Red Band	Black
Phosphate Compounds	Light Green w/Red Band	Black
Polymers	Orange w/Green Band	Black
Sewer (Sanitary or Other)	Dark Gray	White
Compressed Air	Dark Green	White
Gas	Red	White
Fire Sprinkler	OSHA Red	White
Other Lines	Light Gray	Black

D. Provide stencil legend on to hatch doors.
   1. Legend to reflect what hatch is entrance to along with a number designation.

END OF SECTION

SECTION 15100

DUCTILE IRON PIPE, FITTINGS, AND APPURTENANCES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide all the interior ductile iron pipe, fittings and appurtenances as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
   1. Section 02675 Disinfection of Water Mains and Water Storage Facilities
   2. Section 15060 Pipe Hangers and Supports
   3. Section 15101 Grooved Piping Systems
   3. Section 15110 Valves and Appurtenances
   4. Section 15120 Piping Specialties

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. All ductile iron pipe and fittings shall be of domestic manufacture.

C. Coordinate the work of this Section with the work of other related Sections.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
   3. Shop Drawings showing piping layouts, dimensions, location of supports and braces, and interfacing with piping and equipment furnished under other Sections of this Specification.

1.05 PRODUCT HANDLING

A. Comply with manufacturer's recommendations.

PART 2 PRODUCTS

2.01 PIPE

A. Interior Use:
1. Have dimensional wall thickness in accordance with ANSI/AWWA C115/A21.15.
2. Pipe shall be ductile iron, Class 53, with a maximum working pressure of 250 psi.
3. Cement lined meeting the requirements of ANSI/AWWA C104/A21.4.
4. Thickness of cement lining:
   a. 1/8-inch for pipes 12-inches and smaller.
   b. 3/16-inch for pipe 14-inches and larger.
5. Exterior Coating
   a. All exposed piping not within tanks containing water shall be red primer.
   b. All exposed piping and fittings within tanks containing water whether submerged or not, shall be pre-finished at the factory before shipment.
      i. Exterior coating shall be a high solid, solvent free, epoxy incorporating ceramic pigment and amine cured epoxy formulated especially to coat the exterior of ductile iron pipe for aggressive atmospheres or liquids, applied at 20-25 mils.
      ii. Coating shall be NSF 61 approved.
      iii. Coating shall be Ceramawrap as manufactured by Induron Protective Coatings or approved equal.
6. At the Contractor's option, exposed piping within tanks containing potable water may be furnished without cement lining and coated inside and out with an NSF-approved fusion bonded epoxy, Skotchkote 134 or approved equal.

B. Pipe Flanges: Conform to ANSI/AWWA C115/A21.15.
1. Faced and drilled to American 125 Standard,
2. Long hubs.

2.02 FITTINGS

A. Interior Use:
1. Manufactured of ductile iron or gray iron, flanged joint design rated for 250 psi,
2. Meet or exceed the requirements of ANSI/AWWA C110/A21.10,
3. Tapping bosses on both sides of each branch and in the center of the fitting on both sides,
4. Interior and exterior coatings shall be as specified in paragraph 2.01,
5. Base bends and tees shall have machined and drilled bases.

2.03 GASKETS

A. Made from vulcanized styrene butadiene (SBR) rubber:
1. Shall meet ANSI/AWWA C111/A21.11,
2. Reclaimed rubber shall not be used.
3. Thickness: 1/8-inch.

2.04 FASTENERS

A. Bolts and Studs:
1. Shall conform to ASTM A307, Grade B for piping not within tanks containing water.

2. Shall be 316 SS for piping within tanks containing water.

B. Nuts:
1. Shall conform to ASTM A563, Grade A, heavy hex for piping not within tanks containing water.
2. Shall be 316 SS for piping within tanks containing water.

2.05 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which the work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FIELD MEASUREMENTS

A. Make necessary measurements to assure precise fit of the piping system.

3.03 COORDINATION

A. Coordinate the work of this Section with equipment suppliers to ensure all dimensions and elevations are compatible.

3.04 INSTALLATION

A Interior Ductile Iron Pipe, Fittings and Appurtenances:
1. During handling protect pipe and fittings from damage.
2. Pipe and fittings cleaned out before assembly,
3. Installed in accordance with the approved piping layout,
4. Installed true to alignment and rigidly supported,
5. Pipe, fittings and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain or loading being imposed upon the equipment.

B. All flange-mounted in-line instrumentation (i.e.: flow meters) shall be installed in a manner that will allow for removal/servicing. Unless specifically called out on the drawings, the Contractor my opt for either of the following jointing methods:
1. Utilize a plain-end section of pipe with adaptor flange connected to the instrumentation device.
2. Utilize a flexible sleeve and tie rods where flanges for connection of tie rod ends are no more than 3 feet apart.

C. Tapped Connections
1. Tapped connections in pipe and fittings shall be made in such manner as to provide a watertight joint and adequate strength against pullout.

2. All drilling and tapping of ductile iron pipe shall be done normal to the longitudinal axis of the pipe; fittings shall be drilled and tapped similarly, as appropriate.
3. Drilling and tapping shall be done only by skilled mechanics.
4. Tools shall be adapted to the work and in good condition so as to produce good, clean cut threads of the correct size, pitch, and taper.

3.05 TESTING

A. Pressure Piping Systems:
1. Provide material and bracing required to isolate the piping system from equipment during the test.
2. Test at a hydrostatic pressure of 150 psi for one (1) hour.
3. Leaks shall be repaired under this Section and the test repeated.

3.06 DISINFECTING

A. All pipe, fittings and appurtenances installed under this Section shall be disinfected before being placed in service.
1. Refer to Section 02675.

END OF SECTION

SECTION 15101

GROOVED PIPING SYSTEMS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide grooved piping systems, stainless steel and ductile iron, as required by the Contract Documents.

B. At the Contractor's option and with approval by the Engineer, the Contractor may utilize grooved piping systems in lieu of flanged piping for complete piping systems or portions of systems where it may simplify pipeline jointing.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplemental Conditions, and Sections in Division 1 of these Specifications.

1. Section 15060 Pipe Hangers and Supports
2. Section 15100 Ductile Iron Pipe, Fittings and Appurtenances
3. Section 15106 Stainless Steel Pipe and Fittings Two and One Half Inches and Smaller
4. Section 15107 Stainless Steel Pipe and Fittings Three-Inches and Larger
5. Section 15110 Valves and Appurtenances

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. All grooved components shall be of one manufacturer (Victaulic Company of America or an approved equal).

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Materials list of items proposed to be provided under this Section.
2. Manufacturer's specifications, catalog cuts, and other data needed to prove compliance with the specified requirements.
3. Shop drawings showing piping layouts, dimensions, location of supports and braces, interface with piping and equipment furnished under other sections of this Specification.

PART 2 PRODUCTS

2.01 PIPE

A. Stainless Steel: Shall conform to the pertinent requirements of ASTM A778.
   1. Schedule 10S pipe shall be roll grooved to conform to ANSI/AWWA C606.
   2. All pipe shall be manufactured by the seamless process.
   3. Pipe grade shall be grade 316L, unless specifically used for the air scour piping system where 304L shall be acceptable.

B. Ductile Iron: Shall conform to the requirements of Specification Section 15100.
   1. The cut groove shall conform to the pertinent section of ANSI/AWWA C606.
   2. Shall be cement lined as specified in Specification Section 15100, paragraph 2.01.

2.02 FITTINGS

A. Stainless Steel: Shall be Schedule 10 construction and conform to ASTM A403.
   1. Fittings shall be Grade WP Class WX,
   2. Grade shall be 316L, unless specially used for the air scour piping system where 304L shall be acceptable,
   3. Shall be roll grooved.

B. Ductile Iron: Grooved end fittings shall comply with ASTM A536 and the following:
   1. Conform to the requirements of AWWA-C110 for center to end dimensions.
   2. Conform to the requirements of AWWA-C153 for wall thickness.
   3. Conform to the requirements of AWWA-C606 rigid radius grooving dimensions for end preparation.

2.03 MECHANICAL COUPLINGS

A. Stainless Steel Couplings: Couplings on stainless steel pipe shall be equal to Victaulic Style 008 (rigid connection) or Style 77S (flexible connection). All connections shall be rigid unless noted otherwise on the Drawings.
   1. Shall be manufactured from 316L, unless specifically used for the air scour piping system where 304L shall be acceptable.

B. Ductile Iron Couplings:
   1. Shall be equal to Victaulic Style 31 cast of ductile iron conforming to ASTM-A536 with an alkyd-phenolic primer coating.

C. Flange Adapter Couplings:
   1. Shall be used to facilitate connection from grooved fittings or pipe to flanged valves, pumps, fittings, pipe and monitoring devices (flow meters, venturi, etc.) shall be equal to Victaulic Style 341.

D. Transition Coupling:
   1. Shall be used to facilitate connection between grooved ductile iron pipe and grooved stainless steel pipe. Shall be equal to Victaulic Style 307.
   2. Connection to threaded couplings, flanges and etc. shall be made with a short, grooved by threaded section of Schedule 40 pipe.

E. Mechanical Coupling Bolts/Nuts
   1. Bolts for stainless steel couplings shall be Type 316 stainless steel, unless specifically used for the air scour piping system where Type 304 stainless steel shall be acceptable, hex head machine bolts per ASTM-A193, Grade B-8, Class 2.

2. Bolts for ductile iron couplings shall be heat treated plated carbon steel, track head, conforming to the physical properties of ASTM-A183, minimum tensile strength 110,000 psi.

2.04 COUPLING GASKETS

A. Shall be equal to flush seal design, grade "M" halogenated butyl as provided by Victaulic Company of America.

2.05 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FIELD MEASUREMENTS

A. Make necessary measurements to assure precise fit of piping system.
1. No piping shall be supported from other pipes.

3.03 COORDINATION

A. Coordinate the work of this Section with equipment suppliers, that this piping system shall be connected to, to ensure that all dimensions and elevations are compatible.

3.04 INSTALLATION

A. Grooved piping systems: The piping system shall be installed in strict compliance with the manufacturer's printed instructions.
1. All piping and fittings shall be installed true to alignment and rigidly supported.
2. Each pipe and fitting shall be cleaned out before assembly.
3. Piping shall be installed in accordance with the approved piping drawing as submitted.
4. Protect pipe and fittings during handling against shocks and free fall.
5. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment.
6. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, a certification shall be submitted stating that such requirements have been complied with.

3.05 TESTING

A. Pressure Piping Systems:
1. Provide material and bracing required to isolate the piping system from equipment during the test.
2. Test at a hydrostatic pressure of 150 psi for one (1) hour.

3. Leaks shall be repaired under this Section and the test repeated.

3.06 DISINFECTING

A. All pipe, fittings and appurtenances installed under this Section shall be disinfected before being placed in service.
   1. Refer to Section 02675.

END OF SECTION

SECTION 15102

COPPER PIPE, FITTINGS, AND APPURTENANCES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide copper pipe, fittings and appurtenances as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting Work of this Section include but are not necessarily limited to General Conditions, Supplementary Conditions and the Sections in Division 1 of these Specifications.
   1. Section 15060 Pipe Hangers and Supports
   2. Section 15110 Valves and Appurtenances

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. All copper pipe and fittings shall be of domestic manufacture.

C. The Drawings are diagrammatic and indicate the general arrangement of piping systems and work included.
   1. Information and components shown on isometric but not shown in plan view or vice versa, shall apply and be provided as if shown on both.
   2. It is not intended to specify or to show every offset, fitting or component, however, it is the intent of these Specifications and Drawings that all required components and materials, whether or not indicated or specified, shall be provided in such a manner as to make the entire piping installation fully complete and operational in all respects.

D. Codes and Regulations:
   1. In addition to complying with the specified requirements, comply with pertinent regulations of governmental agencies having jurisdiction.
   2. In the event of conflict between or among specified requirements and pertinent regulations, the more stringent requirement shall govern.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

3. Shop Drawings showing piping layouts, dimensions, location of supports and braces, and interfacing with piping and equipment furnished under other Sections of this Specification.

1.05 PRODUCT HANDLING

A. Comply with manufacturer's recommendations.

PART 2 PRODUCTS

2.01 PIPE

A. Copper Tubing:
1. Meet or exceed the requirements of ASTM B88,
2. Shall be hard drawn Type L for long runs of piping.
3. Shall be soft tempered Type K for connection to valve operators and instrumentation.

2.02 FITTINGS

A. Copper Fittings:
1. Meet or exceed the requirements of ANSI B16.18,
2. Cast brass or bronze,
3. Solder joints,
4. Unions shall be brass with ground joints,
5. Dielectric unions shall be used to join dissimilar materials,
6. Brass compression type for connections to valve operators and instrumentation.

2.03 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which the work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FIELD MEASUREMENTS

A. Make necessary measurements to assure precise fit of the tubing system.

3.03 COORDINATION

A. Coordinate the work of this Section with equipment suppliers to insure all dimensions and elevations are compatible.

3.04 INSTALLATION

A. All tubing shall be installed to the proper line and grade, and be rigidly supported.
   1. Directional changes shall be made using the proper fittings.
   2. Run parallel and at right angles to walls,
   3. Systems shall be pitched to provide for complete drainage of the system.
   4. Unions shall be provided close to main pieces of equipment and in branch lines to permit ready dismantling of tubing without disturbing main lines or adjacent branch lines.
   5. Joints shall be made with solder composed of 95 percent tin and 5 percent antimony.
   6. Underground joints shall be made up with 1000 degree F. silver solder.
   7. Threaded joints shall be made tight with graphite paste or other approved compounds.
   8. Once a joint has been made it shall not be remade without a thorough cleaning of the joint.

B. Unions shall be installed to facilitate the removal/servicing of all in-line instrumentation devices (i.e.: probe insertion tees, flow cells, rotometer, etc.) and control valves (pressure reducers, backflow preventers, solenoid valves, etc.).

3.05 TESTING

A. Pressure Piping Systems:
   1. Provide material and bracing required to isolate the piping system from equipment during the test.
   2. Test at a hydrostatic pressure of 150 psi for one (1) hour.
   3. Leaks shall be repaired under this Section and the test repeated.

END OF SECTION

SECTION 15104

PLASTIC PIPE AND FITTINGS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide all interior plastic piping and appurtenances as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting Work of this Section include but are not necessarily limited to General Conditions, Supplementary Conditions and the Sections in Division 1 of these Specifications.
   1. Section 11423 Chemical Feed Equipment
   2. Section 15060 Pipe Hangers and Supports
   3. Section 15108 Tubing, Hose, Fittings, and Appurtenances
   4. Section 15110 Valves and Appurtenances
   5. Section 15120 Piping Specialties

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. The Drawings are diagrammatic and indicate the general arrangement of piping systems and work included.
   1. Information and components shown on isometric but not shown in plan view or vice versa, shall apply and be provided as if shown on both.
   2. It is not intended to specify or to show every offset, fitting or component, however, it is the intent of these Specifications and Drawings that all required components and materials, whether or not indicated or specified, shall be provided in such a manner as to make the entire piping installation fully complete and operational in all respects.

C. Codes and Regulations:
   1. In addition to complying with the specified requirements, comply with pertinent regulations of governmental agencies having jurisdiction.
   2. In the event of conflict between or among specified requirements and pertinent regulations, the more stringent requirement shall govern.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this section.
   2. Manufacturer's specifications, catalog cuts and other data needed to prove compliance with the specified requirements.

3. Shop Drawings showing piping layouts, dimensions, location of supports and braces, interface with piping and equipment furnished under other Sections of this Specification.
4. Manufacturer's recommended installation procedures which, when approved by the Engineer, shall become the basis for accepting or rejecting actual installation procedures used on the work.

1.05 PRODUCT HANDLING

A. Comply with manufacturer's recommendations.

PART 2 PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC and CPVC) PIPE

A. Plastic pipe shall be manufactured from rigid un-plasticized polyvinyl chloride compounds that comply with the pertinent sections of ASTM D1784, for Class 12454-B.
1. Pipe shall be manufactured in accordance with ASTM D1785 (PVC) and F-441 (CPVC).
2. Size: As shown on the Drawings,
3. Type: Schedule 80.

2.02 POLYVINYL CHLORIDE (PVC and CPVC) FITTINGS

A. The plastic fittings shall:
1. Conform to ASTM D2467 (PVC) and F-439 (CPVC),
2. Joints: Socket type unless shown otherwise on the Drawings,
3. Flanged joints shall have 1/8-inch full face gaskets,
4. Fittings, specials, unions and flanges shall be of the same schedule number as the pipe they are attached to.

2.03 SOLVENT CEMENT

A. Cement for pipe and fittings shall meet or exceed the requirements of ASTM D2564 (PVC) and F-493 (CPVC).

B. Primer for pipe and fittings shall meet or exceed the requirements of ASTM F-656.

2.04 SLEEVES

A. All sleeves shall be galvanized Schedule 40 steel or SDR 21 PVC.
1. All piping through walls, beams and floors shall be sleeved.

2.05 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FIELD MEASUREMENTS

A. Make necessary measurements in the field to ensure a precise fitted piping system.

B. Follow the general layout shown on the Drawings in all cases except where other work may interfere.

3.03 COORDINATION

A. Coordinate the work of this Section with equipment suppliers, which the piping system shall be connected to, to ensure that all dimensions and elevations are compatible.

B. Coordinate as required with other trades to ensure proper and adequate provision in the work of those trades for interface with the work of this Section.

3.04 INSTALLATION

A. Plastic Piping System:
   1. Piping shall be installed in strict compliance with the manufacturer's printed instructions and in accordance with the approved piping layout.
   2. All piping and fittings shall be installed true to alignment and rigidly supported.
   3. Plastic pipe to metal pipe connections shall be made with flanged joints.
   4. Do not thread metal pipe into plastic fittings, valves or couplings, nor shall plastic piping be threaded into metal fittings, valves or couplings. Use socket thread adapters for threaded connections. Particular care shall be taken not to over-stress threaded connections.
   5. Joints for plastic pipe shall be solvent welded except flanged or threaded where required In making solvent welded connections, clean dirt and moisture from pipe and fittings, bevel pipe ends slightly and apply solvent cement of the proper grade. Solvent welded joints shall be made in accordance with ASTM D2855.

B. Sleeves:
   1. Finish flush with the finished surface on walls and beams,
   2. Extend two inches above the finished floor surface,
   3. Sleeves passing through walls and beams shall be sealed on both sides.

C. Pipe Hangers and Supports:
   1. Concrete inserts for hangers and supports shall be firmly attached to the forms prior to the placement of the concrete.
   2. Inserts shall be set in accordance with the requirements of the piping layout and the Contractor shall verify these locations from approved piping layout drawings.
   3. Comply with Section 15060 - Pipe Hangers and Supports.

3.05 TESTING

A. After a twenty-four hour curing period, piping systems shall be subjected to a hydrostatic pressure test:
   1. Duration: Six hours,
   2. Pressure: Twenty five psi above the anticipated maximum working pressure,
   3. If system fails the test, the reasons for failure shall be corrected and the system re-tested by the Contractor.

END OF SECTION

SECTION 15106

STAINLESS STEEL PIPE AND FITTINGS
TWO AND ONE HALF INCHES AND SMALLER

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide and test stainless steel pipe, fittings and appurtenances as indicated and specified.
   1. Furnishing and installing interior, above grade, stainless steel pipe, fittings and specials with butt welded, threaded, press fitted, or flanged and plain ends.
   2. Furnishing and installing stainless steel pipe sleeves and stainless steel pipe wall casting for interior and exterior wall and foundation wall penetrations.

B. Pipe and fittings 2 1/2-inch and smaller are included in this specification. Pipe and fittings larger than 2 1/2-inch shall be provided in accordance with Section 15107.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections of Division 1 of these Specifications.
   1. Section 15060 Pipe Hangers and Supports
   2. Section 15101 Grooved Piping Systems
   3. Section 15110 Valves and Appurtenances
   4. Section 15120 Piping Specialties

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements of the work of this Section.

B. Provide manufacturer's certification in writing, that materials meet or exceed minimum requirements as specified.

C. Welder Qualifications:
   1. Quality and certify welding procedures, welders, and operators in accordance with ANSI B31.1, paragraph 127.5 for shop and project site welding of piping work.

D. Job Conditions:
   1. Coordinate dimensions and drillings of flanges with flanges for valves, pumps and equipment to be installed in the piping systems.

1.04 SUBMITTALS:

A. Submit the following in accordance with Section 01300:
   1. Pipe manufacturer’s technical specification and product data.
   2. Certified shop and erection drawings. Contractor shall submit electronic files of the piping layout including the following.
      a. Pipe layouts in full detail.

b. Location of hangers and supports.
c. Location and type of anchors.
d. Location of couplings and expansion joints.
e. 1/2-inch = 1-foot scale details of all wall penetrations and fabricated fittings or special fittings.
f. Schedules of pipe, fittings, expansion joints and other appurtenances.

3. Certificates: Sworn certificates in duplicate showing compliance with material used and shop tests performed with appropriate standard.
4. Catalog cuts and technical data for expansion joints, couplings, gaskets, pipe supports and other accessories.
5. Submit reports required for welding certifications per ASME B31.1 paragraph 127.6.

B. Material Certification:
1. Provide certification from the piping and fittings manufacturer that the materials of construction specified are recommended and designed for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
2. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated.

C. A copy of the contract mechanical process and civil drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.
1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.
1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.05 DELIVERY, STORAGE AND HANDLING:

A. During loading, transportation and unloading, prevent damage to pipes and fittings. Load and unload each pipe under control at all times. Under no circumstances will a dropped

pipe be used unless inspected and accepted by Engineer. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation.

PART 2 PRODUCTS

2.01 PIPE: (Two and One Half-Inches and Smaller)

A. Provide Schedule 40S pipe manufactured by the seamless process from 316L stainless steel conforming to ASTM A312 for any stainless steel piping with the exception of air scour piping.
1. Finish shall be No.1 or better.

B. Air scour piping shall be Schedule 40S pipe manufactured by the seamless process from 304L stainless steel.

C. All lengths shall be marked with their gage and type of stainless steel.

2.02 FITTINGS: (Two and One Half-Inches and Smaller)

A. Provide Schedule 40S fittings, Class CR, manufactured by the seamless process from 316L stainless steel conforming to ASTM A403 for any stainless steel piping, except for the air scour piping where 304L stainless steel shall be acceptable.

2.03 FLANGES

A. Provide 150 lb. drilled flanges manufactured from 316L stainless steel, unless specifically used with the air scour piping system where 304L stainless steel shall be acceptable.

B. Flanges shall be of the “slip on” type.

C. Provide full face gaskets manufactured from EPDM.

2.04 PRESS FITTINGS

A. Press fittings shall be as manufactured by Viega LLC, Broomfield, CO.

B. Stainless steel press fittings shall conform to the material and sizing requirements of ASME A312 or ASTM A403.

C. O-rings for press fittings shall be EPDM or FKM, depending on the application.

2.05 THREADED FITTINGS

A. Pipe threads shall conform to ASME B1.20.1.

2.06 BOLTS AND NUTS

A. Bolts for flange bolting shall be manufactured from 316 stainless steel conforming to ASTM F593, Group 2, unless specifically used for air scour system piping where 304 stainless steel shall be acceptable.

B. Nuts for flange bolting shall be manufacturing from 316 stainless steel conforming to ASTM F594, Group 2, unless specifically used for air scour system piping where 304 stainless steel shall be acceptable.

2.07 INSTRUMENTATION TUBING AND FITTINGS

A. All instrument air header takeoffs and branch connections less than 2 inches shall be Type 316 stainless steel tubing, as manufactured by Swagelok or approved equal.

B. All instrument shut-off valves and associated fittings shall be supplied in accordance with the piping specification sand all instrument installation details. Fittings shall be Swagelok Type 316 stainless steel and valves shall be Whitey Type 316 stainless steel.

C. All process connections to instruments shall be annealed stainless steel tubing, Type 316.

D. All tube racks shall be supported by stainless steel and installed as per manufacturer's installation instructions.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 COORDINATION

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this section.

3.03 INSTALLATION

A. General: The piping system (pipe fittings, valves, etc.) shall be shop fabricated and welded except for field assembly connection, connections to equipment, and where shown otherwise on the drawings shall be flanged.
   1. All piping shall be installed to the proper line and grade and be rigidly supported.
   2. Piping shall run parallel and at right angles to walls and ceilings.
   3. Cut pipe ends shall be smooth and at right angles to the axis of the pipe.
   4. Field welding of this system shall be kept to a minimum. All welding shall be by the MIG or TIG method. Butt welds shall have full penetration.
   5. All welding shall be performed by welders certified in welding stainless steel pipe.
   6. Weld brushes shall be of stainless steel and only used on stainless steel. All discoloration and deposits left by welding shall be removed by picking.
   7. Contractor shall weld on to the pipe 1/2" ports with isolation ball valves at low points in the piping in sufficient quantity to allow for proper draining of liquids during the cleaning process.

B. Installation of tubing:
   1. Cuts made on tubing shall be reamed.
   2. Bends in tubing shall be made with a proper bending tool unless bends require the use of an elbow fitting.

3. Stainless steel tubing shall be installed by pipe fitters skilled in the installation of stainless steel tubing.
4. Parallel lines shall be held plumb by adequate tubing supports.
   1) Waviness or sagging lines will not be accepted.
5. Stainless steel tubing shall be flushed clean with an appropriate fluid approved by the Engineer.

C. Installation of press connections:
1. Installation shall be in accordance with the manufacturer's installation instructions.
2. The pipe shall be fully inserted in the fitting and the pipe marked at the shoulder of the fitting.
3. The fitting alignment shall be checked against the mark on the pipe to assure the pipe is fully inserted in the fitting.
4. The joints shall be pressed using the tool approved by the manufacturer.

D. Installation of threaded connections:
1. Threaded joints shall have pipe joint compound or Teflon tape applied to the male threads only.
   a. Jointing material shall be compatible for the fluid being contained.
2. Tighten joint with a wrench and backup wrench as required.

E. All flange-mounted in-line instrumentation (i.e.: flow meters) shall be installed in a manner that will allow for removal/servicing. Unless specifically called out on the drawings, the Contractor shall provide the following jointing methods.
1. Utilize a plain-end section of pipe with adaptor flange connected to the instrumentation device.

3.04 TESTING

A. Clean of dirt, dust, oil, grease and other foreign material, before pressure and leakage tests.

B. Pressure and Leakage Tests:
1. Conduct combined pressure and leakage test in pipelines.
2. Furnish and install temporary testing plugs or caps; pressure pumps, pipe connections, meters, gages, equipment, and labor.
3. Test when desired and comply with Engineer's orders and specifications.
4. Fill section of pipe with water and expel air.
5. Pressure and leakage test consists of first raising water pressure (based on elevation of lowest point of section under test and corrected to gage location) to pressure in psi (bar). Pressure test all piping systems at 150-percent of the working pressure as determined by the Engineer, but at no less than 25 psi or greater than 150 psi.
6. No visible leakage in joints.
7. If unable to achieve and maintain specified pressure for one hour with no additional pumping, section failed to pass test.
8. If section fails pressure and leakage test, locate, uncover, and repair or replace defective pipe, fitting, or joint, at no additional expense and without time extension. Conduct additional tests and repairs until section passes test.
9. Immediately upon completion of testing, drain and dry piping to remove all traces of water and condensation.
10. Modifications to test procedure only if permitted by Engineer.

END OF SECTION

SECTION 15107

STAINLESS STEEL PIPE AND FITTINGS
THREE INCHES AND LARGER

PART 1 GENERAL

1.01 DESCRIPTION:

A. Provide and test stainless steel pipe, fittings and appurtenances as indicated and specified.

1.02 Related work:

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections of Division 1 of these Specifications.
   1. Section 15060 Pipe Hangers and Supports
   2. Section 15101 Grooved Piping Systems
   3. Section 15110 Valves and Appurtenances
   4. Section 15120 Piping Specialties

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements of the work of this Section.

B. Provide manufacturer's certification in writing, that materials meet or exceed minimum requirements as specified.

C. Welder Qualifications:
   1. Quality and certify welding procedures, welders, and operators in accordance with ANSI B31.1, paragraph 127.5 for shop and project site welding of piping work.

D. Job Conditions:
   1. Coordinate dimensions and drillings of flanges with flanges for valves, pumps and equipment to be installed in the piping systems.

1.04 SUBMITTALS:

A. Submit the following in accordance with Section 01300:
   1. Pipe manufacturer’s technical specification and product data.
   2. Certified shop and erection drawings. Contractor shall submit electronic files of the piping layout including the following:
      a. Pipe layouts in full detail.
      b. Location of hangers and supports.
      c. Location and type of anchors.
      d. Location of couplings and expansion joints.
      e. 1/2-inch = 1-foot scale details of all wall penetrations and fabricated fittings or special fittings.

f. Schedules of pipe, fittings, expansion joints and other appurtenances.

3. Certificates: Sworn certificates in duplicate showing compliance with material used and shop tests performed with appropriate standard.
4. Catalog cuts and technical data for expansion joints, couplings, gaskets, pipe supports and other accessories.
5. Submit reports required for welding certifications per ASME B31.1 paragraph 127.6.
6. Manufacturer's descriptive literature and technical data on insulation and proposed method of installation.

B. Material Certification:

1. Provide certification from the piping and fittings manufacturer that the materials of construction specified are recommended and designed for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
2. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated.

C. A copy of the contract mechanical process drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.05 DELIVERY, STORAGE AND HANDLING:

A. During loading, transportation and unloading, prevent damage to pipes and fittings. Load and unload each pipe under control at all times. Under no circumstances will a dropped pipe be used unless inspected and accepted by Engineer. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation.

PART 2 PRODUCTS

2.01 STAINLESS STEEL PIPE:

A. Manufacturers:
1. Douglas Brothers
2. Felker
3. Bristol Metals
4. Dixie Southern

B. Material:
1. Type 316L sheet and plate per ASTM A240, unless otherwise noted such as for air scour piping.
2. Maximum carbon content of 316L material limited to 0.03 percent.
3. Finish: 2D.
4. Air scour piping only shall be Type 304L stainless steel.

C. Fabrication:
1. Fabricate in accordance with ASTM A778 in NPS sizes shown with dimensional tolerances per ASTM A530.
2. Perform welding by qualified welders conforming to standard procedures. Weld piping with wall thickness up to 11 gauge, 0.125-inch, with the TIG (GTAW) process. Properly bevel heavier walls and use a root pass with the TIG (GTAW) process followed by subsequent passes with the TIG (GTAW), MIG (GMAW), or Metallic Arc (SMAW) process.
3. Add filler wire of ELC grades to all welds to provide a cross section at the weld equal to or greater than the parent metal. Distribute smooth and evenly weld deposit and provide a crown of no more than 1/16-inch on the I.D. and 3/32-inch on the O.D. of the piping.
4. Concavity, undercut, cracks or crevices are not acceptable.
5. Butt Welds: Full penetration to the interior surface, with inert gas shielding provided to the interior and exterior of the joint.
6. Remove excessive weld deposits, slag, spatter, and projections by grinding.
7. Continuously weld angle face rings on both sides to the pipe or fitting.
8. Grind all welds on gasket surfaces smooth.
9. Contour pipe branches, taps and bosses to the radius of the main pipe run and bevel and weld with full penetration. No projections to the inside of the branch or main run are acceptable. Provide a smooth transition from ID of run to ID of branch.
10. Wire-brush inside and outside weld areas with brushes of stainless steel that are specifically designed to be used only on stainless steel.
11. After manufacture, passivate stainless steel pipe, fittings, and appurtenances by immersion in a pickling solution of 6 percent nitric acid and 3 percent hydrofluoric acid. Temperature and detention time to be sufficient for removal of oxidation and ferrous contamination without more than superficial etch of surface. Perform a complete neutralizing operation by immersion in a trisodium phosphate rinse followed by clean water wash. Perform in accordance with ASTM A380.
12. After fabrication, either passivate by immersion (see above paragraph) or scrub interior and exterior of welds with same solution or pickling paste and stainless

steel wire brushes to remove weld discoloration and then neutralize and wash clean. Perform in accordance with ASTM A380.

13. Perform all welding in the shop. Field welding is not acceptable.
    a. If field welding is allowed for certain circumstances, the Contractor shall submit the welders qualifications and an acceptable method of cleaning the pipe and fittings for review prior to start of any field welding.
14. Fittings: Butt weld type manufactured in accordance with ASTM A774 of the same raw material and in the same thicknesses as the pipe. Socket weld fittings are not acceptable.
    a. Elbows up to 24-inch Diameter: Provide smooth flow-die formed, long radius; with centerline to end of elbow equal to 1.5 times the nominal pipe size.
    b. All short radius, special radius, and reducing elbows and long radius elbows greater than 24-inch diameter: Fabricate with pieces in accordance with the following table with dimensions in accordance with AWWA C208:

Bend, degrees	Number of Pieces
0 to 22.5	2
23 to 45	3
46 to 67.5	4
68 to 90	5

15. Fabricate tees and branch connections true and square with wall thickness same as pipe.
16. Reducers evenly tapered with tangent ends for butt weld connection.
    a. Reducers may be straight tapered cone construction.
17. Secure flanges to pipe ends and plug openings prior to shipment.

D. Design:
1. Stainless steel pipe: All piping 3-inches and larger shall be SCH 10S.
2. Joints: Flanged or, bolted split sleeve type couplings as indicated and specified. Split couplings requiring cut or roll grooving of the pipe not allowed unless specifically called for.
3. Flanged Joints: Van Stone back-up flange type, ANSI 150 lb.
4. Provide stainless steel back-up flanges of A240-316/L, or 304L stainless steel for air scour piping flanges, with the following thickness. Galvanized steel and ductile iron flanges are not acceptable.

Pipe Size (inches)	Flange Thickness (inches)
3 and 4	0.375
6 and 8	0.500
10 to 18	0.750

5. Hardware: Type 316 stainless steel unless specifically used with air scour system piping where Type 304 stainless steel shall be acceptable.
6. Fabricate flanged joint face rings fabricated of rolled stainless steel angles.

7. Use angle face rings with thickness equal to or greater than the wall of the pipe or fitting to which it is welded. Continuously weld on both sides to the pipe or fitting. Fabricate angle legs so as not to interfere with the flange bolt holes.
8. Isolate stainless steel flanges from other ferrous metal connections at valves and equipment with flange insulating kit.
    a. Pipe flange insulating kit, double washer type:
        (1) Flange gasket: Type E, 1/8-inch thick neoprene-faced phenolic.
        (2) Insulating sleeves: 1/32-inch thick polyethylene, full length, one for each flange bolt.
        (3) Insulating washers: 1/8-inch thick phenolic, two for each flange bolt.
        (4) Mechanical washers: 1/8-inch thick Type 316 stainless steel, two for each flange bolt.

2.02 BOLTED SPLIT SLEEVE TYPE COUPLINGS:

A. Provide stainless steel couplings in accordance with Section 15120.

2.03 EXPANSION JOINTS:

A. Provide in accordance with Section 15120.

2.04 PIPE SUPPORTS:

A. Provide in accordance with Section 15060.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 COORDINATION

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this section.

3.03 INSTALLATION:

A. Ensure pipelines parallel to building walls wherever possible. Install piping to accurate lines and grades. Where temporary supports are used, ensure rigidity to prevent shifting or distortion of pipe. Provide for expansion where necessary.

B. Pitch piping toward low points. Provide for draining low points.

C. Before assembly, remove dirt and chips from inside pipe and fittings.

D. Make flanged joints with bolts; bolt studs with nut on each end; or studs with nuts where one flange is tapped.
   1. Except as otherwise specified, provide number and size of bolts conforming to same ANSI standards.
   2. Provide Type 316 stainless steel hardware, unless specifically used for air scour piping system where 304 stainless steel hardware shall be acceptable.
   3. Provide ring gaskets of materials designed for the service specified and indicated, 1/16-inch thick gaskets.
   4. Make up flanged joints tight with care being taken to prevent undue strain upon valves or other pieces of equipment.

E. All flange-mounted in-line instrumentation (i.e. flow meters) shall be installed in a manner that will allow for removal/servicing. Unless specifically called out on the drawings, the Contractor shall provide the following jointing methods.
   1. Utilize a plain-end section of pipe with adaptor flange connected to the instrumentation device.

3.04 FIELD TESTING:

A. Clean of dirt, dust, oil, grease and other foreign material, before pressure and leakage tests.

B. Pressure and Leakage Tests:
   1. Conduct combined pressure and leakage test in pipelines.
   2. Furnish and install temporary testing plugs or caps; pressure pumps, pipe connections, meters, gages, equipment, and labor.
   3. Test when desired and comply with Engineer's orders and specifications.
   4. Fill section of pipe with water and expel air.
   5. Pressure and leakage test consists of first raising water pressure (based on elevation of lowest point of section under test and corrected to gage location) to pressure in psi (bar) numerically equal 150-percent of the working pressure as determined by the Engineer, but at no less than 25 psi or greater than 150 psi.
   6. No visible leakage in joints.
   7. If unable to achieve and maintain specified pressure for one hour with no additional pumping, section failed to pass test.
   8. If section fails pressure and leakage test, locate, uncover, and repair or replace defective pipe, fitting, or joint, at no additional expense and without time extension. Conduct additional tests and repairs until section passes test.
   9. Immediately upon completion of testing, drain and dry piping to remove all traces of water and condensation.
   10. Modifications to test procedure only if permitted by Engineer.

END OF SECTION

SECTION 15108

TUBING, HOSE, FITTINGS AND APPURTENANCES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work Included: Provide all the tubing, hose, fittings and associated appurtenances as required by the Contract Documents.
   1. In general, provide all the tubing, hose, fittings, and associated appurtenances for the chemical storage and feed systems.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
   1. Section 11423 Chemical Feed Equipment
   2. Section 15104 Plastic Pipe and Fittings

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Coordinate the work of this Section with the work of other related Sections.

1.04 SUBMITTALS

A. Comply with the pertinent provisions of Section 01300.

B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.05 PRODUCT HANDLING

A. Comply with manufacturer's recommendations.

PART 2 PRODUCTS

2.01 HOSE

A. Hose used to contain sodium hydroxide (NaOH) shall have the following attributes:
   1. Teflon inner-core (FDA) approved.
   2. Double braided stainless-steel casing
   3. Inside diameter: 1/2-inch tubing size.

2.02 TUBING

A. Tubing used to contain polyaluminum chloride, sodium hypochlorite, phosphate, and fluorosilicic acid shall be FEP (Fluorinated Ethylene Propylene) as manufactured by Parflex/Atlantic.
   1. 100% virgin FEP with resins complying with ASTM D 3296.
   2. Size: 1/2-inch I.D.
   3. Working pressure at 70 degrees F.: 180 psi.

2.03 FITTINGS.

A Fittings for the above-specified hose shall be:
   1 Manufactured from 303 stainless steel.
   2 Crimped to the hose.
   3 Fitting to hose connections shall have a working pressure equal to the hose (1200 psi).

B. Fittings for the above-specified tubing shall be push-on type with self-sealing threads, NSF 61 certified, for use with chemical applications.

2.04 THREADED CONNECTIONS

A. Threaded connections shall be made-up with Teflon with the following attributes:
   1. Made of virgin PTFE.
   2. Conforming to MIL-T-27730A.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which the work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 COORDINATION

A. Coordinate the work of this Section with equipment suppliers to ensure all dimensions and elevations are compatible.

3.03 INSTALLATION

A. Install the work of this Section in strict accordance with the manufacturer's instructions.

B. Tubing shall be used:
   1. On the suction and discharge side of all metering pumps as indicated on the drawings, without coiling.
   2. Drain lines from pressure relief lines.

END OF SECTION

SECTION 15110

VALVES AND APPURTENANCES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide valves and appurtenances as required by the Contract Documents.

B. The items of this Section include but are not necessarily limited to:
1. Check Valves
2. Ball Valves
3. Butterfly Valves
4. Valve Operators
5. Hydraulically Operated Surge Anticipator/Pressure Relief Valves
6. Hydraulically Operated Backpressure Sustaining Valves
7. Pressure Reducing Valves
8. Air and Combination Air/Vacuum Valves
9. Duck Bill Check Valves
10. Solenoid Valves
11. Needle Valves
12. Sampling Ports
13. Flap Valves

C. Work Not Included:
1. Valves on plumbing systems as shown on the Plumbing Drawings and specified under Section 15400, Plumbing.
2. Valves on HVAC systems as shown on the HVAC Drawings and specified under Section 15500, HVAC.
3. Direct burial valves which are specified in Section 02640, Valves and Appurtenances.
4. Valves on the MIEX System, as specified in Section 11610, Magnetic Ion-Exchange Treatment System.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
1. Section 11209 PFAS Removal Treatment System
2. Section 11240 Horizontal GreensandPlus Filters
3. Section 11423 Chemical Feed Equipment
4. Section 15075 Mechanical Identification
5. Section 15100 Ductile Iron Pipe, Fittings and Appurtenances
6. Section 15101 Grooved Piping System
7. Section 15102 Copper Pipe, Fittings and Appurtenances
8. Section 15104 Plastic Pipe and Fittings
9. Section 15106 Stainless Steel Pipe and Fittings Two and One Half Inches and Smaller
10. Section 15107 Stainless Steel Pipe and Fittings Three-Inches and Larger

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. All of the types of valves and appurtenances shall be products of established firms who are experienced in the manufacture of the particular item to be furnished.
   1. All valves and their appurtenances shall be of domestic manufacture.

1.04 SUBMITTALS

A. Comply with the pertinent provisions of Section 01300.

B. Product Data:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications catalog cuts, and other data needed to prove compliance with the specified requirements.

1.05 PRODUCT HANDLING

A. Handle in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. General:
   1. All valves and appurtenances shall be of the size shown on the Drawings and as far as possible all equipment of the same type shall be from one manufacturer.
   2. All valves and appurtenances shall have the name of the manufacturer, flow directional arrows and the working pressure for which they are designed, cast in raised letters upon some appropriate part of the valve body.
   3. All valves shall open right (clockwise). Operators shall have arrows cast thereon to indicate direction of rotation to operate the valve.
   4. All iron valves shall have:
      a. An exterior coating of red oxide primer FDA approved for potable water use.
      b. An interior coating of an NSF/ANSI 61 certified fusion bonded epoxy.
         i. The interior of valves with seats that are bonded to the valve body, with the exception of disc edge, rubber seat and finished portions, shall be evenly coated with an NSF 61 approved 2-part liquid epoxy. Minimum dry film thickness shall be 8 Mils.
      c. All submerged valves shall have all wetted interior and exterior iron surfaces coated with an NSF 61 epoxy coating as specified above.

2.02 CHECK VALVES/FOOT VALVES

A. Check Valves (Silent Check)/Foot Valves:
   1. Body: Cast iron with flanged ends conforming to ANSI Class 125.
   2. Seat: Bronze,
   3. Plug: Bronze,

4. Bushing Bronze,
5. Spring: Stainless Steel,
6. Globe style,
7. Drip tight seating at 150 psi.
8. Foot valve strainer shall be T302 stainless steel.

B. Check Valves (2 Inch and Smaller):
1. Bronze construction,
2. Disc. seat: Teflon,
3. "Y" pattern,
4. Horizontal swing,
5. WOG rating: 200 psi.

C. Check Valves (PVC/CPVC Piping):
1. PVC/CPVC check valves shall be NIBCO as the Owner has standardized on this manufacturer's valves.
2. Ball Type:
   a. Type 1, Grade 1 PVC (cell classification 12454-B) or Type IV, Grade 1 CPVC (cell classification 23447-B), conforming to ASTM D1784.
   b. True union with EPDM "O" rings.
   c. Socket or flanged ends as required.
   d. Rated for 150 psi working pressure at 75 degrees F.
3. Swing Check Type:
   a. Heavy-duty PVC/CPVC construction.
   b. EPDM seals.
   c. Dual drain plugs.
   d. Built-in O-ring flange seals
   e. Furnish PVC counterweight
4. NIBCO Check Valves shall be classified as a "manufactured product" as it relates to BABA compliance defined in Specification Section 00820G. Due to specific equipment requirements, a BABA waiver through the USEPA will be applied for by the Owner, and the contractor shall obtain standard equipment as included herein.

ce defined in Specification Section 00820G. Due to specific equipment requirements, a BABA waiver through the USEPA will be applied for by the Owner, and the contractor shall obtain standard equipment as included herein.

2.03 BALL VALVES

A. Ball Valves (2-inches and Smaller):
1. Metallic Piping (does not include stainless steel):
   a. Two-piece bronze body,
   b. WOG pressure rating: 600 psi,
   c. Teflon seats and seals,
   d. Full port design,
   e. Adjustable packing gland,
   f. Screwed or soldered ends.
2. Stainless Piping:
   a. All 316L stainless steel construction,
   b. Teflon seats, packing and "O" rings,
   c. Swing-out design,
   d. Full port design,
   e. Joint: As required,
   f. Locking stainless steel handle.

B. Plastic Piping:
1. PVC Type 1, Grade 1, or CPVC Type IV, Grade 1.
2. Comply with ASTM D1784
3. Double entry true union with EPDM "O" rings.
4. Teflon seats and EPDM packing.
5. Socket or flanged ends, as required.
6. Working pressure 150 psi at 75 degrees F.
7. PVC/CPVC ball valves shall be NIBCO as the Owner has standardized on this manufacturer's valves.
8. NIBCO Check Valves shall be classified as a "manufactured product" as it relates to BABA compliance defined in Specification Section 00820G. Due to specific equipment requirements, a BABA waiver through the USEPA will be applied for by the Owner, and the contractor shall obtain standard equipment as included herein.

2.04 BUTTERFLY VALVES

A. Butterfly Valves (ductile iron piping):
1. Comply with ANSI/AWWA C504.
2. Flanges conform to ANSI B16.1, Class 125 cast iron flange.
3. Cast iron body in compliance with ASTM A126, Class B.
4. Cast iron waterway surfaces shall be NSF 61 epoxy coated at the factory, minimum 8 mils DFT.
5. Shaft: Type 304 stainless steel in compliance with Table 3 of AWWA C504
6. Shaft seals: "V" type chevron packing.
7. Bearings: Permanently self-lubricated sleeve type.
8. Disc:
    a. Ductile iron meeting the requirements of ASTM A536, or
    b. Cast iron meeting the requirements of ASTM A126, Class B.
    c. For valves 6" and smaller, disks may be ASTM A351 Grade CF8N stainless steel.
    d. Iron discs shall have a Type 316 stainless steel edge.
e. Seat: BUNA-N.
f. Zero leakage at a pressure differential of 150 psi.
g. Operator:
    a. Hand wheel actuator of the geared type with enclosed and sealed housing.
    b. Clearly indicates the valve's position.
    c. Holds the valve in any intermediate position between full open and fully closed without creeping or fluttering.
    d. Motor-operators shall be furnished on valves where required.

B. Butterfly Valves (PVC piping):
1. Constructed from PVC Type 1 Cell Classification 12454 or CPVC Type IV Cell Classification 23447.
2. Bolt hole patterns shall conform to ANSI B16.5, Class 150.
3. Shaft: Type 316 stainless steel.
4. Shaft Seals: EPDM O-rings
3. Disk: PVC
4. Seat: EPDM
5. Zero leakage at a pressure differential of 150 psi.
6. Operators:

a. Lever operators shall be furnished on all valves 8-inch in diameter and smaller.
b. Handwheel operators shall be furnished on all valves 10-inch and larger.
1. Actuator shall be worm gear type with high impact polypropylene handwheel.
2. Clearly indicates the valve's position.
3. Holds the valve in any intermediate position between full open and fully closed without creeping or fluttering.
c. Motor-operators shall be furnished on valves where required.

C. Butterfly Valves – Air Scour Service:
1. Manufacturers:
a. DeZurik, or equal.
2. Provide valves rated for 250-degree F continuous operation and 300 degree F intermittent operation.
3. Body:
a. Wafer-lug type with full-lug body, drilled and tapped for mounting bolts design.
b. Material:
c. Type 316 stainless steel
d. Provide to mate with 125-lb. ANSI B16.1 flanges.
e. Wafer-lug type with full-lug body, drilled and tapped for mounting bolts.
4. Seat: Dovetail, EPDM, installed in the body with elastomer formed continuously over the ends to provide seal with mating pipe flanges.
5. Disk: Air profile design, aluminum bronze ASTM B148 Alloy 952 or Type 316 stainless steel.
a. Provide bubble-tight shut off at 25 psi working air pressure.
6. Stem: One-piece of Type 316 stainless steel with bronze or Teflon bushings and EPDM or Buna-N O rings or self-adjusting packing.
a. Disc stem connection:
i. 12-inch and smaller: Type 316 stainless steel torque plug.
ii. 14-inch and larger: Type 316 stainless steel disc screws.
7. Valve Operators:
a. Manually operated valves 12-inch and smaller provide lever-type with 10-position lock plate and valve position indicator.
b. Manually operated valves 14-inch and larger provide geared-type permanently lubricated, totally enclosed operator with stops to prevent over-travel, and with valve position indicator and hand wheel or chain wheel as specified herein.
c. Electric motor actuators: Provide as specified herein.

2.05 VALVE OPERATORS

A. Manual Operators: Shall be as specified with the valve with the following exceptions:
1. Chainwheel operators shall be provided for valves whose centerline is higher than 6 feet above the finished floor, unless otherwise indicated on the drawings or directed by the Engineer.

B. Electric Motor Operators:
1. The entire actuator shall be watertight according to NEMA-4 Standard. The terminal compartment and limit switch compartment covers will be fastened to the actuator housing with captured stainless-steel bolts.

2. The motor will stroke in sixty sections, shall be specifically designed for actuator service and be characterized by high starting torque, low stall torque and low inertia.
    a. The motor shall be of the induction type, totally enclosed and non-ventilated.
    b. The motor shall be capable of operating in any position and shall be properly sealed from the gear case to allow removal of the motor without loss of lubricant.
    c. The motor shall operate from 120 VAC, 1 phase input source.
3. Torque switches shall be provided to de-energize the motor circuit if the valve encounters an obstruction during travel.
    a. Each actuator shall have independent open direction and close direction torque switches.
4. Travel limit switches shall be provided to de-energize the motor control circuit when the actuator reaches the limits of travel in the open and closed directions.
    a. The limit switch drive shall be a mechanical design and of the stacked counter gear type, easily set with a screwdriver.
    b. The standard configuration will be two counter gear rotors with limit switches consisting of two (2) normally closed and (2) normally open contacts per rotor.
    c. Limit switches shall have silver contacts and be completely enclosed in their own NEMA-4 case.
5. The actuator shall incorporate a space heater in the limit switch compartment to aid in the prevention of damage to the switches and motor resulting from condensation.
6. The electrical terminals are to be housed in a compartment that is isolated from the torque/limit switch compartment.
    a. Terminals shall be of the plug and socket design which simultaneously disconnects the motor and control wiring when the terminal compartment cover is removed.
7. All power gearing shall be made of hardened steel or bronze and operate in a grease lubricant.
    a. Output drive gearing will be of the worm shaft/gear configuration with the worm gear constructed of bronze.
8. The actuator shall be furnished with a mechanical dial indicator to show continuous valve position.
9. A handwheel shall be permanently attached to the actuator for manual operation.
    a. The handwheel shall not rotate during motor operation and a declutching mechanism shall be provided for manual operation.
10. Open/close actuators shall be furnished with an integral control package which connects to the actuator by means of plug and socket terminals.
    a. The control enclosure will be provided in accordance with NEMA-4 standards.
    b. Motor controls shall include mechanical reversing contactors.
    c. All models shall include Open/Stop/Close control, Local/Off/Remote selector switches and Open/Close lights.
11. Modulating valve actuator control enclosure shall be constructed in accordance with NEMA-4 standards.
    a. Motor controls shall include mechanical reversing contractors.
    b. All models shall include Open/Stop/Close control, Local/Off/Remote selector switches, Open/Close lights and a positioner board to:
        i. Accept a 4-20mA DC control signal.
        ii. Output a 4-20mA signal proportional to valve position.

12. Provide remote push button stations for valves with control stations at an elevation greater than 7 feet above the finished floor.

2.06 HYDRAULICALLY-OPERATED CONTROL VALVES

A. Main Valve. The main valve shall be a hydraulically operated, diaphragm-actuated, globe pattern valve, Hytrol Model 100 as manufactured by Cla-Val Co., Newport Beach, CA, or approved equal.
   1. The valve body and cover shall be ductile iron (ASTM A-536).
   2. End connections shall be 125-pound ANSI drilled flanges.
   3. Resilient, synthetic rubber disk and removable single stainless-steel seat.
   4. Designed to facilitate repairs internally without removing the valve from the line.
   5. Valve shall be hydrostatically tested at a minimum of two times the rated service pressure.
   6. Diaphragm assembly:
      a. Stainless steel valve stem shall be fully guided at both ends by a bronze bearing in the valve cover, and an integral bearing in the valve seat.
      b. Diaphragm shall consist of nylon fabric bonded with synthetic rubber and shall be used as a seating surface.
      c. Packing glands and/or stuffing boxes are not permitted.
      d. There shall be no pistons operating the valve or pilot controls.

B. Pilot Valves:
   1. The pilot valve shall be easily accessible and shall be removable from the main valve under pressure.
   2. Pilot Control — Bronze
   3. Trim — Stainless steel
   4. Rubber — Buna-N
   5. Tubing and Fittings — Copper and Bronze

C. Surge Anticipator/Pressure Relief Valves:
   1. The surge anticipator/pressure relief valve shall open at an adjustable rate on the initial low-pressure wave in anticipation of the returning high pressure surge, as well as act as a conventional pressure relief valve. The valve shall close slowly to prevent subsequent surges. The valve shall be an angle-body Model 52-03 as manufactured by Cla-Val Co., Newport Beach, CA, or approved equal.

D. Backpressure Sustaining Valves:
   1. The backpressure sustaining valve shall be of the reduced cavitation design and shall automatically maintain a constant upstream pressure within close limits via a pilot control system, opening fast to maintain steady upstream line pressure, but closing gradually to prevent surges. The valve shall be a Model 650-01 as manufactured by Cla-Val Co., Newport Beach, CA, or approved equal.
      a. Valve shall be furnished with check feature to close valve on a pressure reversal to prevent return flow.
      b. The valve shall be 12” reduced port set to maintain a back pressure of 15 psi, with continuous flows ranging from 700 to 1,400 gpm.

2.07 PRESSURE REDUCING VALVES (2-1/2 INCH AND SMALLER)

A. Pressure reducing
   1. Body: Bronze
   2. Strainer: Stainless Steel
   3. Seat disc: EPDM
   4. Diaphragm: EPDM
   5. Reduced outlet pressure = 50 psi or less

2.08 AIR AND COMBINATION AIR/VACUUM RELIEF VALVES

A. The relief valves shall be the equal of APCO Valve and Primer Corporation models indicated below for the various usages.

B. Air Release Valves (Model #50):
   1. Size: 1/2-inch
   2. Body: Cast iron
   3. Stem: Stainless Steel
   4. Float: Stainless Steel
   5. Seat: Buna-N

C. Combination Air and Vacuum Valves:
   1. Size: To accommodate turbine pump capacity:
   2. Body: Cast iron
   3. Baffle: Delrin
   4. Float: Stainless Steel
   5. Seat: Buna-N
   6. Diffuser Brass

D. Provide double acting throttling device on combination air and vacuum valves installed on vertical turbine pumps, which allows throttling of air out of the valve, full air flow back in to prevent vacuum and water column separation in the pump.
   1. Housing: Malleable iron
   2. Adj. screw and nut Stainless steel
   3. Spring Stainless steel
   4. Plug Teflon

2.09 DUCK BILL CHECK VALVES

A. Chemical Service:
   1. Provide duck bill type check valve of compatible material for the following chemicals for chemical bulk tank overflows:
      a. 10 to 15 percent sodium hypochlorite
      b. 25 percent sodium hydroxide
      c. 25 percent hydrofluorosilicic acid
      d. Blended phosphate
   2. Provide slip-on type valve with Type 316 stainless steel clamps or other suitable material clamps for chemicals that are not compatible with stainless steel.

B. Process Drains:
   a. Material: EPDM
      1) Provide flanged or slip-on type valve with Type 316 stainless steel clamps as indicated.
      2) Provide inline type with flanged connection or insertable as indicated.

2.10 SOLENOID VALVES:

A. Valves shall be direct acting packless two-way solenoid valves for water service.
   1. Normally closed, unless otherwise indicated
   2. Operation with 120-volt, 60 Hertz power
   3. Continuous duty Class A insulation and NEMA 4X enclosure.
   4. Valve body:
      a. Forged brass
      b. Minimum 250 psi working pressure
      c. NPT connections
      d. Buna-N seat
      e. Wetted parts stainless steel.
   5. Operate satisfactorily in any position.

2.11 NEEDLE VALVES

A. Needle Valves (1 inch and smaller)
   1. All 316 stainless steel construction
   2. Regulating stem: 316 stainless steel
   3. PTFE packing.

2.12 SAMPLING PORTS

A. Sampling ports shall be smooth-nosed wall-type faucets, Elkay Model No. LK69CP or equal.

1.	Material	Brass
2.	Valve type	Brass stem assembly
3.	Connection	1/2” NPT male

2.13 FLAP VALVES:

A. Type:
   1. Hinged, single flap type designed to close tight whenever downstream pressure exceeds upstream pressure.

B. Materials:

1.	Body and Flap:	Cast iron, ASTM A126-B.
2.	Seat:	Bronze, ASTM B21-CA464 or B133-CA110 or neoprene.
3.	Hinge Arms:	Bronze, ASTM B584-CA865.
4.	Hinge Pins:	Designed in double shear, silicon bronze ASTM B98-CA655 or Type 316 stainless steel.

C. Fabrication:
   1. Flap: Spherical dished design, size to withstand maximum operating loads.
   2. Hinge Arm: Provide two pivot points. Provide an adjustable lower pivot with limited rotation and a threaded upper hinge post to adjust flap valve sensitivity.
   3. Provide a lubrication fitting for each pivot.
   4. Provide double nut connections, cotter pins are not acceptable.
   5. Ends: 125 lb. ANSI standard drilling.

D. Gravity Flow Flap Valves:
   1. Provide bronze seats pneumatically impacted into dove-tail grooves machined to a 63 micro-inch finish.

E. Pumped Flow Flap Valves:
   1. Resilient Seat: Neoprene or Buna-N, bonded in a groove machined in the body to provide contact surface for the seat machined in the flap.
   2. Provide a steel leaf-spring.
      a. Provide spring attached to body and extend over the flap to provide a safety limit of travel.
      b. Provide a neoprene or Buna-N pad on the spring contact area.

F. Wall Thimbles:
   1. Material: Cast Iron, ASTM A126.
   2. One piece construction, of section to withstand all operational and installation stresses.
   3. Provide a water stop cast around the periphery of the thimble.
   4. Provide a machined front flange and provide tapped holes for the flap valve attaching studs.
   5. Provide a permanent gasket of uniform thickness or mastic between the flap valve and the wall thimble.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 COORDINATION

A. Coordinate the work of this Section with equipment suppliers, that the piping system shall be connected to, to ensure that all dimensions and elevations are compatible.

B. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

3.03 VALVE INSTALLATION

A. The valves and appurtenances shall be installed at the locations shown on the Drawings.
   1. Valve operators shall be easily accessible and rigidly supported.
   2. After installation check valve operation. Valve shall operate smoothly through its entire operating range.
   3. Valve tags shall be installed on all valves with designations specifically labeled on the process or instrumentation drawings.

B. Swing and flapper-type check valves shall be installed horizontally, or vertically if direction of normal flow is upwards.

C. Air release valve assemblies shall be equipped with a line size ball valve for isolation.
   1. A copper drain line shall extend from the top of all air release valves to within 2 inches above a floor drain or drain channel.

2. A ½-inch air release valve shall be installed on all high points of the process piping system where air can accumulate, whether or not indicated on the drawings, and as approved or directed by the Engineer. Air release valves are not required where other provisions for releasing air are indicated on the drawings.

D. Solenoid valves shall be installed with unions on both sides of the valve to facilitate removal.

1. A line size ball valve shall be installed upstream of the union if necessary to facilitate solenoid valve removal without affecting water feed to branches off the common feed line.

END OF SECTION

SECTION 15120

PIPING SPECIALTIES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide expansion joints, wall pipes, wall sleeves, filler rings, flexible mechanical pipe couplings, cam and groove couplings, and tapped connections for the piping systems all as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 15100 Ductile Iron Pipe, Fittings and Appurtenances
   2. Section 15101 Grooved Piping Systems
   3. Section 15104 Plastic Pipe and Fittings
   4. Section 15106 Stainless Steel Pipe and Fittings Two and One Half Inches and Smaller
   5. Section 15107 Stainless Steel Pipe and Fittings Three Inches and Larger

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Coordinate the work of this Section with the work of other Sections.

1.04 SUBMITTALS

A. Comply with the pertinent provisions of Section 01300.

B. Product Data:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.05 PRODUCT HANDLING

A. Handle in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 EXPANSION JOINTS

A. Expansion joints shall be Redflex Type J-1 as manufactured by Red Valve Co. Inc., Carnegie, PA. The expansion joint shall have the following attributes:
   1. Redflex Model:
      a. Type J-1 for "straight thru" joints.
      b. Type J-10 for concentric reducers
      c. Type J-11 for eccentric reducers
   2. Size as shown on the Drawings,
   3. Materials of construction: Buna-N,
   4. Single "filled" arch, open configuration,
   5. Flanges shall be 125 lb. conforming to ANSI Standards:
      a. Constructed integral with body.
   6. Pressure rating: 140 lb standard, 190 lb high,
   7. Retaining rings.

B. Control Units:
   1. Gusset plate thickness: 1/2-inch,
   2. Rod diameter: 5/8-inch,
   3. Number of rods: 3,
   4. Materials: Galvanized steel.

2.02 WALL PIPES

A. Ductile iron wall pipes shall have an integrally cast thrust collar as manufactured by American Cast Iron Pipe Co.
   1. Wall pipe shall be used where indicated on the drawings, and shall conform to ANSI/AWWA C110/A21.10.
   2. Ends of wall pipes shall be flanged or flange by mechanical joint. Flanges shall be of same class as that of pipe being connected.
   3. The wall pipes shall be of the dimensions required with ends flush with both faces of the wall or as shown on the Drawings.
   4. Ductile iron wall pipes shall be of approved type, dimension and wall thickness.
   5. Ductile iron wall pipes shall be provided for all pipes passing through reinforced concrete walls.

B. At the Contractor's option, if approved by the Engineer, wall sleeves for concrete floor and wall penetrations may be made by means of a sleeve capable of being bolted directly to the formwork to prevent misalignment.
   1. Seal of the annular space between the carrier pipe and the sleeve shall be by means of a confined rubber gasket and capable of withstanding 350 psi.
   2. Manufactured from Ductile Iron with an integrally cast waterstop of 1/2" minimum thickness and 2 1/2" minimum height.
   3. Shall be "Omni Sleeve" or an approved equal

2.03 WALL SLEEVES

A. The annular space created by the wall sleeve and the pipe shall be positively sealed with "Link Seal" manufactured by GPT Industries or an approved equal.
   1. Seals shall be the modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening.
   2. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut.
      a. After the seal assembles positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely watertight seal between the pipe and wall opening.
   3. The seal shall be constructed so as to provide electrical insulation between the pipe and wall, thus reducing chances of cathodic reaction between these two members.
   4. All wall sleeves of which any portion is below main floor slab and penetrates an exterior wall shall have link seals on both the interior and exterior faces of the wall. All wall sleeves above this elevation shall have link seals on the interior wall only. Wall sleeves that penetrate a wall between a tank and an interior room shall not be allowed, and a wall pipe as specified in this section shall be used.
   5. The Contractor shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabricating or installing the seals.
      a. The inside diameter of each wall opening shall be sized as recommended by the manufacturer to fit the pipe and Link-Seal to assure a water-tight joint.
   6. The Contractor shall familiarize himself with the installation of the seals through the manufacturer's instruction bulletin which illustrates the proper procedure for installing and tightening the seal to provide a water-tight pipe penetration.

2.04 FLEXIBLE MECHANICAL PIPE COUPLINGS

A. Flexible mechanical ductile iron pipe couplings for jointing of plain ends of ductile iron pipe shall be suitable for a 200-psi water working pressure and shall be of the proper size and suitable for use on the piping on which it is installed.
   1. Couplings shall be of ductile iron construction and shall be provided with middle ring not less than 12-inches in length.
   2. Tee head alloy steel bolts with heavy hex nuts, molded rubber gaskets, follower rings and accessories as required for the complete installation.
   3. Where indicated, the coupling shall be provided with not less than two tie rods extended from flange connections on each side of the couplings.
   4. Follower rings shall be amply proportioned to take, without deformation, the strains imposed on the coupling by the installation.

2.05 FLANGE ADAPTERS

A. Ductile iron flange adapters as manufactured by Uni-Flange shall be provided where indicated on the drawings to allow for equipment removal or approved by the Engineer for use in joining flanged piping with slight misalignment.
   1. Flange: Ductile iron, ASTM A536, Grade 65-45-12, drilled to ANSI B16.1 or ANSI B16.2.
   2. Gasket: SBR Buna-N

3. Set Screw: AISI 4140 steel with break-away head

2.06 FILLER RINGS

A. Filler rings of the same materials, facing and drilling as the flanges they are used with shall be provided in flanged piping where necessary and approved for the proper fitting and layout of the piping.

2.07 CAM AND GROOVE FITTINGS

A. Cam and groove adapters for the chemical storage tanks fill lines shall be:
1. Size: 2 inch.
2. Material: Polypropylene.
3. Style: Male adapter by male NPT.
4. Interchange with all products produced to MIL-C-27487E.

B. Cam and groove dust cap shall:
1. Size: 2 inch.
2. Material: Polypropylene.
3. Handles: Locking.
4. Security chain: 12 inches long; stainless steel.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Expansion Joint: The expansion joints and appurtenances shall be installed at the locations shown on the Drawings.
1. Misalignment of piping shall not exceed 1/8-inch.
2. Install control unit per manufacturer's requirements.

B. Wall Pipes
1. The Contractor shall be responsible for having wall pipes readily available.
2. Shall be tightly secured in the formwork at time of concrete placement.
3. Thrust collars shall be located in the center of the wall in which the wall pipe is to be installed.

C. Wall Sleeves
1. Securely anchor to formwork as required by the manufacturer.

END OF SECTION

SECTION 15300

FIRE PROTECTION

(Part of Work of Section 15301 – FIRE PROTECTION SPRINKLER SYSTEMS FILED SUB-BIDS, Filed Sub-Bid Required)

PART 1 GENERAL

1.01 GENERAL PROVISIONS

A. Attention is directed to the Contract, General Conditions, Supplementary Conditions, and all Sections within Division 01 – General Requirements, which are hereby made a part of this section of the Specifications.

B. Equality of material, article, assembly or system other than those named or described in this section shall be determined in accordance with the provisions of the Contract and General Conditions.

C. Examine all Drawings and all Sections of the Specifications and requirements and provisions affecting the work of this Section.

1.02 SCOPE OF WORK

A. Provide a complete, automatic, wet pipe fire protection system for the Wading River Water Treatment Plant (WTP) as indicated on the plans, including, but not limited to, valves, piping, sprinkler heads, hangers and seismic restraint. Fire Protection Sprinkler Systems Filed Sub-Bid Work shall start at the connection to the City's water supply approximately 10-feet away from the proposed WTP as shown on the plans.

B. Provide testing and flushing of the entire new system from the new supply connection to most remote interior connection. ENSURE THE WATER SUPPLY IS FLUSHED PER NFPA-24 & NFPA-13 PRIOR TO CHARGING THE SPRINKLER SYSTEM.

C. Provide hangers, inserts, anchors, sleeves, supports, seismic restraints, fire stopping at sleeves and supplementary steel for piping and equipment supports, required for a complete installation of each system specified and indicated.

D. Provide valve tags, charts and pipe marking.

E. Provide operating and maintenance manuals.

F. Provide guarantees.

G. Provide shop drawings and reproducible record drawings of actual installation.

H. Provide cleaning and rubbish removal for trade related items.

I. Disconnect and reinstallation of fire protection equipment temporarily interrupted during construction, if necessary.

J. Provide necessary supervision and coordination information to any other trades involved in the construction, to accommodate space, support or service requirements for equipment and piping provided under this section of the specifications.

K. Provide shop drawings relative to fire protection systems as follows: Before buying or installing any fire protection equipment, prepare and submit shop drawings of equipment and piping, to scale, of fire protection systems piping to the Engineer. The Fire Protection Sprinkler Systems Contractor shall submit Hydraulic Calculations which shall be stamped by a Registered Professional Engineer in Massachusetts. Shop drawings and hydraulic calculations shall also be submitted to, and approved by, appropriate Underwriters or Authorities as required by the Owner.

L. Provide flow test data, taken within a twelve month period for basis of design.

M. Review all Civil, Structural, Plumbing, HVAC, Electrical, and Architectural drawings and visit site prior to submission of bid to familiarize self with conditions and scope of construction.

N. Coordinate, with Electrical Contractor, the installation and compatibility of all flow, tamper, pressure and alarm devices, required and specified, for the proper annunciation and transmission of an alarm or trouble condition to the local Fire Department or monitoring agency.

O. All Fire Protection work from the water supply connection as noted on the Drawings to the last outlet in the interior system shall be installed by a sprinkler fitter licensed in the state of Massachusetts.

P. Firestopping at all penetrations where work of this section penetrates fire-rated assemblies shall be provided by the Waterproofing, Dampproofing, and Caulking Contractor under Section 07900 - Sealants and Firestopping.

Q. Furnish access panels for the work of this section to the trade in which the panel is to be located.

R. All staging, exterior and interior, shall be furnished and erected by the Fire Protection Sprinkler Systems Contractor and maintained in safe condition for proper execution of its work.

S. Erection and dismantling of staging shall be performed only by trained, certified, and experienced staging personnel qualified to perform such work. Copies of such certifications, clearly indicating qualifications, shall be provided.

1.03 CODES, PERMITS AND FEES

A. Unless otherwise specified or indicated, materials, workmanship and equipment performance shall conform with the latest governing edition of the following

standards, codes, specifications, requirements, and regulations, but not limited to:

1. All Applicable NFPA Standards
2. 780 CMR Massachusetts State Building Code Ninth Ed.
3. American Society of Mechanical Engineers
4. American Society of Testing and Materials
5. American National Standards Institute
6. Underwriters' Laboratories, Inc.
7. Occupational Safety and Health Administration
8. Massachusetts Department of Environmental Protection
9. Local Fire Department
10. Local Water Department
11. American Water Works Association

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825 (Supplement I, II & III) Approval Guide

MANUFACTURER'S STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-71 Cast Iron Swing Check Valves, Flanges and Threaded Ends
MSS SP-58 Pipe Hangers and Supports – Materials, Design and Manufacture
MSS SP-69 Pipe Hangers and Supports, Selection and Application

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA-13 (2013) Standard for the Installation of Sprinkler Systems
NFPA-25 (2017) Inspection, Testing, and Maintenance of Water Based Fire Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL-01 Building Materials Directory
UL-04 Fire Protection Equipment Directory
UL-668 Hose Valves for Fire Protection

B. Under this section of the specification, pay all fees, submit all necessary documents, obtain all permits, certificates and necessary approvals from authorities having jurisdiction, for work under this specification, prior to installation. All costs for these requirements shall be borne under this section of the specification.

1.04 CUTTING AND PATCHING

A. Refer to Div. 1, for cutting and patching. Coordinate locations with the General Contractor.

B. Cutting and patching through existing or new construction using core drill and measuring larger than 6 inches in diameter, or 6 inches by 6 inches shall be performed by Trades specializing in the specific surfaces affected, e.g., carpentry, masonry,

metals, etc., except where noted otherwise. Notify the specific Trade(s) of exact locations and sizes for openings required.

C. Exposed concrete coring: Notify Contractor of exact locations and sizes for all openings required in exposed concrete, to be executed under Section 03300 – Cast-in-Place Concrete.

D. Concrete coring less than 6 inches: Any new penetration cut through existing concrete less than 6 inches in width shall be executed by this Section.

E. Concrete coring 6 inches or larger: Notify Contractor of exact locations and sizes for openings 6 inches or larger in diameter required in concrete, to be executed under Section 03300 – Cast-in-Place Concrete.

F. Masonry openings less than 6 inches: Any new penetration cut through existing masonry less than 6 inches in width shall be executed by this Section.

G. Masonry openings 6 inches or larger: Notify Contractor of exact locations and sizes for openings 6 inches or larger in width required in masonry, to be executed under Section 04200 – Unit Masonry, utilizing lintels, furnished per Section 05500 – Metal Fabrications.

H. New penetrations cut through existing or new concealed gypsum board shall be executed by this Section.

I. All cutting shall conform to the requirements of Section 01045 – Cutting and Patching. Notify Engineer prior to any cutting or coring larger than 2 inches.

J. Fire Protection Sprinkler Systems Contractor shall coordinate pipe penetrations and openings in floors and walls prior to construction with the respective trades and the General Contractor. Fire Protection Sprinkler Systems Contractor shall furnish wall pipes or sleeves for the General Contractor to install when constructing concrete floors and walls or the Masonry Contractor to install when constructing the masonry walls. Coordinating pipe penetrations and furnishing wall and floor pipes and sleeves for installation by the General Contractor shall be completed by the Fire Protection Sprinkler Systems Contractor prior to reverting to cutting through new floors and walls. Cutting shall be completed as a last resort means to install the necessary piping under this Section. Prior to construction the Fire Protection Sprinkler Systems Contractor shall prepare and submit a pipe penetration drawing for review and approval by the General Contractor and Engineer identifying all coordinated penetrations where a wall or floor pipe or sleeve will be furnished for installation by the General Contractor or respective trade.

1.05 SHOP DRAWINGS

A. Shop drawings shall be submitted in accordance with requirements set forth by the Owner/Engineer.

B. This Fire Protection Sprinkler System Contractor shall assume the associated cost and

entire responsibility for coordination with all the trades involved for any items of material or equipment substituted for those specified or shown. Such changes shall not be a matter for subsequent change order for extra work to the Contract.

1. List of Shop Drawings:
2. Piping, Fittings and Accessories
3. Alarm Valves
4. Control & Check Valves
5. Gauges
6. Flow switches, monitoring switches and alarms
7. Sprinkler heads, layouts, and hydraulic calculations
8. Seismic restraints
9. Firestopping, Sleeves and escutcheons
10. Backflow Preventer
11. FDC

1.06 DRAWINGS, SPECIFICATIONS AND COORDINATION

A. It is the intention of Contract Documents to call for complete, finished work, fully tested and ready for continuous operation. Any apparatus, appliance, material or work not shown on the drawings by mention in the specifications, or vice versa, or incidental accessories necessary to make work complete and acceptable in all respects and ready for operation shall be furnished, delivered and installed under this Section of the Specifications without additional expense to the Owner.

B. Drawings are generally diagrammatic and are intended to convey scope of work and indicated general arrangements of equipment, piping, and fixtures. Exact location to be determined in the field.

C. Manufacturers catalog numbers specified herein are intended only as a guide to type and quality to be provided by this Fire Protection Sprinkler System Contractor.

D. Follow drawings in layout work, check drawings of, and coordinate with, other trades to verify special provisions, installation requirements and spaces in which work provided under this Section of the Specifications will be installed. Maintain maximum headroom or space conditions at all points. Where headroom or space conditions appear inadequate, notify the Owner/Engineer before proceeding.

E. Maintain a clean, dry, legible and current record drawing.

F. Where, due to Union regulations or Trade Agreements, any of the work shown on the Drawings or specified herein is considered work of other trades, the work in question shall be subcontracted as a part of this Section of the Specifications and responsibility for the complete installation shall be included in this Section of the Specifications.

1.07 INSPECTION OF SITE CONDITIONS

A. Prior to submission of bid, the Fire Protection Sprinkler Systems Contractor shall visit the site and/or review the related construction documents to determine the conditions under which the work is to be performed, and familiarize itself with existing

conditions. It shall report in writing to the Engineer/Owner any conditions which may adversely affect the Contractor's work.

1.08 WARRANTIES

A. All materials, types of equipment and workmanship furnished under this section shall carry standard warranty against all defects in material and workmanship for a period of not less than one (1) year from date of acceptance of Substantial Completion by Owner.

1.09 DESIGN CRITERIA

A. The sprinkler systems shall be designed to provide the following specified sprinkler discharge density over the specified hydraulically most demanding discharge area as indicated on the drawings.

B. Maintain a minimum 10 percent pressure cushion between the available water supply and the total system demand point.

C. Velocities; Maintain flow velocities in piping to below 20 feet per second unless otherwise directed.

D. Sprinkler mains shall not be run over switchgear, paralleling gear, UPS or battery strings. Coordination drawings shall indicate equipment locations. Sprinkler mains shall not pass through switchgear, telephone, data, UPS or electric rooms unless the system serves the space.

1.10 WATER FLOW TEST DATA

A. This design is based on a modeled flow test provided by the Engineer. The Fire Protection Sprinkler Systems Contractor shall conduct a flow test with the assistance of the Owner and Engineer to verify the design.

1.11 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Deliver to the designated representative of the Owner, through the Engineer, two (2) hard copies and one (1) electronic PDF draft of operating, service and replacement data for all equipment which will require operating, maintenance or replacement and make one copy of this literature available during the instruction of the operating personnel while the other is checked for completeness by the Engineer.

B. Operating manual: upon completing the work, provide the Owner with two (2) hard copies and one (1) electronic PDF of the approved operating manual containing approved shop drawings, and details, and typewritten instruction relative to the care and operation of the equipment, all properly indexed and bound in hard back, three ring binders. The manual shall have the following contents:
   1. Introduction:
      a) Explanation of Manual and its use
      b) Address and telephone number of this contractor

2. Shop drawings and required calculations for all systems.
3. Maintenance:
   a) Recommended List of Spare Parts: Furnish typed set of instructions for ordering spare parts with sectional views of the fittings or equipment showing parts numbered or labeled to facilitate ordering replacements. Each set shall include a list with itemized prices of those parts recommended to be kept on hand as spares, as well as the name and address of where they may be obtained.
   b) Maintenance Data for each type of sprinkler head, valve, piping specialty and fire protection specialty.
   c) Dimensional drawings for all equipment
4. Manufacturer's Literature:
   a) Sprinkler Heads
   b) Seismic Restraints
   c) Valves
   d) Piping, hangers and Appurtenances
   e) Backflow Preventer
   f) Alarm devices
5. Testing procedures for each system including frequency. Include a current copy of NFPA 25.
6. Written Guarantee: Refer to Paragraph "Warranties".

1.12 COORDINATION DRAWINGS

A. The General Contractor, HVAC Contractor, Plumbing Contractor, Electrical Contractor, and the Fire Protection Sprinkler Systems Contractor shall coordinate all process, HVAC, plumbing, electrical and sprinkler work with that of each trade, in order to:
   1. Avoid interferences between general construction, mechanical, electrical, structural and other specialty trades.
   2. Maintain clearances and advise other trades of clearance requirements for operation, repair, removal and testing of equipment.
   3. Indicate aisleways and accessways required on coordinated shop drawings for mechanical equipment rooms, electrical rooms, and WTP floor.
   4. Coordinate location of wall pipes, sleeves and inserts, including setting in place prior to pouring concrete.

B. The Fire Protection Sprinkler Systems Contractor for the work of this Section shall prepare Coordination Drawings showing all the work of this Section to be installed. The Coordination Drawings shall be not less than 1/4-inch scale for MEP spaces and not less than 1/8-inch scale for other areas. Coordination drawings shall be produced in digital (CAD) files and electronic PDF format.

C. The Fire Protection Sprinkler Systems Contractor for the work of this Section shall attend a series of meetings arranged by the Contractor to resolve any real or apparent interferences or conflicts with the work of the other contractors or with ceiling heights shown on the drawings.

D. The Fire Protection Sprinkler Systems Contractor for the work of this Section shall

then make adjustments to its work on the Coordination Drawings to resolve any real or apparent interferences or conflicts.

E. After any real or apparent interferences and conflicts have been incorporated into the Coordination Drawings, the Fire Protection Sprinkler Systems Contractor shall prepare the final Coordination Drawings and submit to the General Contractor.

F. The Fire Protection Sprinkler Systems Contractor for the work of this Section shall not install any of its work prior to the preparation of the final Coordination Drawings. If the work of this Section proceeds prior to the final Coordination Drawings, any change to the work to correct the interferences and conflicts which result will be made by the Fire Protection Sprinkler Systems Contractor for the work of this Section at no additional cost to the Owner.

G. Coordination Drawings are for the use of involved contractors during construction and shall not be construed as replacing any shop, "as-built", or Record Drawings required elsewhere in these Contract Documents.

H. Engineer's review of Coordination Drawings shall not relieve the Fire Protection Sprinkler Systems Contractor for the work of this Section from its overall responsibility for coordination of all work performed pursuant to the Contract or from any other requirements of the Contract.

1.13 COOPERATION AND COORDINATION WITH OTHER TRADES

A. The work shall be so performed that the progress of the entire building construction including all other trades, shall not be delayed nor interfered with. Materials and apparatus shall be installed as fast as conditions of the building will permit and must be installed promptly when and as desired.

B. Confer with all other trades relative to location of all apparatus and equipment to be installed and select locations so as not to conflict with work of other Sections. Any conflicts shall be referred immediately to the Engineer for decision to prevent delay in installation of work. All work and materials placed in violation of this clause shall be readjusted to the Engineer's satisfaction, at no expense to the Owner.

C. Where work of this section will be installed in close proximity to work of other sections or where there is evidence that the work of this section will interfere with work of other sections, assist in working out space conditions to make satisfactory adjustment. Prepare and submit for approval 3/8-inch scale or larger working drawings and sections, clearly showing how this work is to be installed in relation to the work of other sections. If the work of this section is installed before coordinating with other trades or so as to cause interference with work of other trades, make changes necessary to protect conditions without extra charge.

D. Keep fully informed as to the shape, size and position of all openings required for all apparatus and give information in advance to build openings into the work. Furnish and set in place all sleeves, pockets, supports and incidentals.

E. All distribution systems which require pitch or slope such as sanitary drains and water piping

shall have the right of way over those which do not. Confer with other trades as to the location of pipes, ducts, lights and apparatus and install work to avoid interferences.

F. Where there is evidence that work of this Fire Protection Sprinkler Systems Contractor will interfere with the work of other trades, this Fire Protection Sprinkler Systems Contractor shall assist in working out space conditions to make satisfactory adjustments.

G. This Fire Protection Sprinkler Systems Contractor shall, with the approval of the Engineer and without extra charge, make reasonable modifications in its work as required by structural interferences, or by interference with work of other trades, or for proper execution of the work.

H. If the Fire Protection Sprinkler Systems Contractor installs its work before coordinating with other trades and its work causes interference with the work of such other trades, it shall make all necessary changes in its work to correct the condition without extra charge and as required by the Engineer.

I. This Fire Protection Sprinkler Systems Contractor shall protect all materials and work of other trades from damage that may be caused by its work and shall make good any damages so caused.

PART 2 PRODUCTS

2.01 PIPE, FITTINGS AND JOINTS

A. Pipe and fittings shall conform to the latest ANSI, ASTM, NFPA and AWWA Standards including latest amendments.

B. Exterior buried cold water and fire protection 4" and larger shall be ductile iron, cement lined Class 52 with mechanical joints and retainer glands. Piping 3" and smaller shall be Type K copper with silver solder joints. All pipe and fittings buried in the ground shall be encased in loose 8 mil. thick polyethylene film sleeve that complies with ANSI A21.5.

C. Wet sprinkler piping inside the building for the Sprinkler System, one and one-half inches (1½") and smaller in size, shall be Schedule 40 threaded black steel, conforming to ASTM Standard A135, approved for use in Fire Suppression Systems.

D. Wet sprinkler System piping inside the building two inches (2") and larger in size, unless otherwise noted, shall be Schedule 10 black steel pipe with rolled groove ends, conforming to ASTM Standard A135, approved for use in Fire Suppression Systems.

E. U.L. listed and F.M. approved groove fittings will be allowed. All fittings shall be approved by Underwriters' Laboratories for use in Sprinkler System and shall be designed and guaranteed for a working pressure of not less than 175-psi cold-water pressure.

2.02 HANGERS AND SUPPORTS

A. Hangers and sway bracing where required, shall be installed to meet NFPA-13, 2013 compliance as to location, spacing, and maximum loads.

B. Hanger material shall be compatible with piping materials with which it comes into contact.

C. Hangers shall be installed, in addition to the above, at all changes of direction (horizontal and vertical), valves and equipment connections. Hangers shall be located so that their removal is not required to service, assemble or remove equipment.

D. Horizontal runs may use band hangers up to 4" size. Piping larger than 4" shall be provided with clevis type.

E. Vertical support shall be by means of riser clamps (anchors with split ring type allowable up to 2" size only) and adjustable pipe support with flange anchored to floor.

F. All rods, clamps, nuts, washers, shields and hangers in all areas shall be hot dipped galvanized coated steel.

G. Valve and piping supports, from the floor, shall be adjustable pipe support and complete with pipe standard and flange, anchored to floor. Supports shall be installed at each control valve, riser tee or elbow and where any un-supported section located up to 4'-0" above finished floor, exceeds 4'-0" in length measured along piping centerline. Where piping and valves are supported vertically from a Uni-Strut type framework in conjunction with riser clamps installed in the horizontal position the minimum rod sizing shall be the same as for vertically hung piping.

2.03 VALVES AND SUNDRIES

A. General
   1. Shutoff valves on the aboveground Fire Protection System shall be UL, FM Butterfly or OS&Y gate valves, as indicated, on sizes 2-1/2" and larger, valves up to 2" shall be UL, FM Ball Valves. All isolation / Control valves shall be monitored.
   2. Check valves shall be 175-pound class for Fire Protection.
   3. Valves shall be provided with seats suitable for the service intended.

B. Sprinkler system valves
   1. All valves specified herein shall be UL/FM approved, 175 PSI minimum working pressure. All control valves shall be provided with tamper switch.
      a) OS&Y gate valve, flanged, shall be provided at backflow preventer. Valve shall be provided with tamper switch.
      b) Butterfly and or Ball valves, with integral tamper switch, shall be provided on all aboveground piping up to 2-1/2 inches in size except as noted above.
      c) Valve and roadway box on buried fire service shall be iron body,

mechanical joint, non rising stem, solid wedge, complete with two piece, cast iron, sliding type valve box with minimum 5.25" shaft diameter and cover marked “Water”.

d) Check valves shall be UL/FM, double door, spring actuated, anti-water hammer style. Ball drip shall be provided on all check valves at Fire Department Connections.

e) Trim valves at dry valve assemblies shall be per manufacturer's recommendation.

2.04 SLEEVES AND ESCUTCHEONS

A All pipes passing through floors, walls, foundations or partitions shall be provided with sleeves having an internal diameter with a minimum of one inch larger than the outside diameter of the pipe or wall pipes matching the diameter of the penetrating pipe.

B. Sleeves through outside walls, foundations, and slab on grade shall be Schedule 40 black steel pipe with a 150 pound black steel slip on welding flanges, welded at the center of the sleeve and shall be painted with one coat of bitumastic paint, inside and outside. Patch around sleeves with hydraulic cement where necessary to maintain a waterproof seal.

C. Sleeves through interior masonry floors and walls shall be Schedule 40, black, steel pipe. Sleeves through interior non-masonry walls or partitions shall be 22 gauge galvanized sheet steel.

D. The sleeves through outside walls and slab on grade shall be provided with pipe to wall penetration closures. Seals shall be mechanical type of interlocking rubber links shaped to fill space between pipe and sleeve. Links shall be assembled with bolts to form a belt around the pipe with pressure plate under each bolt head and nut. After seal assembly is positioned, tightening of bolts will provide watertight seal. This Fire Protection Sprinkler Systems Contractor shall determine the required inside diameter of each individual sleeve before ordering, fabricating or installing. The inside diameter of each sleeve shall be sized as recommended by the manufacturer to fit the pipe to assure a watertight joint.

E. Sleeves through walls shall terminate flush with face of wall. Sleeves through floor shall terminate 1" above finished floor.

F. Required fire resistance of floors and walls shall be maintained where penetrations occur. The Waterproofing, Dampproofing, and Caulking Contractor shall provide fire rated caulking for the space between the pipe and sleeve installed per manufacturer’s recommendations to a depth as required to maintain the rating of the floor, wall or partition.

G. Escutcheons shall be provided with a set screw to properly hold escutcheon in place and shall be provided at all exposed floor, ceiling, and wall penetrations in finished areas. Floor penetrations, which require a riser clamp above or below the floor, shall be exempt from the escutcheon requirement on the clamp side.

2.05 GAUGES

A. Pressure Gauges:
   1. Gauges shall be installed with suitable "T" handle gauge cocks to permit servicing. All gauges shall be five inch diameter, dial type. Dial gradations reading in "PSIG" shall be such that the normal operating pressure shall be indicated near the middle of the scale.
   2. Gauges shall be installed at inlet and outlet side of backflow preventer, at Alarm Check Assembly and as shown on drawings.

2.06 AUTOMATIC SPRINKLERS

A. Sprinkler Heads: Standard spray, standard response or quick response, bulb type, and style as indicated or required by the application and drawings shall be provided. Unless otherwise indicated, provide heads with a K=8.0 or greater and a temperature rating of 155°F or 286°F as shown on the drawings. The finishes of all sprinkler heads, cover plates and escutcheons shall be coordinated with the Engineer. Acceptable manufacturers include Tyco, Reliable and Viking.

B. In all areas, where electrical equipment is located, an approved type shield, to keep water off the electrical equipment, shall be provided.

C. Sprinkler Heads shall be the style, k-factor, temperature rating, and finish as indicated on the drawings.

D. Provide next to the alarm valves, a finished steel cabinet suitable for wall mounting, with hinged cover and space for 6 spare sprinkler heads plus sprinkler head wrench.

2.07 SPRINKLER SHOP DRAWINGS

A. Contractor shall provide hydraulically calculated shop drawings, for approval, of entire system in addition to obtaining all flow test information for same.

2.08 PIPE IDENTIFICATION AND VALVE TAGS

A. All piping, except that piping which is within inaccessible chases, shall be identified with semi-rigid plastic identification markers equal to Seton Setmark pipe markers. Direction of flow arrows are to be included on each marker. Each marker background shall be appropriately color coded with a clearly printed legend to identify the contents of the pipe in conformance with the “Scheme for the Identification of Piping Systems” (ANSI A13.1-1981). Setmark snap-around markers shall be used for overall diameters up to six (6) inches and strap-around markers shall be used above six (6) inch overall diameter. Markers shall be located adjacent to each valve, at each branch, at each cap for future, at each riser take off, at each pipe passage through wall, at each pipe passage through floors, at each pipe passage to underground and on all vertical and horizontal piping at 20-foot intervals maximum.

B. All valves shall be designated by distinguishing numbers and letters carefully coordinated with a valve chart. Valve tags shall be 19 gauge polished brass, 1-1/2

inch diameter with stamped black filled letters similar to Seton S type 250-BL, or approved equal. Lettering shall be 1/4-inch high for type of service and 1/2-inch for valve number. Tag shall be attached to valves with approved brass "S" hooks, or brass jack chain. Whenever a valve is above a hung ceiling, the valve tag shall be located immediately above the hung ceiling.

C. Provide wall mounted sign at all auxiliary drains. Tyco sign type B or equal.

D. Provide in main valve room at riser, a sign indicating the system requirements. Tyco sign Type D or equal.

2.09 SEISMIC RESTRAINTS

A. Provide seismic restraint types as described in NFPA 13, Installation of Sprinkler Systems.

2.10 INSPECTORS TEST AND DRAIN CONNECTIONS

A. Test pipe not less than 1 inch in diameter, terminating in a smooth bore corrosion resistant orifice to provide a flow equivalent to one sprinkler shall be provided for each system. Each floor, area or each hydraulically calculated area on floors with multiple hydraulically most remote areas shall be provided with an inspector's test assembly at the hydraulically most remote point. Each test connection valve shall be ready accessible and labeled. The discharge shall be to the outside, to an open drain connection capable of accepting full flow under system pressure to another location where water damage will not result.

B. Drain connections shall be provided when a change in piping direction prevents drainage of sections of branch lines or mains through the main drain valve. The drain shall consist of a valve not smaller than 3/4-inch size and plug, which shall be brass.

2.11 ALARM INITIATING AND SUPERVISORY DEVICES

A. Water flow at wet system alarm valves shall activate an alarm by way of a paddle type flow switch. Flow switches shall be Potter Roemer, FM approved, UL listed equipped with two (2) SPDT contacts, adjustable retard dial, cast aluminum saddle, flexible polyethylene paddle, rubber gasket and dust proof cover.

B. Valve Supervisory (Tamper) Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain two SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

C. Pressure switches shall be pressure actuated switches with two SPDT switches and adjustable operating pressure. Enclosures shall be die cast with tamper resistant fasteners, powdercoat finish and two 1/2-inch electrical conduit openings.

D. Switches shall be rated for 250 psi and shall be UL listed and FM approved. Retard shall be accomplished through the use of a retarding chamber, setting shall be 20-40

seconds.

E. Transmitting Equipment (flow, monitor, pressure switches) provided under this Section of the Specification shall be compatible in all respects with fire alarm supervisory control system. Coordinate with Electrical Contractor for requirements before purchasing transmitting equipment as herein specified for fire protection equipment.

2.12 ALARM CHECK VALVE ASSEMBLY

A. Assembly shall include an alarm check valve, standard trim piping, pressure gauges, bypass, testing valves, main drain, butterfly isolation valve, and other components as required for a fully operational system.

2.13 FIRESTOPPING

A. Firestopping shall be asbestos-free material capable of maintaining an effective barrier against flame, gases, and temperature. Firestopping shall be noncombustible and nontoxic to human beings during installation and during fire conditions. Devices and equipment for firestopping service shall be UL FRD listed or FM P7825 approved for use with applicable construction, and penetrating items.

B. Fire Hazard Classification: material shall have a flame spread of 25 or less, a smoke developed rating of 50 or less when tested in accordance with UL 723 or UL listed and accepted.

C. Firestopping Rating: firestopping materials shall be UL FRD listed or FM P7825 approved for "F" and "T" ratings at least equal to fire-rating of fire wall or floor in which penetrated openings are to be protected, except that "F" and "T" ratings may be 3 hours for firestopping in through-penetrations of 4-hour fire rated wall or floor.

D. Joint Sealant firestopping shall be provided by the Waterproofing, Dampproofing, and Caulking Contractor under Section 07900.

2.14 BACKFLOW PREVENTER

A. Double check assembly shall be approved by the Massachusetts Department of Environmental Protection (MassDEP), complete with OS&Y gate valves, as indicated, on inlet and outlet. Provide by-pass meter on double check assembly where required by local water department regulations for fire service use.

B. Installation of all backflow preventers shall be in accordance with Massachusetts State Plumbing Code and MassDEP regulations 310 CMR 22.22 "cross connections".

C. Contractor shall provide repair kits for double check backflow preventer.

D. Double-check assemblies 3" and larger shall be supported from the floor by means of adjustable pipe supports with floor flanges anchored to floor. Provide spool piece before and after unit to receive support saddles.

2.15 FIRE DEPARTMENT CONNECTION

A. Fire Department Connection (FDC) shall be a wall mounted, 4" Storz x 4" NPT connection with cap, chain, and 30-degree bend down.

B. The FDC shall be between the main control valve and the alarm valves.

C. The check valve shall be located at least two feet into the valve room. All piping shall pitch towards the valve room.

2.16 ALARM BELL

A. Assembly shall include a 6" diameter body housing, striker assembly, gong, wall plate and related components necessary for complete operation. Bell shall be suitable for outdoor surface mount with weatherproof electrical box. Coordinate voltage with fire alarm contractor.

2.17 TEST HEADER

A. Provide where shown on the Drawings, a UL Listed test header with four (4) 2 1/2-inch hose end gate valves with cap and chain.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install piping approximately as shown on the drawings, piping shown on the drawings is diagrammatic only and exact location shall be determined in the field.

B. Review all architectural, structural, process, HVAC, plumbing, electrical and site drawings before starting work to familiarize oneself with the details of construction in addition to coordinating with other trades to eliminate possible conflicts.

C. Piping shall be installed straight and direct as possible, forming right angles or running parallel to walls, structural items and other piping.

3.02 FLUSHING AND TESTING

A. General
   1. All labor, materials, instruments, devices and power required for testing shall be provided by this Contractor. The tests shall be performed in the presence and to the satisfaction of the Engineer, General Contractor and the Local Fire Department and such other parties, as may have legal jurisdiction. No piping in any location shall be closed up, furred in, or covered before testing.
   2. Where portions of piping systems are to be covered or concealed before completion of the project, those portions shall be tested separately in the manner specified herein for the respective entire system.
   3. Any piping or equipment that has been left unprotected and subject to

mechanical or other injury in the opinion of the General Contractor shall be retested in part or in whole as directed.

4. The Engineer retains the right to request a recheck or resetting of any pump or instrument by the Fire Protection Systems Sprinkler Contractor during the guarantee period at no additional cost.
5. Repair, or if directed, replace any defective work with new work without extra charge to the Contract. Repeat tests as directed, until the work is proven to meet the requirements specified herein.
6. Restore to its finished condition any work, damaged or disturbed, provided by other contractors and engage the original contractor to do the work of restoration to the damaged or disturbed work.
7. Caulking of screwed joints or holes in piping will not be acceptable.
8. This Contractor shall notify the General Contractor and any inspectors having jurisdiction, a minimum of 48 hours in advance of making any required tests so that arrangements may be made for their presence to witness its scheduled tests.
9. Sprinkler Systems
    a. Testing and flushing shall be in accordance with NFPA-13 - 2013 "Standard for the Installation of Sprinkler Systems."
    b. Each system shall be tested to a hydrostatic pressure of 200 PSI for two hours.
    c. All new water flow detecting devices and circuits shall be flow tested through the inspector's test connection and activate within five minutes of initiation.
10. Water Source
    a. All flow tests on the Fire Protection systems shall be performed in the presence of the Authority having jurisdiction.
    b. Sprinkler flow test discharge and flushing water discharge shall be coordinated with the General Contractor and the local water department as to acceptable discharge points prior to scheduling of flushing and tests. This contractor shall provide all hose and equipment necessary to perform the required testing and flushing.
11. As Built Drawings and Contractor Certificates
    a. Fire Protection Sprinkler Systems Contractor shall have, on hand, at time of final inspection by the Authority having jurisdiction, for Temporary / Final Certificate of Occupancy, all completed Certificates of Material and Testing for Aboveground and Underground Piping as well as the As- built drawings of the Fire Protection Installation.

3.03 PATCHING, REPLACEMENT AND MODIFICATION OF EXISTING WORK

A. After installation of pipelines, the Fire Protection Sprinkler Systems Contractor shall neatly patch, repair, and/or replace existing work where damaged, removed or altered for pipe line installation. This work shall be similar and equal in quality to the work removed or damaged, unless otherwise shown or specified.

3.04 SPRINKLER HEAD INSTALLATIONS

A. Use proper tools to prevent damage during installations.

B. All pendent mounted sprinklers shall be installed on return bends.

C. All sprinkler heads installed in acoustical ceiling tiles shall be centered in tiles.

D. All Sprinkler heads shall be installed in accordance with their listing and the manufacturers' instructions.

3.05 SEISMIC PROTECTION OF PIPING

A. The system piping shall be protected against damage from earthquakes. Seismic protection of the piping system shall be provided in accordance with NFPA 13 and the Massachusetts State Building Code. Seismic protection shall include flexible couplings, sway bracing, seismic separation assemblies where piping crosses building seismic separation joints, and other features as required in NFPA 13 for protection of piping against damage from earthquakes. Branch lines shall be equipped with sway braces at the end sprinkler head and at intervals not exceeding 30 ft.

3.06 FIRESTOPPING INSTALLATION

A. Install firestopping assembly at locations shown and as specified in accordance with UL FRD systems or FM P7825 designs, and as recommended by manufacturer.

B. Firestopping Locations: Waterproofing, Dampproofing, and Caulking Contractor shall completely fill openings around penetrating items with firestopping material to prevent spread of fire in the following locations:
   1. Around cable, conduit, piping, and their supports that penetrate fire-rated above grade floor slabs, interior partitions, and exterior walls
   2. Around openings and penetrations through fire-rated ceiling assemblies
   3. Around penetration of vertical fire-rated service shafts.
   4. Around openings and penetrations through fire-rated enclosures.
   5. Other locations indicated.

3.07 INSTALLATION OF GAUGING AND MONITORING EQUIPMENT

A. Installation shall be in strict accordance with manufacturer's instructions.

B. The complete package shall be the Product of one Supplier. After fabrication all devices shall be tested for proper operation. Electrical components shall be functionally tested with for functions and controls. Settings of all instruments and controls shall be verified for conformance to these specifications.

C. Submit a complete booklet containing job specific shop prints as listed below, together with sequence of operation and drawings of all major components. Partial submittals shall not be accepted. No fabrication shall commence until the complete booklet has been approved.

D. Items of equipment and/or materials specifically identified herein or on the drawings by a manufacturer's name or model or catalog number are to establish a minimum

standard of quality. The Fire Protection Sprinkler Systems Contractor must furnish equipment that meets these minimum standards of quality. If the Contractor wishes to submit on equipment other than that specifically named in the Construction Documents, he does so at his own risk, as alternate equipment will be approved at the sole discretion of the Engineer and Owner.

END OF SECTION

SECTION 15301

FIRE PROTECTION FILED SUB-BIDS

PART 1 GENERAL

1.01 FIRE PROTECTION FILED SUB-BID

A. The work of the following section requires a filed sub-bid in accordance with M.G.L. C.149, S.44A through 44J, inclusive, as amended. This section will be covered under a single filed sub-bid for the Fire Protection Sprinkler Systems category of work.
1. Section 15300 – Fire Protection

B. Reference Drawings: The work of this Section is shown on Drawings:
1. 01-FP-1
2. 20-FP-1 through 20-FP-4

C. Requirements of Submitting Sub-bids:
1. Sub-bids for work under this Section shall comply with the requirements of M.G.L. C.149, S.44D and 44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in the Advertisement for Bids and Information for Bidders; and shall be accompanied by a Bid Deposit in the amount of five percent of the sub-bid price complying with the requirements of M.G.L. C.149, S.44B(2). The following should appear on the upper left-hand corner of the envelope:

SUB-BIDDER: Contractor Name

SUB-BID FOR: Fire Protection Sprinkler Systems

PROJECT: Wading River Water Treatment Plant
Contract No. 10, DWSRF-16764

D. SUB-SUBLISTINGS

1. Sub-sub trades are categories of work within a filed sub-bid trade and are indicated in paragraph E on the Form for Sub-bid. If sub-sub trades are requested and identified follow the instructions below. The proposed contract price submitted by the filed sub-bidder on the Form for Sub-Bid includes the cost of any sub-sub trades.
a. Sub-sub bids are required for the following subcategories of this section:

Class of Work	Reference Paragraph

2. Sub-bidders shall include the appropriate information for the above listed sub-categories in Paragraph E of the Form for Sub-bid.
3. If the filed sub-bidder customarily performs the above work with its own workforce the sub-bidder should list its own name and trade, and leave the dollar amount blank.
4. If the filed sub-bidder does not customarily perform the above work with its own workforce the sub-bidder should list the name of the contractor performing the work, the trade and insert a dollar amount.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 15400

PLUMBING

(Part of Work of Section 15401 – PLUMBING FILED SUB-BIDS, Filed Sub-Bid Required)

PART 1 GENERAL

1.01 DESCRIPTION

A. The work under this section includes all labor, materials, tools, and equipment necessary to complete the plumbing work as required by the Contract Documents. The work under this Contract shall include, but is not limited to, the following:

1. Underground soil, waste, vent, and roof drain piping to a point 10 feet beyond the exterior face of the building (unless noted otherwise),
2. Above ground soil, waste, vent, and roof drain piping,
3. All vent piping to above the roof,
4. Gas piping from the inside of the facility to the pressure regulator at the exterior face of the building,
5. All gas piping shall be installed by a licensed gas fitter. Gas piping system shall be installed in strict accordance with all rules and regulations of the local authorities. All permit fees and incidentals to the work under this Contract shall be paid for by the Plumbing Subcontractor,
6. Hot and cold-water piping, fittings, valves and specialties as shown and as required and final connections to all plumbing fixtures as required,
7. Washdown stations,
8. Electric water heaters,
9. Emergency shower and eye wash stations,
10. Hose bibs and wall hydrants,
11. Water Closets, lavatories, sinks, and other plumbing fixtures and equipment as required by the Contract Drawings,
12. Hangers and supports for piping and equipment,
13. Cleaning, testing and sanitizing of the plumbing system,
14. Warranty in a form acceptable by the Owner.

1.02 RELATED WORK IN OTHER SECTIONS

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.

1. Section 02200 Earthwork
2. Section 03300 Cast-In-Place Concrete
3. Section 09900 Painting
4. Division 11 Equipment
5. Division 15 Mechanical
6. Division 16 Electrical

1.03 CODES, PERMITS AND INSPECTIONS

A. Comply with the requirements of State, National, local and other authorities having jurisdiction at no additional cost to the Owner. Perform work in accordance with National and State plumbing codes, as appropriate. The more stringent code shall apply. Obtain and pay for all permits. Comply with the National Fire Code and National Fire

Protection Association for work not subject to authorities having jurisdiction. Take complete charge of and responsibility for all legal requirements of this work.

1.04 PROJECT/SITE CONDITIONS

A. Install all work in locations shown on the Drawings or as directed in the field at no additional cost to the Owner.

B. Prepare drawings showing proposed rearrangements of work to meet field or project conditions, including changes to work specified in other section. Obtain permission of Engineer before proceeding.

1.05 SUBMITTALS

A. Shop drawings shall be submitted for the following:

1. Plumbing fixtures,
2. Hangers and supports,
3. Piping and fittings (all types),
4. Valves,
5. Cleanouts, traps, escutcheons,
6. Hose bibs and wall hydrants,
7. Access panels,
8. Insulation,
9. Water heaters,
10. Wash down stations,
11. Emergency shower and eye wash stations,
12. Backflow prevention devices,
13. Roof drains.

B. Submit shop drawings and product data grouped to include complete submittals of related systems, products and accessories in a single submittal.

C. Mark dimensions and values in units to match those specified, as applicable.

1.06 PROTECTION OF WORK AND PROPERTY

A. The Plumbing Subcontractor shall be responsible for the care and protection of all work included under this Section until it has been tested and accepted by the Owner.

B. Protect all equipment and materials from damage from all causes, including theft. All materials and equipment damaged or stolen shall be repaired or replaced with equal material or equipment at no additional cost to the Owner.

1.07 SAFETY PRECAUTIONS

A. Comply with all of the safety requirements of OSHA throughout the entire construction period of the project.

B. Furnish, place and maintain proper guards for prevention of accidents and other necessary construction required to secure safety of life and/or property.

1.08 ELECTRICAL WORK

A. Electrical wiring shall be done by the Electrical Subcontractor under Division 16, Electrical.

1.09 COOPERATION AND COORDINATION

A. The work shall be performed so that the progress of the entire building construction, including all other trades, shall not be delayed or interfered with. Materials and apparatus shall be installed as fast as conditions of the building will permit and must be installed promptly.

B. Confer with all other trades relative to location of all apparatus and equipment to be installed and select locations so as not to conflict with work of other Sections. Any conflicts shall be referred immediately to the Engineers for decision to prevent delay in installation of the work. All work and materials placed in violation of this clause shall be readjusted to the Engineers satisfaction at no additional cost to the Owner.

C. Where there is evidence that work of this Plumbing Subcontractor will interfere with the work of other trades, this Plumbing Subcontractor shall assist in working out the space conditions to make satisfactory adjustments.

D. All distribution and sanitary systems that require pitch or slope such as sanitary, waste, roof drain, water and other piping shall have the right of way over those which do not.

1.10 ACCESSIBILITY

A. All work shall be installed so that parts requiring inspection, operation, maintenance or repairs are readily accessible.

PART 2 PRODUCTS

2.01 ACCESS PANELS

A. Furnish access panels for walls and ceilings as required to permit access for cleanouts, removal, replacement and servicing of all concealed plumbing and equipment requiring access and all other items requiring maintenance and adjustment. Provide access to each concealed piping system isolation valve.

B. Access panels shall be installed by the General Contractor.

C. Access panels shall be primed painted and provided with cylinder lock and two keys.

2.02 PIPE AND FITTINGS

A. All materials and equipment shall be of the best quality, new, in compliance with the governing codes, and free from all defects.

B. All exposed water and waste piping and fittings, not required to be insulated, shall be heavy-duty commercial quality chromium plated.

C. All above ground water pipe and fittings shall be Type L hard drawn copper tubing, incise marked with cast bronze or wrought copper fittings, no lead, 95/5 soldered or brazed.

D. Soil, waste, vent and roof drain pipe and fittings under floor slab shall be service weight cast iron soil pipe and fittings with resilient gaskets.

E. All above grade shall be one of the following:
1. Hubless cast iron soil pipe and fittings manufactured in accordance with CISPI Standard 301-75, joined with a 4 band clamp from a list of approved clamps and installed in accordance with CISPI Pamphlet Designation 310-78.
2. Iron size brass or copper pipe with cast brass drainage fittings.
3. Hard drawn Type K or L copper tubing, using wrought copper sweat fittings.
4. PVC and galvanized pipe and fittings will not be permitted.

F. Gas piping shall be Steel Pipe: ASTM A 53; Type E or S; Grade B; Schedule 40; black.
1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.
2. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1.

2.03 VALVES

A. All systems under this section shall be provided with valves to permit complete and sectional control of the system. They shall be located to permit easy operation, replacement and repair, and shall be the product of one manufacturer, such as Milwaukee, Stockham, Watts or approved equal.

B. All systems shall be gravity drainable.

C. Water Valves:
1. Ball valves shall be with stainless stem and ball, bronze solder equal to Milwaukee BA1505 or approved equal.
2. Drain valves shall consist of hose end valve with brass cap and chain. Provide valved drains at all low points in water piping system and at bases of all risers so that entire system or a section of the system may be drained for maintenance and service.
3. Check valves shall be horizontal regrinding free-way type, equal to Milwaukee 1509 or approved equal.

D. Pressure Reducing Valve:
1. Furnish and install at water meter a dedicated Watts No. 45 water pressure-reducing valve, set at 80 psi to serve the building plumbing system. Main building service and each branch shall include a dedicated backflow preventer.

E. Backflow Preventers:
1. Provide a reduced pressure backflow preventer, as manufactured by Watts, for each branch on the water service entrance including the potable water supply, the wash down hose stations branch, and the branch line serving the MIEX process area.

F. Gas Valves:

1. Gas Valves, NPS 2 and Smaller: ASME B16.33 and IAS-listed bronze body and 125-psig pressure rating.
2. Plug Valves, NPS 2-1/2 and Larger: ASME B16.38 and MSS SP-78 cast-iron, lubricated plug valves, with 125-psig pressure rating.

2.04 UNIONS

A. All unions shall be suitable for working pressure of not less than 125 lbs. water working pressure and shall be full size and same material as adjacent piping.

2.05 HANGERS, INSERTS AND SUPPORTS

A. All hangers, inserts and supports shall be Carpenter Patterson, Calco, Walworth or approved equal. All hangers shall be secured to approve adjustable type inserts, wherever possible and practicable. Field drilling, where required, shall be by this subcontractor. The use of explosive fasteners is prohibited.

B. All soil, waste, roof drain, vent and water piping shall have friction clamps as applicable.

C. All hangers for piping 2-inches and smaller shall be Type A bands or approved equal. Hangers for piping larger than 2-inches shall be of the adjustable clevis hanger, similar to Carpenter Patterson Figure 100. Hanger rods shall be machine threaded ends only. The use of wire, wood blocks and tubing as braces is prohibited.

D. Where pipes are installed in groups, corrosion resistant gang type hangers with heavy copper coated saddles shall be used in all locations. Double nut all hangers.

E. Inserts shall be Carpenter Patterson Figures 266 and 650, each hot dipped galvanized.

F. Unless otherwise stated, all hangers and supports, including rods, shall be hot dipped galvanized after fabrication.

G. For hangers and all associated hardware, material shall be FRP when used in a chemical rooms or within 10 feet of an open chemical feed area.

H. . Size of hanger rod shall be not less than the following:

Pipe Size	Rod Size
3/4" to 1-1/2"	3/8"
2" to 3-1/2"	1/2"
4" to 5"	5/8"

I. All hangers with copper piping shall be copper.

I. Provide insulation shield at all hangers supporting insulated pipe.

J. Refer to Specification Section 15060, Pipe Hangers and Supports, for additional piping support requirements.

2.06 PACKAGED TEMPERED WATER HEATER

A. A factory-packaged water heater designed to provide tempered water for emergency shower/eyewash stations shall be provided as shown on the Drawings. The water heater shall be electric with automatic controls and listed by UL. The system shall be a Model EMV emergency tepid water delivery system as manufactured by Hubbell, or equal. The unit shall be designed to operate at 208 volts, 1 phase, and 60 hertz with a maximum load of 3.0 KW. The system shall be specifically designed for tepid water delivery to emergency safety shower/face/eyewash fixtures in accordance with ANSI Z358.1-1998. Packaged system shall consist of a long-life cement lined electric water heater with integrally mounted, factory supplied, calibrated and performance tested, triple redundant thermostatic pressure balanced mixing valve system. Unit shall be supplied ready for electrical and plumbing service connections.

B. The electric water heater shall be a 120-gallon capacity vertical carbon steel tank lined with seamless Hydrastone cement applied via centrifugal spinning process resulting in even distribution of a minimum 1/2" cement thickness and maximum thickness of 3/4" over all interior surfaces, and a cement density of 0.20 lbs/cubic inch minimum in order to provide increased longevity and inhibit oxidized water ingress. Hand troweled applications that do not meet above requirements shall not be acceptable. Storage Vessel shall not require any type of anodic protection.

C. Tank inlet and outlet water connections shall be a minimum of 1 1/2" NPT non-ferrous copper-silicon/brass insulated with a 3" thick polyurethane foam insulation at minimum value of R-7 per inch and a minimum total value of R-21. Insulating value shall exceed the ASHRAE standard 90.1-2013 requiring an R-value of 12.5 for stand-by heat loss by a minimum of 10% Water heater shall be rated for 150 psig working pressure.

D. Outer protective jacket shall be a dent-resistant composite jacket to resist rust and corrosion.

E. Delivery water temperature control shall be provided by an integrally-piped, factory installed and packaged thermostatic mixing valve. Valve shall be specifically designed, tested and manufacturer designated for use in emergency safety drench applications. Design flow rate shall be 20 gpm, (23 GPM w/ face/eyewash) delivery water set point shall be 85°F, Temperature safety system shall consist of a diaphragm-operated valve actuator to ensure a continuous delivery flow of tepid water. The valve shall monitor pressure on both cold and hot water inlets. On loss of cold water pressure, the valve shall "fail safe" to cold and prevent delivery of hot water to avoid scalding. On loss of hot water pressure, the valve shall allow the full ANSI-required flow of cold water to the emergency safety fixture. Water pressure drop across the system must not exceed 5 psi at 20 GPM flow, and mixing valve must have a Cv rating not less than 10.0.

F. The system shall be supplied complete with all electrical operating controls. Safety devices and accessories shall include a low watt density in color immersion heating element, an adjustable immersion temperature controller, a safety high limit switch with manual reset, a dial temperature and pressure gauge, an ASME temperature and pressure relief valve, and an automatic air vent valve.

G. The water heater manufacturer shall warranty all electrical components against defects in workmanship and material for a period of one (1) year from date of Substantial Completion, and the pressure vessel for a full five (5) years, non-pro-rated, from date of Substantial Completion.

2.07 INSULATION

A. Pipe Insulation:
1. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials. Comply with UL 723 for flame spread/smoke developed ratings of 25/50.
2. Basis-of-Design Product: Subject to compliance with requirements, provide Armacell LLC; ArmaFlex Ultra LapSeal or ArmaFlex Black LapSeal or comparable product by one of the following:
   a. Armacell
   b. Aeroflex USA, Inc.
   c. K-Flex USA
3. Shall have pressure-sealing lap adhesive. No metal bands or staples shall be allowed.

B. Fittings, Flanges and Valves:
1. Shall be covered with permanently non-combustible one-piece factory premolded insulated PVC fitting covers. Insulation shall be applied to the fittings. The end of the insulation shall be tucked snugly into the throat of the fitting and the edge adjacent to the pipe covering tucked in, fully insulating the pipe fitting. The one piece PVC fitting cover shall be secured with stainless steel tack fastening.
2. All seam edges of the cover shall be sealed with pressure sensitive vapor-barrier tape, color to match. The tape shall extend over the adjacent pipe insulation and overlap 2 inches beyond fitting cover.
   a. Insulation thickness on all fittings, flanges and valves shall be the same thickness as listed for pipe and tubing.

C. Protector Shields:
1. Provide a PVC covering protector shield at each hanger location. Shields shall not be less than 12 inches long or three times the insulation outside diameter, whichever is the greater dimension.
   a. The protector shields shall cover 120 degrees of the insulation surface arc.

D. All plumbing pipe, except gas piping, shall be insulated, including:
   1. All domestic cold water,
   2. All domestic hot water supply piping,
   3. All tempered water piping.

E. Domestic Water and Non Potable Water Supply Piping:
1. Pipe insulation shall be minimum 1/2-inch thick for all hot and cold-water piping and valves up to 1" diameter and 1-inch thick for piping and valves greater than 1" diameter. Provide 6 PSF insulation at hangers. Insulation shall meet ASTMC 335 for thermal efficiency.
2. Fittings and valves shall be insulated with molded or fabricated fitting covers of equal thickness and identical in composition to adjacent pipe insulation with PVC jacket.
3. PVC jacket shall meet ASTM D1784, Class 1453-C with flame spread of 25 or less, smoke developed rating of 50 or less.

F. Complete moisture or vapor seal shall be provided wherever insulation terminates against metal hangers, anchors and other projections through insulation on cold surfaces for which a vapor seal is specified.

2.08 HOSE BIBS AND WALL HYDRANTS

A. Hose bibs shall be manufactured by Woodford Manufacturing Company or approved equal, Woodford Model 24-CP, inside sill faucet, chromium plated 3/4-inch hose thread outlet and removable tee handle with vacuum breaker and chained protective cap.

B. Wall hydrants shall be manufactured by Woodford Manufacturing Company or approved equal, Woodford Model B65-CP.
   1. Freezeless type with anti-siphon vacuum breaker.
   2. Bronze casing.
   3. All bronze interior parts.
   4. Replaceable bronze seat and seat washer.
   5. Chrome box.
   6. Hinged cover with operating key.
   7. Length to suit building wall thickness.

2.09 ESCUTCHEONS

A. Escutcheons shall be pipe set in mastic at all sleeves.

B. Escutcheons shall be chrome plated heavy brass fitting the pipe and covering snugly secured in place by set screws or clips. Provide escutcheons at all pipes penetrating walls and floors in finished rooms.

2.10 WASHDOWN STATIONS

A. Washdown stations shall be provided at the locations noted on the Drawings. Each washdown station shall have the following:
   1. Stainless steel hose rack large enough to store 50 ft. of heavy duty hose,
   2. Fifty (50) feet of 1-1/2" heavy duty, reinforced red non-collapsible rubber hose, brass 1-1/2" coupling.
   3. Ball type brass valve,
   4. Watergun:
      a. Front trigger,
      b. Self closing,
      c. Bronze body.

2.11 EMERGENCY SHOWER AND EYE WASH STATION

A. Combination Unit:
   1. Shall have a ten (10) inch diameter yellow, impact resistant plastic shower head.
   2. Valve shall be a one (1) inch ball valve operated by a stainless steel pull chain with a triangular handle.
   3. Eye wash bowl shall be ten (10) inches in diameter, yellow, impact resistant plastic.
   4. Eyewash shall have a chrome plated brass spray head assembly with twin, soft flow eye wash heads and protective spray head covers.
   5. Eyewash valve shall be 1/2-inch ball valve operated by a stainless steel push flag handle.

6. Unit shall have heavy wall 2" schedule 80, corrosion-resistant PVC piping with 2" socket-welded supply joint. The base is a 6" diameter PVC floor flange.
7. Unit to be provided with an identification sign (14" by 3 1/2") which reads "Emergency Shower and Eyewash Station". Sign shall be affixed to the unit.
8. Selection based on Bradley model S19-310PVC or approved equal.

2.12 WATER METER

A. Water meter shall be furnished by the local water department and installed by contractor.

2.13 ROOF DRAINS

A. Furnish 6-inch diameter roof drain and overflow drain, Dura-Coated cast iron bodies with combination membrane flashing clamp/gravel guards, double Top-Set deck plate and low silhouette cast iron domes. Roof drain based on Josam 22500 series combination roof drain and overflow drain.

B. Coordinate roof drains with General Contractor and Roofing Subcontractor prior to ordering to verify compatibility with actual roofing materials being provided and to very locations on the roof. The roof and overflow drains shall be furnished by the Plumbing Contractor and installed by the General Contractor.

C. Roof and overflow drain piping shall be furnished and installed by the Plumbing Subcontractor in accordance with the Contract Drawings and the specifications herein.

2.14 PLUMBING FIXTURES

A. Provide Water Closets, lavatories, sinks, and other plumbing fixtures and equipment as required by the Plumbing-Electrical Schedule, Plumbing Fixture Schedule, and Drain Schedule on the Contract Drawings.

PART 3 EXECUTION

3.01 ACCESS PANELS

A. All access panels shall be located and positioned so that the equipment and items requiring access to can be easily reached, and the size shall be sufficient for this purpose.

3.02 SLEEVES, INSERTS, ANCHOR BOLTS AND PLATES

A. The Plumbing Subcontractor shall be responsible for the location of and maintaining in proper position all sleeves, inserts and anchor bolts. In case of failure to do so, plumbing subcontractor shall be responsible for cutting and patching of finished work and paying all costs, at no additional cost to Owner.

3.03 PIPING

A. All piping shall be rigidly supported from the building structures by means of approved hangers and supports. Piping shall be supported to maintain required grading and pitching of the lines, to prevent vibration and to secure piping in place, and shall be arranged so as to provide for expansion and contraction. In no case shall risers, mains or branches contact building structures.

B. Hanger placement and design shall include appropriate lateral and longitudinal restraints as required to conform with the seismic design requirement of 780 CMR 16.00.

C. All materials specified in this section which occur above suspended ceiling shall not be supported directly from the building structures. The suspended ceiling system shall not be utilized to support any plumbing materials or systems.

D. Anchors for hot water lines shall be independent of all other hangers.

3.04 PLUMBING FIXTURES

A. Installation:
1. Set fixtures level and in proper alignment with respect to walls and floors, with fixtures equally spaced.
2. Provide supplies in proper alignment with the fixtures and with each other.
3. Provide flush valves in alignment with the fixture, without vertical or horizontal offsets.
4. All fixtures shall have independent stops on hot and cold supplies.
5. Refer to Architectural and Structural details of partitions and floor finishes before placing order for brackets and supports for fixtures.

B. Emergency Shower and Eye Wash:
1. Install in accordance with the manufacturer's instructions at the location shown on the Drawings.
2. Install flow switches in piping.

3.05 INSULATION

A. Pipe, Fittings, Valves and Flanges:
1. Shall be installed on clean dry surfaces after all tests have been satisfactorily completed and approved.
2. All water piping of every description specified herein shall be insulated throughout with the specified insulation.
3. Insulation thickness on all fittings, valves and flanges shall be the same thickness as specified for the piping.
4. Insulation shall be continuous through all sleeves.
5. Rigid pipe insulation inserts shall be installed at each hanger of a thickness equal to the adjoining insulation. Insulation jacket over the insert shall be the same as the adjoining insulation.

3.06 DISINFECTION OF WATER SYSTEMS.

A. Disinfect Potable and Non Potable Water Systems:
1. The entire water distribution system shall be thoroughly disinfected with a solution of not less than 50 parts per million (ppm) of available chlorine. The disinfection solution shall be allowed to remain in the system for a period of three hours after which time all valves and faucets shall be opened and the system shall be flushed with clean water until the residual chlorine content is not greater than 0.2 ppm, unless otherwise directed.
2. Samples and testing for total coliform shall be taken by the Owner, with testing paid for by the Owner. The Contractor shall assist if necessary to obtain the samples.
3. Retesting, if necessary, shall be paid for by the Plumbing Subcontractor.

B. Other Testing and Adjusting:
   1. Provide personnel and equipment and arrange for and pay the costs of all required tests and inspections required by governmental agencies having jurisdiction.

3.07 CLEANING

A. At the completion of the Work of this Section:
   1. Clean all fixtures, equipment, apparatus and exposed trim.
   2. Protect this work during construction. All finished work which is damaged shall be replaced.
   3. Flush all drainage systems to ensure the lines are free of all debris.

END OF SECTION

SECTION 15401

PLUMBING FILED SUB-BIDS

PART 1 GENERAL

1.01 PLUMBING FILED SUB-BID

A. The work of the following sections requires a filed sub-bid in accordance with M.G.L. C.149, S.44A through 44J, inclusive, as amended. These sections will be covered under a single filed sub-bid for the Plumbing category of work.
1. Section 15060 – Pipe Hangers and Supports
2. Section 15400 – Plumbing

B. Reference Drawings: The work of this Section is shown on the following Drawings:
1. 02-C-6
2. 20-D-11
3. 20-P-1 through 20-P-2; 99-P-1 through 99-P-2

C. Requirements of Submitting Sub-bids:
1. Sub-bids for work under this Section shall comply with the requirements of M.G.L. C.149, S.44D and 44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in the Advertisement for Bids and Information for Bidders; and shall be accompanied by a Bid Deposit in the amount of five percent of the sub-bid price complying with the requirements of M.G.L. C.149, S.44B(2). The following should appear on the upper left-hand corner of the envelope:

SUB-BIDDER: Contractor Name

SUB-BID FOR: Plumbing

PROJECT: Wading River Water Treatment Plant
Contract No. 10, DWSRF-16764

D. SUB-SUBLISTINGS

1. Sub-sub trades are categories of work within a filed sub-bid trade and are indicated in paragraph E on the Form for Sub-bid. If sub-sub trades are requested and identified follow the instructions below. The proposed contract price submitted by the filed sub-bidder on the Form for Sub-Bid includes the cost of any sub-sub trades.

a. Sub-sub bids are required for the following subcategories of this section:

Class of Work	Reference Specification Section

2. Sub-bidders shall include the appropriate information for the above listed sub-categories in Paragraph E of the Form for Sub-bid.

3. If the filed sub-bidder customarily performs the above work with its own workforce the sub-bidder should list its own name and trade, and leave the dollar amount blank.

4. If the filed sub-bidder does not customarily perform the above work with its own workforce the sub-bidder should list the name of the contractor performing the work, the trade and insert a dollar amount.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 15440

SUMP PUMPS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide sump pumps as required by the Contract Documents.
   1. In general provide the sump pumps and associated piping required for the lower level of the water treatment plant.

1.02 RELATED WORK

A. Documents affecting the work of this Section include but are not necessarily limited to General Conditions, Supplementary Conditions and the Sections in Division 1 of these Specifications.
   1. Section 03300 Cast-In-Place Concrete
   2. Section 15104 Plastic Pipe and Fittings
   3. Section 15110 Valves and Appurtenances
   4. Division 16 Electrical

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
   3. Shop Drawings in sufficient detail to show the required anchorage and interface of the work of this Section with the work of adjacent trades.
   4. Manufacturer's recommended installation procedures which, when approved by the Engineer, shall become the basis for accepting or rejecting actual installation procedures used on the Work.

1.05 PRODUCT HANDLING

A. Comply with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUMP PUMPS

A. Sump pumps shall be corrosion-resistant as manufactured by Goulds Pump (Model No. LSP07), Zoeller Co., or an approved equal.
1. Stainless steel or glass-reinforced thermoplastic base, motor and pump housing with handle.
2. glass-reinforced thermoplastic impeller.
3. Stainless steel screws, bolts, and washers.
4. Mechanical seal (ceramic and carbon).
5. Output: approx. 25 gpm at 30 feet feet total dynamic head.
6. 1 1/2 inch NPT discharge.
7. Vertical float operated mechanical switch.
8. Operating range of 3 to 9-inches.

B Motors
1. 115 volt (7.1 amps), 60 hertz, 1 phase, 1725 rpm, 3/4 hp.
2. Automatic reset thermal overload protection.
3. Oil filled, hermetically sealed.
4. Twenty (20) foot UL listed, three wire neoprene cord with a molded plug.

2.02 DISCHARGE PIPING.

A. PVC Pipe, Fittings and Appurtenances
1. Shall be as specified in Section 15104.

2.03 PIPE HANGERS AND SUPPORTS

A. Pipe Hangers and Supports
1. Shall be as specified in Section 15060.

2.04 VALVES AND APPURTENANCES

A. Valves and Appurtenances
1. Shall be as specified in Section 15110.

2.05 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FIELD MEASUREMENTS

A. Make necessary measurements in the field to assure precise fit of items.

3.03 INSTALLATION

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

B. Sump pumps shall be installed as shown on the Drawings and in accordance with the manufacturer's recommendations.

3.04 TESTING

A. The pumps shall be given a running test during which it shall demonstrate their ability to operate without vibration or overheating and to perform on their design curve for the existing conditions.
   1. All defects or defective equipment shall be corrected or replaced.

3.05 STARTUP

A. Sump pumps shall be started and tested in accordance with the manufacturer's recommendations and confirm proper operations.

3.06 TRAINING

A. Not Required.

3.07 SPARE PARTS

A. None Required.

END OF SECTION

SECTION 15500

HEATING, VENTILATION AND AIR CONDITIONING

(Part of Work of Section 15501 – HEATING, VENTILATION AND AIR CONDITIONING FILED SUB-BIDS, Filed Sub-Bid Required)

PART 1 GENERAL

1.01 DESCRIPTION

A. The work under this Section includes furnishing and installation of all materials and services required to complete the work under this Section. Such work may include, but is not limited to the following:
   1. Sheet metal and Fibrous-glass ductwork.
   2. Diffusers, registers and grilles.
   3. Exhaust fans.
   4. Wire guards, belt guards and other fan accessories.
   5. Dampers and damper operators.
   6. Back draft dampers.
   7. Thermostats, temperature sensors and humidistats.
   8. Dehumidifier units.
   9. Propane fired unit heaters,
   10. Electric unit heaters,
   11. Ductless packaged split AC/HP units.
   12. Insulation.
   13. Automatic Temperature Controls.

1.02 RELATED WORK IN OTHER SECTIONS

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
   1. Section 09900 Painting
   2. Section 10200 Louvers/Dampers
   3. Division 11 Equipment
   4. Division 15 Mechanical
   5. Division 16 Electrical

1.03 COMPLIANCES

A. All work shall conform to State and Local regulations, National Fire Protection Association Standards, National Building Code, Underwriters Laboratory, Inc. requirements and all authorities having jurisdiction.

B. This Contractor must comply with all the laws of the State of Massachusetts and the Owner, including the building laws pertaining to the safety of the public and employees. Obtain all permits, comply with the inspecting authorities and authorities having jurisdiction at no additional cost to the Owner. Pay all taxes, legal fees for same, obtain all approvals and certificates of inspection. Give due and proper notice to all officials having jurisdiction in the various departments, as may be needed, and in general, take complete charge of, and responsibility for all legal requirements of this work.

1.04 SUBMITTALS

A. Electronic PDF copies of shop drawings shall be submitted for each item installed under this section in accordance with the General Conditions as supplemented. The review of shop drawings shall not relieve the Contractor of responsibility for deviation from the contract drawings or specifications unless he has, in writing, called the attention of the design engineer to such deviation prior to the bidding, nor shall it relieve Contractor from responsibility of errors or omissions in such drawings. Shop drawings shall include motor data sheets, wiring diagrams, exploded view diagrams, complete dimensional drawings, and any manufacturer's literature with all references to other models deleted from the text.

B. Four (4) copies of operation and maintenance manuals shall be submitted for each piece of equipment furnished herein.

1.05 GENERAL REQUIREMENTS

A. The entire work provided in this section of the specifications shall be constructed and finished in every respect in workmanlike and substantial manner, according to the contract drawings and this specification, ready for continuous and trouble free operation, meeting the approval of the Owner.

B. It is not intended that the drawing shows every pipe, offset, fittings or appliance, or exact location of piping, diffusers, registers and equipment. The Contractor shall furnish and install such parts as may be necessary to complete the systems in accordance with the best practice in this trade and to the satisfaction of the design engineer. Exact location of diffusers, registers and all other equipment shall be determined in the field at no additional cost to the Owner.

1.06 STANDARDS

A. The following standards shall form a part of this specification as referenced:
   1. Air Moving and Conditioning Association (AMCA):
      a. Publication 99 - Standards and recommended Practices of Air Moving Devices.
      b. Standard 210 - Test Code for Air Moving Devices.
   2. Sheet Metal and Air Conditioning Contractors' National Association
      a. HVAC Ductwork Construction.

PART 2 PRODUCTS

2.01 GENERAL

A. All heating and cooling systems shall be provided with automatic day and night (seven day programmed) temperature controls. All unit heaters shall be provided with an option to operate without the controls (i.e., manual). The heat and air conditioning system shall be provided with an option to circulate air without heating or cooling, when desired.

2.02 FANS

A. Wall Fans

1. Wall Fans shall be complete with motors, drives, motorized dampers, wire guards, etc. Fans shall deliver the specified air quantities at the specified pressure when tested in accordance with the requirements of AMCA and shall bear AMCA certified rating seal. Fans shall be statically and dynamically balanced.
2. All motors shall be provided with adjustable rails or bases and V-belt drive. Motor sheaves shall be adjustable to provide not less than 20 percent speed variation. Sheaves shall be of the synchronized adjustment type.
3. All Fans and motors shall have permanently lubricated bearings.

2.03 LOUVERS

A. Louvers shall be furnished and installed under SECTION 10200, Louvers/Dampers.

B. Connection to louvers shall be provided under this section of the specifications. Louver plenums when indicted on drawings shall be the full size of the louver and be sealed water and air tight and provided with a low point drain piped to grade.

C. Louvers not specified to be provided with a plenum shall be provided with a suitable ductwork connection to accept installation of dampers. All inactive portions of the louver shall be blanked off with an insulated panel to provide a water and air tight seal to outside.

D. Louvers located in the chemical rooms shall be epoxy coated.

2.04 DAMPERS

A. Automatic Dampers

1. Dampers shall be low leakage opposed blade type guaranteed to leak no more than 2 cfm per square foot at 2-inches W.C. Frames shall be fabricated from 0.081-inch thick extruded 6063-T5 aluminum channel. Blades shall be made parallel of 16 gauge extruded aluminum. Maximum blade width shall be 4-inches. Blade edges and jambs shall be provided with seals. Control shaft shall be minimum 1/2-inch diameter. Bearings shall be self-lubricating.
2. Damper motors shall be Honeywell, Barber Colman or approved equal and except where indicated otherwise on the contract documents shall be spring closed. The size and number of actuators per damper shall provide twelve (12) inch pounds of torque per square foot of damper area. The torque delivered, including linkage losses, shall be 25% greater than the minimum torque required by the equipment manufacturer. Linkage shall be rated for twice the maximum force of the actuators.

B. Back Draft Dampers

1. Back draft dampers shall consist of a set of delicately balanced louvers, mounted in a metal frame that open automatically when excess pressure exists or the fan starts, and shut down by gravity when the fan stops or the pressure drops. The blades shall be constructed of aluminum sheets not less than 0.025 inches thick. The edges of the blades shall be provided with neoprene or felt edges for tight closures and to prevent rattling.

C. Louvers located in the chemical rooms shall be epoxy coated.

2.05 THERMOSTATS

A. Thermostats shall be wall mounted room type multi-stage thermostats with adjustable differential of 3 degrees F per stage and 5 degrees F between stages and shall have bi-metal or vapor-pressure- sensitive elements. Thermostats shall have locked or concealed adjustment device by means of which the operating points can be adjusted through a range of 50-100 degrees F. Thermostats shall be provided with a thermometer and shall be rated for 120 volts.

2.06 DEHUMIDIFIER UNITS

A. Furnish and install dehumidifier units of size and capacity as scheduled on the drawings. Dehumidifier Units shall be of manufacturer and model as indicated on the schedule or approved equal.

B. DH-1, 2, and 3 shall be furnished with a condensate pump and a unit mounted humidistat to cycle unit to maintain set point.

C. DH-4A and 4B shall be furnished with rubber vibration pads mounted under the unit equipment supports. A wall mounted humidistat with on/off/auto subbase to cycle unit to maintain set point shall be provided.

2.07 STARTERS

A. Starters shall be provided if required by the equipment manufacturer. Where starters are required, equipment shall be provided with integral motor starters by the HVAC contractor, except where equipment is indicted to be served from a motor control center (MCC).

2.08 UNIT HEATERS

A. Electric Unit Heaters
   1. Electric Unit Heaters shall be Indeeco or approved equal, unless otherwise noted on the drawings. Heater shall meet all UL, NEC and OSHA requirements.
   2. Unit heater shall be constructed of heavy gauge die-formed steel housing, unless otherwise noted on the drawings. Fan motor shall be completely enclosed.
   3. Unit heater shall have fan delay feature to eliminate cold drafts. Heater shall also be provided with individually adjustable discharge louvers to control airflow through the unit.

B. Gas Unit Heaters
   1. Gas Unit Heaters shall be Sterling Model XF-100 or approved equal. Heater shall meet all UL, NEC and OSHA requirements.

2.09 SHEET METAL

A. General Material Requirements: 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.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G60.
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. All ductwork shall be insulated with 1" thick Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials with a self-adhering backing. Comply with ASTM C 534, Grade 1, Type II for sheet materials.
   1. Subject to compliance with requirements, provide Armacell LLC; AP ArmaFlex SA or a comparable product by one of the following:
      a. Armacell
      b. Aeroflex USA, Inc.
      c. K-Flex USA
   2. Installation shall follow the manufacturer's installation instructions or ASTM C 1710.
   3. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Provide hinged access door with compression latches inside and outside, outside handles and neoprene gasket all around.
   1. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

E. Hanger Rods for Corrosive Environments: Galvanized rods with threads painted with zinc-rich galvanizing.

2.10 FIBROUS-GLASS DUCTS AND FITTINGS

A. Fibrous-Glass Duct Materials: Resin-bonded fiberglass, faced on the outside surface with fire-resistive FSK vapor retarder and with a smooth fiberglass mat finish on the air-side surface.
   1. Duct Board: Factory molded into rectangular boards.
   2. Round Duct: Factory molded into straight round duct and smooth fittings.
   3. Temperature Limits: 40 to 250 deg F inside ducts; 150 deg F ambient temperature surrounding ducts.
   4. Maximum Thermal Conductivity:0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   5. Moisture Absorption: Not exceeding 5 percent by weight at 120 deg F and 95 percent relative humidity for 96 hours when tested according to ASTM C 1104/C 1104M.
   6. Permeability:0.02 perms maximum when tested according to ASTM E 96/E 96M, Procedure A.
   7. Antimicrobial Agent: Compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   8. Noise-Reduction Coefficient: 0.65 minimum when tested according to ASTM C 423, Mounting A.
   9. Required Markings: EI rating, UL label, and other markings required by UL 181 on each full sheet of duct board.

B. Closure Materials:
   1. Pressure-Sensitive Tape: Comply with UL 181A; imprinted by the manufacturer with the coding "181A-P," the manufacturer's name, and a date code.
      a. Tape: Aluminum foil-scrim tape imprinted with listing information.
      b. Minimum Tape Width: 2-1/2 inches 3 inches for duct board thicker than 1 inch.
      c. Staples: 1/2-inch outward clinching, 2 inches o.c. in tabs, one tab per joint.
      d. Water resistant.
      e. Mold and mildew resistant.
      f. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

g. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Fabrication:

1. Select joints, seams, transitions, elbows, and branch connections and fabricate according to SMACNA's "Fibrous Glass Duct Construction Standards," Chapter 2, "Specifications and Closure," and Chapter 4, "Fittings and Connections."
2. Fabricate 90-degree mitered elbows to include turning vanes.
3. Reinforcements: Comply with requirements in SMACNA's "Fibrous Glass Duct Construction Standards," Chapter 5, "Reinforcement" for channel- and tie-rod reinforcement materials, spacing, and fabrication.
4. Preformed Round Duct: Comply with NAIMA AH116, "Fibrous Glass Duct Construction Standards," Section VII, "Preformed Round Duct.

2.11 DIFFUSERS, REGISTERS AND GRILLES.

A. All diffusers, registers and grilles shall be as indicated on Drawings or equal as manufactured by Titus, Tuttle and Bailey or Metalaire.

B. All diffusers and registers shall be furnished with opposed blade dampers unless indicated otherwise.

2.12 PIPING

A. All air conditioning unit condensate piping shall be Type “M” copper with soldered joints. All refrigerant piping shall be Type “L” ACR piping with soldered joints.

B. All condensate piping shall be insulated with 1/2 inch thick armacell flex pipe insulation and covered with PVC fitting protector and jacket. All refrigerant piping shall be insulated with 1/2 inch thick armacell flex pipe insulation and covered with a PVC fitting protector and jacket.

2.13 DESTRATIFICATION FANS

A. Furnish and install destratification fans where shown on the drawings. Refer to drawing schedule for fans size and manufacturer.

B. Fans shall be provided with wall-mounted solid-state speed control switches.

2.14 PACKAGED DUCTLESS SPLIT AC/HEAT PUMP UNIT

A. Furnish and install Ductless AC/HP units where shown on the schedule and drawings. Ductless AC/HP units shall be as manufactured by Mitsubishi, or approved equal.

2.15 AUTOMATIC TEMPERATURE CONTROLS

A. Furnish all control equipment required to fulfill the intent of these specifications. Provide wiring diagrams, field supervision and final project checkout to insure proper continuous, energy efficient and trouble free operation of the installed system.

1. Wiring diagrams must be generated by the control manufacturer on his standard drawing paper and must be approved (initialed) by a licensed automatic temperature control engineer employed by the manufacturer.
2. Supervision of the installation shall be done by a field supervisor employed directly by the manufacturer of the controls. This person will be responsible for the supervision of the installation in accordance with the engineering drawings, setup and calibration after the installation, operational checkout and training of Owner's operating personnel.
3. Control equipment shall be as manufactured by Honeywell Inc., Powers Regulators or approved equal.
4. All electrical wiring for the automatic temperature control system will be done by this subcontractor.

B. Sequence Of Control:

1. Ductless Split AC/HP units:
   a. The units are controlled by wall mounted programmable thermostat.

2. Exhaust Fan: EF-1, EF-2, EF-3 and EF-4
   a. Exhaust fans shall be controlled by a wall mounted switch.

3. Exhaust Fan: EF-5
   a. Exhaust fan shall be controlled by a wall mounted ON-OFF manual starter and wall mounted switch. With the starter in the ON position the exhaust fan shall run.

4. Exhaust Fan: EF-6
   a. Exhaust fan shall be controlled by a wall mounted ON-OFF-AUTO manual starter and cooling thermostat. With the starter in the ON position the exhaust fan shall run. With the starter in the AUTO position the fan shall cycle as determined by the wall-mounted thermostat to maintain 85-degree set point. Interlock fan with outside air intake louver actuator.

5. Electric unit heater EUH-1
   a. Built-in thermostats shall cycle the unit heater fans to maintain temperature in the spaces served.

6. Electric unit heaters EUH-2, EUH-3, EUH-4, EUH-5, EUH-6, EUH-7, and EUH-8
   a. Wall mounted thermostats shall cycle the unit heater fans to maintain temperature in the spaces served.

7. Gas-fired unit heaters GUH-1, GUH-2, GUH-3, GUH-4 and GUH-5
   a. Wall mounted thermostats shall cycle the unit heater fans to maintain temperature in the spaces served.

8. Destratification Fan PF-1
   a. Destratification fan shall be controlled by wall-mounted solid-state speed control switch.

9. Dehumidifier DH-1, DH-2, DH-3, DH-4A and DH-4B
   a. DH-1, DH-2 and DH-3 shall be controlled by unit mounted Humidistat. The Humidistat shall cycle the unit to maintain 50% R.H.
   b. DH-4A and DH-4B shall be controlled by a wall mounted humidistat with on/off/auto subbase. Humidistat shall cycle the unit to maintain 50% R.H.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install items in strict accordance with the manufacturer's recommendations and with all applicable regulations, at no additional cost to the Owner.

B. Electric wiring and installation of all control devices furnished under this section of specifications shall be done by this subcontractor. Wiring diagrams shall be submitted by him and he shall coordinate all work with the Electrical Contractor to aid rapid completion of the project. Supervision of the installation shall be provided by this subcontractor's licensed foreman in charge of this project.

C. Installation of automatic temperature control valve bodies shall be done by the Plumbing Subcontractor, under the supervision of this subcontractor.

D. Installation of motorized dampers shall be done by this subcontractor.

E. Insulated ductwork, supply and return air registers, shall be installed in strict accordance with the HVAC Duct Construction Standards and best practice in the trade.

F. Thermostat shall be securely attached to a suitable base mounted on the wall or other building surface, as approved. Thermostats shall be located where shown, if not shown, where it will respond to the average temperature in the room. Thermostat shall be mounted 60-inches above the floor, and shall not be mounted on an outside wall, if other locations are possible. If mounted on an outside wall, an insulating type base shall be provided.

3.02 GUARANTEE

A. After the completion of the installation, contractor shall adjust and check all devices furnished under this contract. He shall place them in complete operating condition subject to the approval of the Engineer.

B. The control system herein specified, shall be free from defects in workmanship and material under normal use and intended service.

C. If within two (2) years from the date of Substantial Completion, any device herein described is found to be defective in workmanship and/or material, it will be adjusted, repaired or replaced free of charge.

END OF SECTION

SECTION 15501

HEATING, VENTILATION AND AIR CONDITIONING FILED SUB-BIDS

PART 1 GENERAL

1.01 HEATING, VENTILATION AND AIR CONDITIONING FILED SUB-BID

A. The work of the following sections requires a filed sub-bid in accordance with M.G.L. C.149, S.44A through 44J, inclusive, as amended. These sections will be covered under a single filed sub-bid for the Heating, Ventilation and Air Conditioning category of work.
   1. Section 15500 – Heating, Ventilation, and Air Conditioning

B. Reference Drawings: The work of this Section is shown on the following Drawings:
   1. 20-H-1 through 20-H-2
   2. 99-H-1 through 99-H-2

C. Requirements of Submitting Sub-bids:
   1. Sub-bids for work under this Section shall comply with the requirements of M.G.L. C.149, S.44D and 44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in the Advertisement for Bids and Information for Bidders; and shall be accompanied by a Bid Deposit in the amount of five percent of the sub-bid price complying with the requirements of M.G.L. C.149, S.44B(2). The following should appear on the upper left-hand corner of the envelope:

      SUB-BIDDER: Contractor Name

      SUB-BID FOR: Heating, Ventilation and Air Conditioning

      PROJECT: Wading River Water Treatment Plant
      Contract No. 10, DWSRF-16764

D. SUB-SUBLISTINGS

   1. Sub-sub trades are categories of work within a filed sub-bid trade and are indicated in paragraph E on the Form for Sub-bid. If sub-sub trades are requested and identified follow the instructions below. The proposed contract price submitted by the filed sub-bidder on the Form for Sub-Bid includes the cost of any sub-sub trades.

      a. Sub-sub bids are required for the following subcategories of this section:

Class of Work	Reference Specification Section

   2. Sub-bidders shall include the appropriate information for the above listed sub-categories in Paragraph E of the Form for Sub-bid.

   3. If the filed sub-bidder customarily performs the above work with its own workforce

the sub-bidder should list its own name and trade, and leave the dollar amount blank.

4. If the filed sub-bidder does not customarily perform the above work with its own workforce the sub-bidder should list the name of the contractor performing the work, the trade and insert a dollar amount.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

INDEX

DIVISION 16 ELECTRICAL

SECTION 16050

BASIC ELECTRICAL

(Part of Work of Section 16101 – ELECTRICAL WORK FILED SUB-BIDS, Filed Sub-Bid Required)

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install the complete electrical work in accordance with the plans and as specified herein. The work shall include but not be limited to the following:
   1. Complete electric service including primary and secondary duct banks, conductors, grounding, metering, etc. Primary cables will be provided by the electric utility company.
   2. Complete power distribution systems including switchboards, panelboards, motor control centers, transformers, over current devices, wiring devices, raceway, cable, wire, etc.
   3. All motor wiring, safety disconnects, and motor starters unless integral with equipment.
   4. Complete emergency power system including generator, transfer switch, and associated equipment, at designated sites.
   5. Control conduit and wiring not provided by other Divisions.
   6. Complete grounding and surge protection system.
   7. Indoor and outdoor lighting system.
   8. Telephone system.
   9. Fire and security alarm systems.
   10. Lightning protection system.
   11. Arc flash hazard analysis.
   12. All support material and hardware for raceway, cable tray and electrical equipment.
   13. Underground system.
   14. Termination of all cable and wire unless otherwise noted. This includes, but is not limited to, final termination of all control and instrumentation wiring in Process Equipment and PLC control panels and consoles.
   15. Building wall, floor and roof penetrations for raceway and cable tray.
   16. Fire rated sealing of all electrical penetrations.
   17. Miscellaneous equipment.
   18. Start up, acceptance testing test reports and instruction of systems operation to the Owner.

B. This section also includes general construction materials and methods for application with electrical installations as follows:
   1. Miscellaneous metals for support of electrical materials and equipment.
   2. Joint sealers for sealing around electrical materials and equipment; and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.
      a. Temporary utilities and connections include the following:

1. Temporary electric service.
2. Temporary service.
3. Temporary lighting to provide adequate illumination of work areas and security.

C. Related Work. Division 16 is responsible for installation, wiring and raceways for electrically operated equipment, cabinet, starters, controls, instrumentation and related items furnished under other divisions. Division 16 shall furnish and install disconnect switches for equipment furnished under other divisions. This shall include but not be limited to the following:
1. Process equipment starters and control panels.
2. PLC control panels, consoles and instrumentation.
3. HVAC and mechanical equipment starters, disconnects, panels, etc.

D. Related Work Not Included:
1. Furnishing and/or installing temperature and HVAC controls for mechanical trades under division 15.

E. Examination of Site:
1. Before submitting a bid, the Contractor shall visit and carefully examine site to identify existing conditions and difficulties that may affect the Work of this Section. No extra payment will be allowed for additional work caused by unfamiliarity with site conditions.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 specification sections, apply to this section.

1.03 QUALITY ASSURANCE

A. Codes and Standards. Perform all work associated with basic electrical materials in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein. Where provisions of the pertinent codes and standards conflict with this specification, the more stringent provision shall govern.
1. Massachusetts Electrical Code (MEC).
2. National Fire Protection Association (NFPA).
3. Underwriters Laboratories, Inc. (UL).
4. Local and State Building Codes.
5. All electrical equipment shall be listed and labeled by UL or an approved independent nationally recognized electrical testing laboratory.

B. Inspector Certifications
1. Provide two copies of the electrical inspector's certificate of approved showing acceptability of work done under this contract.

1.04 SUBMITTALS

A. Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Follow the procedures specified in Division 1 Section “Submittals” and in addition, the Contractor shall prepare and submit a complete submittal list to the Owner’s Representative. The submittal list shall include all submittal items covered in the Division 16 specification sections.

C. Shop drawings shall be submitted to the Owner’s Representative for approval. Shop drawings shall identify the specific equipment and material being supplied; the quantity being supplied; and all accessories, dimensions, descriptions, mounting and connection details, wiring diagrams, elementary control diagrams, equipment interface diagrams and any other information necessary to determine compliance with the plans and specifications. Fabrication and installation shall be in accordance with the approved shop drawings.

D. As-built copies of all shop drawings shall be submitted to the Engineer. This shall include but not limited to the following:
   1. Switchboards.
   2. Motor Control Centers.
   3. PLC and Control Panels.

E. Permits and Easements. Submit copies of reports, permits, and easements necessary for installation, use, and operation.

F. Test Reports. Submit copies of reports of tests, inspections, and meter readings as specified. Tests, inspections, and meter readings shall be performed using the Contractor’s temporary power source unless otherwise specified.

1.05 RECORD DRAWINGS

A. The Contractor shall maintain a complete and separate set of prints of Contract Drawings and specifications at job site for duration of the contract. The Contractor shall record work completed and all changes from original Contract. Drawings shall clearly and accurately include work installed as a modification or as an addition to the original design.

B. At completion of work and prior to final request for payment, the Contractor shall submit a complete set of reproducible record drawings showing all systems as actually installed.

1.06 JOB CONDITIONS

A. Existing Conditions:
   1. Maintain and protect existing building services, which transit the area affected by selective demolition.

2. Existing Utilities. Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.
3. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
4. Verify that the electrical installation may be made in complete accordance with all pertinent codes and regulations and the original design.

B. Coordination.
1. Coordinate the installation of electrical items with the schedules for work of other trades to prevent unnecessary delays in the total work.
2. Coordinate with all utility and telephone companies and make all installations for their services in accordance with all utility company requirements.
3. Any changes shall be done at the Contractor's expense.
4. Where lighting fixtures and other electrical items are shown in conflict with locations of structural members and mechanical or other equipment, furnish and install all required supports and wiring to clear the encroachment.
5. Any work installed contrary to or without acceptance by the Engineer shall be subject to change as directed by the Engineer, and no extra compensation will be allowed to the Contractor for making these changes.

C. Accuracy of Data:
1. The Drawings are diagrammatic and functional only, and are not intended to show exact circuit layouts, number of fittings, components and place in satisfactory operational power, lighting, and other electrical systems shown. Install additional circuits, components and material wherever needed to conform to the specific requirements of the equipment whether or not indicated or specified.
2. Information and components called for in the specification but not shown on plans or vice versa, shall apply and shall be provided as though required expressly by both.
3. The locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Field measurements shall take precedence over scaled dimensions from Drawings. Exact locations shall be as accepted by Engineer during construction. Obtain in the field all information relevant to the placing of electrical work and, in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an acceptable manner.
4. The Contract Drawings and the specifications are intended to comply with all pertinent codes, regulations and standards. In the event of discrepancy, the Contractor shall immediately notify the Engineer in writing of said discrepancies and apply for an interpretation and, unless an interpretation is offered in writing by the Engineer prior to the execution of the Contract, the applicable rules and regulations shall be complied with as a part of the Contract.
5. In case of difference between building codes, specifications, state laws, industry standards and the Contract Documents, the most stringent shall govern. Should the Contractor perform any work that does not comply with the requirements of

the applicable building codes, state laws, and industry standards, he shall bear all cost arising in correcting these deficiencies.

6. Verify size and ratings of motors and other electrically operated devices supplied by others.
7. Check with Engineer before installation of work for outlets not specified as to location or for work that interferes with other trades.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protection. Use all means necessary to protect electrical system materials before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements. In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the Engineer and at no additional cost to the Owner. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the Engineer, at the cost and expense of the Contractor, or shall be replaced by the Contractor at his own expense.

C. Protect the work of other trades. Restore any damage caused to other trades to the condition existing prior to damage at no additional cost to the Owner.

D. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, the manufacturer shall be required to ship its material in sections sized to permit passing through such restricted areas in the building.

1.08 SPECIAL WARRANTY

A. Compile and assemble the warranties specified in Division 16 into a separate set of vinyl covered three ring binders, tabulated and indexed for easy reference.

B. Provide complete warranty information for each item. Information to include:
   1. Product or equipment list.
   2. Date of beginning of warranty or bond.
   3. Duration of warranty or bond.
   4. Names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.09 DEFINITIONS

A. As used in this specification, “provide” means “furnish and install”, “furnish” means “to purchase and deliver to the project site complete with every necessary appurtenance and support and to store in a secure area in accordance with manufacturers instructions”, and “install” means “to unload at the delivery point at the site or retrieve from storage, move to point of installation and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project”.

B. Finished Areas. In general, areas with carpet or tile floors, lay-in or fixed ceiling tile, special architectural ceiling treatment, or tiled, plastered, or paneled walls shall be considered finished areas.

C. Interior. For the purposes of this specification, interior is any area within the boundaries of the foundation of any building within the superstructure or other structures not classified as a building.

D. Hazardous (Classified) Areas. Hazardous (classified) areas are designated on the drawings in conformance with the Massachusetts Electrical Code (MEC). All equipment and the installation shall conform to requirements for installation in the designated hazardous area as described in Articles 500, 501, and 502 of the MEC.

1.10 TEMPORARY POWER

A. The Contractor shall furnish, install, maintain, and remove the temporary electrical power and lighting systems, including lamps, and pay for all labor, materials, and equipment required therefore. All such temporary electrical work shall meet the requirements of the Massachusetts Electrical Code, the local utility company, and OSHA.

B. The Contractor shall make all necessary arrangements with the local utility company as to where the temporary electric service can be obtained from.

C. The Contractor shall secure and pay for all required permits and back charges for work performed by others, and other expenses incidental to the installation of the temporary electric service.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials and equipment shall be listed by UL unless it can be demonstrated that no UL standards exist for a specific item or class of equipment.

B. All other materials, not specifically described but required for a complete and operable electrical installation, shall be new, first quality of their respective kinds, specification grade or better, and as selected by the Contractor subject to the acceptance by the Engineer.

2.02 INTERCHANGEABILITY

A. In all design and purchasing, interchangeability of items of equipment, subassemblies, parts, motors, starters, relays and other items is essential. All similar items shall be of the same manufacturer, type, model and dimensions.

B. For ease of maintenance and parts replacement, to the maximum extent possible, use equipment of a single manufacturer.

C. The Engineer reserves the right to reject any submittal which contains equipment from various manufacturers if suitable materials can be secured from fewer manufacturers and to require that source of materials be unified to the maximum extent possible.

PART 3 - EXECUTION

3.01 COORDINATION

A. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

B. Field verify all locations and dimensions to ensure that the equipment will be properly located, readily accessible, and installed in accordance with all pertinent codes and regulations, the contract documents, and the referenced standards.

C. The work shall be carefully laid out in advance, and where cutting, drilling, etc., of floors, walls, ceilings, or other surfaces is necessary for the proper installation, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Owner.

D. In the event any discrepancies are discovered, immediately notify the Owner's Representative in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 INSTALLATION

A. Install all equipment and fixtures in complete accordance with the manufacturer’s recommendations and all pertinent codes and regulations.

B. Thoroughly inspect all items of equipment and any items dented, scratched, or otherwise damaged in any manner shall be replaced or repaired and painted to match original finish.
   1. All items so repaired and refinished shall be brought to the attention of the Engineer for inspection and acceptance.

C. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete or supported from or on other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building and equipment which must be placed in service before further construction can take place.

E. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

F. The final routing of raceways shall be determined by structural conditions, interference with other trades and by terminal locations on apparatus. The Engineer reserves the right of a reasonable amount of shifting at no extra cost up until time of roughing in the work.

G. Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation.

H. In general, wiring and raceway systems for security alarm, fire alarm, telephone and intercommunications systems shall be furnished and installed under this section even if not fully indicated on the drawings.

I. Each lighting and each receptacle circuit shall have its own neutral, dedicated to that circuit. A common neutral for more than one signal phase circuit is not allowed.

J. Surface mounted panel boxed, junction boxes, conduits, etc., shall be supported by spacers to provide a clearance between wall and equipment.

K. Upon completion of all installation, lamping, and testing, thoroughly inspect all exposed portions of the electrical installation and completely remove all exposed labels, soils, markings and foreign material.

3.03 MARKING AND LABELING

A. All panelboards, indoor transformers, cabinets, control panels and other specified equipment shall be labeled with engraved laminated plastic plates, minimum 3/4" high with 3/8" engraved letters. Punch tapes with mastic backings are not acceptable.

B. All starters, disconnect switches and other specified equipment shall be marked with engraved laminated plastic plates, minimum 1/2" high with 1/4" engraved letters. Where individual switches are circuit breakers in power or distribution panelboards do not have cardholders, they shall be marked with 1/2" high labels.

C. All empty conduits shall have labels tied to the pull string at each end of each empty conduit, marked as to identification of each end. Junction boxes with circuits provided for future use shall be labeled with appropriate circuit designation.

D. All panelboards directories shall be filled out with typewritten identification of each circuit.

3.04 TESTS & SETTINGS

A. Provide the services of an independent Testing Agency to perform the specified tests for the following systems:

1. Medium voltage cable (where furnished and installed by the Contractor).
2. Pad mounted transformer (where furnished and installed by the Contractor).
3. Standby power.
4. Ground resistance.

5. Arc flash hazard analysis.

B. The Testing Company shall be certified by and perform all testing in accordance with National Electrical Testing Association (NETA) standards and procedures. All testing results shall be submitted on NETA forms and the testing data shall be certified by the respective Agency. Test results shall indicate recommended action for a sub-par test results. Results shall list recommended test values that should be obtained for new installation.

C. Provide necessary material, equipment, labor and technical supervision to perform and complete the Electrical Acceptance Tests as required.

D. Acceptance tests as herein specified are defined as those tests and inspections required to determine that the equipment involved is acceptable as delivered to the job site, that the equipment may be energized for final operational tests and is in accordance with the Specifications.

E. Final acceptance of the equipment and/or workmanship will depend upon performance characteristics as determined by the subject tests, in addition to complete operation tests, on all electrical equipment to show that it will perform the functions for which it was designed.

F. If the test and inspection data submitted should indicate deficiencies in the operation of the electrical apparatus or in the manufacturer thereof, the Contractor shall promptly implement the necessary adjustments, corrections, modifications and/or replacements necessary to be made to meet the specified requirements.

G. Upon completion of the remedial work, the Testing Agency shall repeat all of the tests on components previously found deficient on the first test or any additional test if they be required. It shall be the responsibility and obligation of the Contractor to have all remedial work accomplished as may be required by second and/or additional tests.

3.05 CLEANING

A. General. When all work is completed and has been tested and accepted by the Owner's Representative, the Contractor shall clean all light fixtures, equipment, and exposed surfaces that have been directly affected by this work. The Contractor, insofar as the work is concerned, shall at all times keep the premises in a neat and orderly condition and at the completion of the work shall properly clean up and remove from the site any excess materials.

END OF SECTION

SECTION 16101

ELECTRICAL WORK FILED SUB-BIDS

PART 1 GENERAL

1.01 ELECTRICAL WORK FILED SUB-BID

A. The work of the following sections requires a filed sub-bid in accordance with M.G.L. C.149, S.44A through 44J, inclusive, as amended. These sections will be covered under a single filed sub-bid for the Electrical category of work.
1. All Work of Division 16 – Electrical

B. Related Sections: the sub-bidder is directed to the following Specification Sections for a determination and description of the full character and extent of the work to be included:
1. Section 01100 – Special Project Procedures (Paragraph 3.15)
3. Section 01510 – Temporary Facilities (Paragraph 2.03)
4. Section 02200 – Earthwork (Paragraph 2.03 and 2.05)
6. Section 03315 – Miscellaneous Concrete Placements (Paragraph 2.04)
9. Section 13100 – Instrumentation and Control
10. Section 13400 – Supervisory Control and Data Acquisition System

C. Reference Drawings: The work of this Section is shown on the following Drawings:
1. Demo D Drawings
2. 01-E-1, 02-E-1 thru 02-E-4, 20-E-1 thru 20-E-9; 99-E-1 thru 99-E-10
3. 04-I-1 through 04-I-5; 20-I-1 through 20-I-3

D. Non-in-line process instruments, indicators, and instrumentation control panels furnished by the General Contractor shall be installed by the Electrical Filed Sub-bid. In-line instruments including, but not limited to, flow tubes, flow switches, float switches, pressure sensors, and level sensors shall be installed by the General Contractor. All conduit, wiring and terminations associated with the instruments, valve actuators, and control panels shall be furnished and installed by the Electrical Filed Sub-bid.

E. Requirements of Submitting Sub-bids:
1. Sub-bids for work under this Section shall comply with the requirements of M.G.L. C.149, S.44D and 44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in the Advertisement for Bids and Information for Bidders; and shall be accompanied by a Bid Deposit in the amount of five percent of the sub-bid price complying with the requirements of M.G.L. C.149, S.44B(2). The following should appear on the upper left-hand corner of the envelope:

SUB-BIDDER: Contractor Name

SUB-BID FOR: Electrical Work

PROJECT: Wading River Water Treatment Plant
Contract No. 10, DWSRF No. 16764

F. SUB-SUBLISTINGS

1. Sub-sub trades are categories of work within a filed sub-bid trade and are indicated in paragraph E on the Form for Sub-bid. If sub-sub trades are requested and identified follow the instructions below. The proposed contract price submitted by the filed sub-bidder on the Form for Sub-Bid includes the cost of any sub-sub trades.
   a. Sub-sub bids are required for the following subcategories of this section:

Class of Work	Reference Paragraph

2. Sub-bidders shall include the appropriate information for the above listed sub-categories in Paragraph E of the Form for Sub-bid.

3. If the filed sub-bidder customarily performs the above work with its own workforce the sub-bidder should list its own name and trade, and leave the dollar amount blank.

4. If the filed sub-bidder does not customarily perform the above work with its own workforce the sub-bidder should list the name of the contractor performing the work, the trade and insert a dollar amount.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 16110

RACEWAY

(Part of Work of Section 16101 – ELECTRICAL WORK FILED SUB-BIDS, Filed Sub-Bid Required)

PART 1 – GENERAL

1.01 SCOPE

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to install raceways in accordance with the plans and as specified herein.

B. All raceway systems shall be complete with fittings, boxes, and necessary connections as required.

C. Types of raceways in this section include the following:
1. Intermediate metal conduit (IMC).
2. Liquid tight flexible conduit.
3. Rigid galvanized steel conduit (RGS).
4. Rigid nonmetallic conduit (PVC).
5. PVC coated RGS conduit.
6. Wireways.
7. Underground ducts.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 specification sections, apply to this section.

B. Related Sections. The following sections contain requirements that relate to this section:
1. Section 16050 Basic Electrical
2. Section 16120 Wires and Cables (for other wiring methods).
3. Section 16190 Supporting Devices (for raceway supports).
4. Section 16130 Cabinets, Boxes and Fittings (for boxes used with conduit and tubing systems).

1.03 QUALITY ASSURANCE

A. Reference Standards:
1. National Fire Protection Association (NFPA) 70 "Massachusetts Electrical Code" (MEC).
2. National Electrical Manufacturers Association (NEMA) Compliance.
3. Underwriter's Laboratories, Inc. (UL) Compliance and Labeling. Provide raceway products and components listed and labeled by UL, Electrical Testing Laboratories (ETL), or Canadian Standards Association (CSA).

1.04 SUBMITTALS

A. Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Submit in accordance with Conditions of Contract and Division 1 specification sections:

PART 2 - PRODUCTS

2.01 MATERIALS

A. Metal Conduit and Tubing
1. Provide rigid steel conduit conforming to ANSI C80.1.
2. Provide intermediate steel conduit conforming to UL 1242.
3. Provide liquid tight flexible metal conduit and fittings conforming to UL 360.

B. Nonmetallic Conduit
1. Rigid Nonmetallic Conduit. PVC, Schedule 40 or 80, 90° C, conforming to NEMA TC-2, UL 651, and MEC Article 347.

C. PVC Coated Rigid Galvanized Steel Conduit
1. PVC coating, 40-mil nominal thickness; bond to metal shall have tensile strength greater than PVC.
2. Interior finish of urethane coating, 2-mil nominal thickness.
3. Threads shall be hot dip galvanized and factor coated with urethane.
4. Conform to NEMA RN 1, NEMA C80.1, and UL 6.

D. Fittings and Couplings:
1. Threaded for rigid and IMC.
2. Compression for EMT.
3. Solvent weld for PVC, NEMA TC3.
4. Ferrous fittings shall be cadmium or zinc-coated, UL 614B.
5. Fittings for use in hazardous locations, UL 886.
6. Conduit Bodies.

E. Wireways
1. General Purpose Wireways. NEMA 1 steel, front accessible, totally enclosed with bolted covers. Finish with rust-inhibiting coating and gray baked enamel finish.
2. Oiltight Wireways. NEMA 12, oiltight and dusttight steel with hinged gasketed cover, external latches, and flanged gasketed joints. Finished with gray enamel paint inside and outside.
3. Watertight Wireways. NEMA 4X, watertight, corrosion resistant stainless steel or fiberglass, depending on chemicals within the room or area and corrosion resistance requirements, with hinged gasketed cover, screw clamps, and flanged gasketed joints.

2.02 ACCEPTABLE MANUFACTURERS

A. Conduit.
1. General Electric.
2. National.
3. Allied Tube and Conduit.
4. Carlon.
5. Electri-Flex Company.
6. Republic.
7. Perma-Cote Industries.
8. Robroy Industries, Inc.
9. Triangle PWC, Inc.
10. VAW of America, Inc.
11. Wheatland Tube Co.

B. Conduit Fittings and Accessories.
1. Pyle-National.
2. American Electric.
3. Appleton Electric Co.
4. Carlon.
5. Crouse-Hinds Division, Cooper Industries, Inc.
6. Thomas & Betts.
7. Killark Electric Mfg. Co.
8. Kraloy Products Co.
9. O-Z/Gedney.
10. Perma-Cote Industries
11. Raco
12. Robroy Industries.
13. Unistrut Corp.

A. Wireways
1. American Electric
2. B-Line Systems, Inc.
3. Circle AW Products.
4. GS Metals Corp.
5. Hoffman Engineering Co.
6. Square D Company.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Uses Permitted
1. Use liquidtight flexible metal conduit for the final 24 inches of connections to motors or control items subject to movement or vibration.
2. Use RGS or IMC for all exterior aboveground installations unless otherwise noted.
3. Use Schedule 40 PVC conduit for exterior direct buried installations.

4. Use Schedule 40 PVC conduit for exterior concrete encased installations. The transition from concrete encasement to riser shall be rigid steel conduit.
5. Use RGS for all other interior installations not exposed to severe moisture or corrosive conditions such as chemical feed area unless otherwise noted.
6. Use Schedule 80 PVC conduit within 10 feet radius of the chemical feed equipment. Use PVC coated RGS conduit for analog (4-20madc) signal wiring within 10 feet radius of the chemical feed equipment.
7. Use EMT for lighting circuits above hung ceilings in finished area/offices only.
8. Use PVC coated RGS for installation in the classified area.

B. Routing

1. Install exposed conduits, parallel or perpendicular to walls, ceilings, or structural members. Do not run through structural members. Avoid horizontal runs within partitions or side walls. Avoid ceiling inserts, lights, or ventilation ducts or outlets. Do not run conduits across pipe shafts or ventilation duct openings and keep conduits a minimum of 6 inches from parallel runs of flues, hot water pipes, or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.
2. Conduits installed in all new construction shall be concealed in walls or slabs. New conduits installed in existing areas shall be concealed where practical.
3. Conduits installed in other interior areas shall not be embedded in waterproofed or water bearing walls. Where possible, conduits to motors or equipment more than 3 feet from walls shall be run in or under the slab and stubbed up to the junction box. For all other interior applications, conduits shall be installed, exposed, or concealed as indicated on the plans.
4. For conduits installed in exterior areas:
   a) Do not run conduits exposed on the exterior surface of buildings.
5. Conduits penetrating exterior walls below grade, at grade floors, or below grade floors shall be sealed to prevent moisture migration. The exterior of the conduit shall be sealed with a mechanical pipe seal. The interior conduit seal shall be a gland type sealing bushing or RTV closed cell silicone foam. Ensure that conduits do not retain water against these seals.
6. Conduits shall penetrate roofs only where specifically shown on the plans. Provide all required flashing. Raceways penetrating fire rated walls, floors, and partitions shall be sealed with a fire rated sealant as described in Division 16 specification Section "Basic Electrical"
7. All conduits must be supported with materials specifically made for this purpose. Do not use wire hangers. Do not attach any parts of the raceway system to ventilation ducts. Conduit supports shall be attached to the building. Support conduits on each side of bends and on a spacing not to exceed the following: 6 feet for conduits smaller than 1 1/4 inches and 8 feet for conduits 1 1/4 inches and larger. Support riser conduits at each floor level with clamp hangers. All underground conduits shall be securely anchored to prevent movement during placement of concrete or backfill. Use precast separators and heavy gauge wire ties or other approved fasteners.
8. Install accessible pull boxes in runs over 100 feet or with more than three 90° bends or equivalent.
9. All empty conduits shall have #14 galvanized steel pull wire and terminate in accessible junction boxes or have accessible capped ends for future use.

10. Use E.Y.S. seal fittings for all conduits leaving hazardous areas and chemical rooms.

C. Conduit Embedded In Slab

1. Electrical conduit may be embedded in concrete according to the provisions of Article 6.3 of ACI 318 "Building Code Requirements for Reinforced Concrete", provided the following conditions are met:
   a) Outside diameter of conduit shall not exceed 1/3 of concrete thickness. Maximum conduit outside diameter shall not exceed 3 inches when embedded in slab.
   b) Conduit shall not be placed closer than three diameters on center. Route conduit to minimize crossing of different conduit runs.
   c) Conduit shall not be embedded in structural concrete slabs less than four inches thick.
   d) A 4-inch minimum concrete cover shall be provided for conduits in structural concrete slabs.
   e) Conduit shall be located between the bottom and top of reinforcing steel. Conduit, crossing in the slab must be reviewed by the Engineer for proper cover.
   f) Conduit is generally not permitted in beams or girders.
   g) Only two conduits may cross at any point. The sum of the outside diameters of the crossing conduits shall not exceed 1/3 of the concrete thickness.
   h) Provide additional reinforcement around all groups of conduits which stub up through the slabs.
   i) Except where there are only isolated runs of conduit in slab, a plan showing conduit detail and the proposed routing of the conduits in slab shall be submitted, for the Engineer's approval prior to installation.

D. Underground Conduits

1. When installed in concrete or underground, apply two coats of approved asphalt paint to metallic conduits. Provide protection for conduit in areas subject to vehicle traffic.
2. Where conduits are installed in concrete slabs, on the ground, underground, or exposed to the weather, make all joints liquid tight and gas tight.
3. Bury all underground conduit, except under concrete slabs placed on fill, to a depth of at least two feet below finished grade unless otherwise indicated on the Drawings.
4. Slope ducts to drain away from buildings into manholes and/or handholes. Adjust final slopes to coordinate with existing site utilities.
5. Install on undisturbed soil where possible. Concrete encase conduits as shown on Drawings. Provide processed gravel and sand in accordance with Section 02200, placed 8 in. lifts and compacted for backfill.
6. After installation, clean and swab ducts.
7. Install galvanized steel pull wires in spare ducts. Cap spare ducts.

END OF SECTION

SECTION 16120

WIRE AND CABLES

(Part of Work of Section 16101 – ELECTRICAL WORK FILED SUB-BIDS, Filed Sub-Bid Required)

PART 1 – GENERAL

1.01 SCOPE

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to install wires, cables, and connectors in accordance with the plans and as specified herein.

B. This section includes wires, cables, and connectors for power, lighting, signal, control, and related systems rated 600 volts and less.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 specification sections, apply to this section.

B. Related Sections:
1. Section 16050 Basic Electrical
2. Section 16195 Electrical Identification

1.03 QUALITY ASSURANCE

A. Reference Standards:

1. National Fire Protection Association (NFPA) 70 "National Electrical Code (NEC)."
2. Underwriter's Laboratories, Inc. (UL) Compliance.
   a) UL Standard 83 Thermoplastic Insulated Wires and Cables.
   b) UL Standard 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.
   c) UL Standard 854 Service Entrance Cable.
3. National Electrical Manufacturers Association (NEMA) Compliance.
   a) WC-5 Thermoplastic Insulated Wire and Cable for the
   b) WC-7 Cross Linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
   c) WC-8 Ethylene Propylene Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
4. Institute of Electrical and Electronic Engineers (IEEE) Compliance.
   a) Standard 82 Test Procedure for Impulse Voltage Tests on Insulated Conductors.

1.04 SUBMITTALS

A. Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Submit the following in accordance with Conditions of Contract and Division 1 specification sections:
   1. Product data for electrical wires, cables, and connectors.
   2. Product data for Megger insulation testing instrument.
   3. Report sheets for Megger testing.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver wire and cable properly packaged in factory fabricated type containers, or wound on NEMA specified type wire and cable reels.

B. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General
   1. Provide factory fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated. Where not indicated, provide proper wire selection as determined by Installer to comply with project's installation requirements, NEC and NEMA standards. Select from the following UL types those wires with construction features which fulfill project requirements.
   2. Provide color coding for phase identification in accordance with requirements in Division 16 section "Electrical Identification."
   3. Provide factory applied nylon or polyvinyl chloride (PVC) external jackets on wires and cables for pulls in raceways over 100 feet in length, for pulls in raceways with more than three equivalent 90 degree bends, for pulls in conduits underground or under slabs on grade, and where indicated.

B. Service Wiring:
   1. 98 percent conductivity copper.
   2. 600 volt insulation, type RHW-RHH.
   3. U.L. listed for underground use in wet locations at 75° C.

C. Building Wiring:
   1. 98 percent conductivity copper.
   2. 600 volt insulation, type THWN-THHN.
   3. Solid conductor: #10 AWG and smaller.
   4. Stranded conductor: #8 AWG and larger.
   5. Minimum branch circuit: #12 AWG.
   6. Minimum control wiring: #14 AWG, unless otherwise indicated.

D. Telephone Wiring:

1. Cable. 12 pair, No. 22 AWG, solid copper, unshielded, twisted pair construction in polyvinyl chloride (PVC) sheath. Conform to Insulated Cable Engineers Association (ICEA) Standard A-80-576, "Communication Wire and Cable for Wiring of Premises." Cable used in plenums shall be listed for use in plenums.

E. Instrumentation

1. Instrumentation wiring for remote monitoring of equipment shall be #14 AWG, copper stranded.
2. Instrumentation wiring for transmitting 4-20mA DC signals shall be shielded, 2-conductor, minimum #18 AWG, equal to Belden No. 8760.

E. Splices:

1. No. 10 and smaller with 600 volt pressure type insulated connector of wire-nut type, or equal; soldered and crimped type not allowed. Ideal type "wire nut" Buchanan type "B-Cap" and Minnesota Mining (3M) type "Scotchiok".
2. No. 8 and larger with solderless lugs or solderless connectors of Lock-tite or similar type properly taped with plastic insulating tape, Minnesota Mining Co. #33, or equal, then two half-lap servings of friction tape, Manson, or equal.'
3. Wire connector systems for use with underground conductors shall be UL listed specifically for such use.
4. Service entrance conductors shall be installed without splices. Electrical equipment feeders shall be spliced only where shown or specifically approved. Control and metering conductors shall be installed without splices.
5. All splices shall be made only by specific permission of the Engineer and then only in manholes or pull boxes and shall be sealed watertight with a heat shrunk insulation.
6. Tighten electrical connectors and terminals in accordance with manufacturer's published torque tightening values. Where manufacture's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and 486B.
7. Use UL listed splice for all underground wires, ducts buried, in conduit and in ducts. Connectors and splices shall be waterproof.

2.02 ACCEPTABLE MANUFACTURERS

A. Wire and Cable.

1. American Insulated Wire Corp.
2. Brintec Corp.
3. Carol Cable Co., Inc.
4. Pirell.
5. General Cable.
6. Rome.
7. Triangle.

B. Connectors and Terminals for Wires and Cable Conductors.
   1. AMP.
   2. Burndy Corporation.
   3. Ideal Industries, Inc.
   4. 3M Company
   5. O-Z/Gedney Co.
   6. Raychem.
   7. Thomas and Betts Corp.

PART 3 - EXECUTION

3.01 WIRE AND CABLE INSTALLATION

A. All wire and cables shall be installed in conduit of size and type indicated on the drawing and specifications.

B. Install electrical cables, wires, and connectors in compliance with NEC.

C. Coordinate cable installation with other work.

D. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary.

E. Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.

F. Conceal all cable in finished spaces.

G. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours, where possible.

H. Power conductors shall be No. 12 AWG minimum. Control conductors may be No. 14 AWG where circuit amperes and the NEC allow and when length does not pose a voltage drop problem.

I. Conductors shall be sized such that voltage drop does not exceed 3 percent for branch circuits or 5 percent for feeder/branch circuit combination.

J. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.

K. All feeder and branch circuit wiring shall be color coded at all termination and splice locations. System neutrals shall be designated in addition to phase conductors. Equipment grounds shall be green.

L. The number of conductors shown on the Drawings is not necessarily the correct number required. As many conductors as are required in each case shall be installed. Grounding conductors are not scheduled.

3.02 FIELD QUALITY CONTROL

A. The Contractor shall test each electrical circuit after permanent cables are in place with terminators installed, but before cable or wire is connected to equipment or devices to demonstrate that each circuit is free from improper grounds and short circuits.

B. The Contractor shall test by Megger Test, the insulation resistance between phases and from each phase to ground for each of the following feeder and motor branch circuits:
1. Panelboards.
2. Motors.
3. Motor Control Centers.

C. The Megger Testing shall be witnessed by the Engineer/Architect. The Engineer/Architect shall be notified at least 48 hours in advance of testing.

D. Measure the insulation resistance at 500 volts dc with a hand cranked or motor driven "Megger" insulation testing instrument. Battery operated test instruments are not permitted. All test instruments are to be provided by the Contractor.

E. If any insulation resistance measures less than 50 megohms, the cable shall be considered faulty with the cable failing the insulation test. In moist environments, bag the ends of the cable to prevent a faulty Megger test.

F. Any cable which fails the insulation tests or which fails when tested under full load conditions shall be replaced with new cable for the full length and retested at no additional cost to Owner.

G. The below grade service or feeder splice shall be water immersion Megger tested in the presence of the Engineer. Each splice shall be immersed in a grounded water immersion bath for 24 continuous hours prior to and during the test. Criteria for failure shall be as described for cable above.

END OF SECTION

SECTION 16130

CABINETS, BOXES AND FITTINGS

(Part of Work of Section 16101 – ELECTRICAL WORK FILED SUB-BIDS, Filed Sub-Bid Required)

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install cabinets, boxes, and fittings in accordance with the plans and as specified herein.

B. 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. Outlet and device boxes.
2. Pull and junction boxes.
3. Boxes and fittings for hazardous locations.
4. Hinged door enclosures.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 specification sections, apply to this section.

B. Related Sections:
1. Section 16050 Basic Electrical
2. Section 16110 Raceways

1.03 QUALITY ASSURANCE

A. Reference Standards.
1. Underwriter's Laboratories, Inc. (UL) Listing and Labeling. Items provided under this section shall be listed and labeled by UL.
2. Massachusetts Electrical Code (MEC) Compliance.
3. National Electrical Manufacturers Association (NEMA) Compliance.

1.04 SUBMITTALS

A. Furnish manufacturer's product data, test reports, and material certifications as required.

B. Submit the following in accordance with Conditions of Contract and Division 1 specification sections:
1. Product data for cabinets and enclosures with classification higher than NEMA 1.
2. Shop drawings for floor boxes and boxes, enclosures and cabinets that are to be shop fabricated (nonstock items).

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cabinets, Boxes, and Fittings, General

1. 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 and provide air sealing gaskets for units mounted in exterior walls.

B. Materials and Finishes

1. Provide fasteners for general use which are corrosion resistant screws and hardware including cadmium and zinc plated items.
2. Provide fasteners for damp or wet locations which are stainless steel screws and hardware.
3. Provide cast metal for boxes, enclosures, and covers which are copper-free aluminum except as otherwise specified.
4. Provide exterior finish which is gray baked enamel for items exposed in finished locations except as otherwise indicated.
5. Provide fittings for boxes, cabinets, and enclosures which conform to UL 514B. Malleable iron or zinc plated steel for conduit hubs, bushings, and box connectors.

C. Metal Outlet Boxes

1. Conform to UL 514A, "Metallic Outlet Boxes," and UL 514B, "Fittings for Conduit and Outlet Boxes." Boxes shall be of type, shape, size, and depth to suit each location and application.
2. Provide cast iron boxes of iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices and closure plugs.

D. Pull and Junction Boxes

1. Comply with UL 50, "Electrical Cabinets and Boxes", for boxes over 100 cubic inches volume. Boxes shall have screwed or bolted on covers of material same as box and shall be of size and shape to suit application cover shall be gasketed.
2. Provide hot-dipped galvanized steel boxes constructed of sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing. Hot-dip galvanized after fabrication. Cover shall be gasketed.

E. Nonmetallic Outlet, Device, and Wiring Boxes

1. Conform to NEMA OS 2, "Nonmetallic Outlet Boxes, Device Boxes, Covers, and box Supports," and UL 514C, "Nonmetallic Outlet Boxes, Flush Device Boxes and Covers." Boxes shall be molded polyvinyl chloride (PVC) units of type, shape, size, and depth to suit location and application.
2. Boxes shall be equipped with threaded screw holes for device and cover plate mounting. Each box shall have a molded cover of matching PVC material suitable for the application.

2.02 ACCEPTABLE MANUFACTURERS

A. American Electric
B. Appleton
C. Carlon
D. Crouse Hinds
E. Hoffman Engineering Co.
F. Killark Electric Mfg. Co.
G. O.Z. Gedney
H. Parker Electrical Mfg. Co.
I. Raco/Bell Division Harvey Hubbell
J. Spring City Electrical Mfg. Co.
K. Square D Co.
L. Steel City/Thomas & Betts

PART 3 – EXECUTION

3.01 INSTALLATION

A. General
1. Install items where indicated and where required to suit code requirements and installation conditions.
2. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.
3. Support and fasten items securely in accordance with Division 16 section "Supporting Devices." Boxes shall be securely mounted to the building structure, independent of the raceway entering or leaving.
4. Sizes shall be adequate to meet MEC volume requirements, but in no case smaller than sizes indicated.
5. Remove sharp edges where they may come in contact with wiring or personnel.

B. Uses Permitted
1. Outlet Boxes.
a. Use nonmetallic boxes in corrosive areas such as chemical feed and storage or as designated on the plans.
b. Use explosionproof boxes in hazardous areas as designated on the plans.
c. Use cast metal boxes in all other locations. Each box with associated covers and fittings shall have a NEMA rating suitable for each location installed.
2. Pull and Junction Boxes.
a. Use general purpose boxes (NEMA 1) in finished areas with framed construction.
b. Use dusttight and oiltight boxes (NEMA 12) in other dry interior areas.
c. Use explosionproof boxes (NEMA 7) in hazardous areas as designated on the plans.
d. Use watertight boxes (NEMA 4) for exterior and wet locations on outdoor structure where moisture is present.

3. Use watertight, corrosion resistant boxes (NEMA 4X) for exterior and corrosive locations or wet and corrosive locations, including, but not limited to, all areas where chemicals are present and where specifically required on the drawings.

3. Cabinets
   a. Install enclosures and associated materials and NEMA types suitable for each location and in conformance with the drawings.

C. Installation of Outlet Boxes
1. Surface mount outlet boxes for exposed conduit runs.
2. Adjust position of outlets in finished masonry walls to suit masonry course lines.
3. Coordinate cutting of masonry walls to achieve neat openings for boxes.
4. Use rotary cutting equipment to cut masonry work for installation of electrical fittings.
5. Locate boxes in masonry walls so that only a corner need be cut from masonry units.
6. Do not use sectional or handy boxes unless specifically requested.
7. Adjust outlet mounting height to agree with required location for equipment served.
8. Wall boxes in block construction shall be masonry boxes with inside ears and shall be concrete tight.
9. Outlet boxes shall be installed at all lighting fixtures.
10. Mount outlet boxes for switches with the long axis vertical or as indicated. Mount boxes for receptacles either vertically or horizontally, but consistently either way. Locate boxes for switches near doors on the side opposite the hinges and close to door trim, even though electrical floor plans may show them on hinge side.
11. For concrete boxes use extra deep boxes to permit side conduit entrance without interfacing with reinforcing, but do not use such boxes with over 6 inch depth.
12. For existing outlet boxes where extension rings are required to be installed, drill new mounting holes in the rings to align with the mounting holes on the existing boxes where existing holes are not aligned.

D. Installation of Pull and Junction Boxes
1. For boxes in main feeder conduit runs, use sizes not smaller than 8 inches square by 4 inches deep. Do not exceed 6 entering and 6 leaving raceways in a single box. Quantities of conductors (including equipment grounding conductors) in pull or junction box shall not exceed those required by MEC.
2. Install clamps, grips, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30 inches inside boxes.
3. Mount pull boxes in inaccessible ceilings with the covers flush with the finished ceiling.
4. Provide pull and junction boxes for telephone, signal, and other systems at least 50 percent larger than would be required by Article 370 of MEC, or as indicated.
5. Steel enclosed wireways and auxiliary gutter may be used at grouped equipment locations and at other locations where multiple circuits are run, when such use is accepted by the Engineer.

3.02 GROUNDING

A. Electrically ground metallic cabinets, boxes, and enclosures.

END OF SECTION

SECTION 16140

WIRING DEVICES

(Part of Work of Section 16101 – ELECTRICAL WORK FILED SUB-BIDS, Filed Sub-Bid Required)

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install wiring devices in accordance with the plans and as specified herein.

B. This section includes the following:
1. Receptacles.
2. Ground Fault Circuit Interrupter Receptacles.
3. Snap Switches.
4. Wall Plates.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions, and Division 1 specification sections, apply to this section.

B. Related Sections:
1. Section 16050 Basic Electrical
2. Section 16440 Disconnect Switches
3. Section 16195 Electrical Identification

1.03 QUALITY ASSURANCE

A. Reference Standards.
1. National Fire Protection Association (NFPA) 70 "Massachusetts Electrical Code (MEC)."
2. Underwriter's Laboratories, Inc. (UL) and National Electrical Manufacturers Association (NEMA) Compliance.

1.04 SUBMITTALS

A. Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Submit the following in accordance with Conditions of Contract and Division 1 specifications sections:
Product data for each type of product specified.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Acceptable Manufacturers
   1. Wiring Devices.
      a) Bryant Electric Co.
      b) General Electric Co.
      c) Hubbell, Inc.
      d) Slater Electric Co.
      e) Leviton.
      f) Pass & Seymour/Legrand.

B. Wiring Devices
   1. Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA standards. Provide ivory color devices and wall plates except as otherwise indicated. Verify color selections with Owner's Representative.
   2. Receptacles.
      a) Receptacles, Industrial Heavy Duty 2-pole, 3-wire grounding rated 20 amperes, 125 volts, back wiring, metal plaster ears, NEMA type 5-20R unless otherwise noted. Provide pin and sleeve design receptacles conforming to UL 498.
      b) Ground Fault Interrupter (GFI) Receptacles. Provide 20 ampere, "feed through" type ground fault circuit interrupter, with integral heavy duty NEMA 5-20R duplex receptacles arranged to protect connected downstream receptacles on same circuit. Provide unit designed for installation in a 2 3/4 inch deep outlet box without adapter, grounding type, Class A, Group 1, per UL Standard 94.3.
      c) Special purpose outlets: NEMA heavy duty class, grounding type with matching plug.
   3. Switches.
      a) Snap Switches. Quiet type alternating current (ac) switches, NEMA heavy duty class, rated at 20 ampere, 120/277 v. Provide matching two pole, 3-way or 4-way switches. Comply with UL 20 and NEMA Standards.

C. Wiring Device Accessories
   1. Cover plates. Single and combination, of types, sizes, and with ganging and cutouts as indicated. Provide plates which mate and match with wiring devices to which attached. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Provide plate color to match wiring devices except as otherwise indicated.
   2. Interior finished areas: Stainless steel, type 302 satin finish, minimum 0.032-inch thick; accurately die cut and beveled; smooth rolled outer edge for flush mounted boxes, edge smoothed to fit surface mounted boxes; with screws to match plate cover finish. Cover plates to be oversized.

3. Interior equipment areas: Galvanized steel, smooth rolled outer edge. Nonmetallic construction for chemical feed and storage area.
4. Exterior and interior wet locations: Die-cast aluminum, satin finished; weatherproof; individual spring loaded gasketed lift lids for devices; corrosion resistant screws to match plate cover finish.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of MEC. The location of all devices shall be subject to the acceptance of the Engineer. The drawings show approximate locations only.

B. Coordinate with other work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other work.

C. Mount all wall switches at 4'-0" above finished floor and all receptacles at 1’- 6" above the finished floor unless otherwise noted.

D. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.

E. Install galvanized steel wall plates in unfinished spaces.

END OF SECTION

SECTION 16190

SUPPORTING DEVICES

(Part of Work of Section 16101 – ELECTRICAL WORK FILED SUB-BIDS, Filed Sub-Bid Required)

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install supporting devices in accordance with the plans and as specified herein.

B. This section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions, and Division 1 specification sections, apply to work of this section.

B. Related Sections:
1. Section 16050 Basic Electrical

1.03 QUALITY ASSURANCE

A. Reference Standards.
1. Massachusetts Electrical Code (MEC) Compliance.
2. Underwriter's Laboratories, Inc. (UL), Electrical Testing Laboratories, Inc. (ETL), or Canadian Standards Association (CSA).

1.04 SUBMITTALS

A. Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Submit the following in accordance with Conditions of Contract and Division 1 specification sections:
1. Product data for each type of product specified.
2. Hanger and support schedule showing manufacturer's figure, number, size, spacing, features, and application for each required type of hanger, support, sleeve, seal, and fastener to be used.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Coatings
   1. 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 unless material is inherently corrosion resistant.

B. Conduit Supports:
   1. Single run hangers: Galvanized steel (or fiberglass reinforced plastic (FRP) within 10-feet of chemical feed systems) conduit straps or clamps, or cast metal beam clamps. Perforated straps and spring steel clips and clamps will not be permitted.
   2. Group run hangers: Minimum 12-gauge galvanized (or FRP within 10-feet of chemical feed systems) preformed U-channel rack with conduit fittings; 25 percent spare capacity.
   3. Hanger rods: Threaded steel (or FRP within 10-feet of chemical feed systems), 3/8-inch diameter.
   4. Vertical run supports: Minimum 12-gauge galvanized (or FRP within 10-feet of chemical feed systems) preformed U-channel struts with conduit fittings.

C. Equipment and lighting supports:
   1. U-channel: 12-gauge galvanized (or FRP within 10-feet of chemical feed systems) preformed U-channel struts with fixture and conduit fittings, as applicable.

D. Anchors:
   1. Hollow masonry: Stainless steel toggle bolts.
   2. Solid masonry: Lead expansion anchors or preset inserts.
   3. Metal surfaces: Machine screws, bolts, or steel clamps as required for application.
   4. Wood surfaces: Wood screws.

E. Conduit Seals. Provide factory fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Provide a cast-in-place water stop wall sleeve with a mechanical pipe seal between the conduit and the sleeve. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

2.02 ACCEPTABLE MANUFACTURERS

A. Metal Angle and U-Channel Systems.
   1. Allied Tube and Conduit Corp.
   2. American Electric.
   3. B-Line Systems, Inc.
   4. GS Metals Corp.

5. Kin-Line, Inc.
6. Unistrut Diversified Products.

B. Conduit Sealing Bushings.
1. Cooper Industries, Inc.
2. GS Metals Corp.
3. Killark Electric Mfg. Co.
4. OZ/Gedney.
5. Product Electric Corp.
6. Raco, Inc.
7. Spring City Electrical Mfg. Co.
8. Thomas & Betts Corp.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install supporting devices to fasten electrical components securely and permanently in accordance with MEC requirements.

B. Coordinate with the building structural system and with other electrical installations.

C. Conform to manufacturer's recommendations for selection and installation of supports.

D. 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.

E. Support parallel runs of horizontal raceways together on trapeze type hangers.

F. 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.

G. 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.

H. Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

I. Install sleeves 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 fire stopping sealant in gaps between sleeves and enclosed conduits and cables.

J. Install conduit seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal. Provide seals for the interior of conduits which penetrate exterior or water bearing walls, consisting of gland type sealing bushings or RTV closed cell silicone foam. Provide explosionproof conduit seal fittings with appropriate potting material where conduits enter or leave a Class 1, Division 1 or 2 environment or a Class 2, Division 1 or 2 environment.

END OF SECTION

SECTION 16195

ELECTRICAL IDENTIFICATION

(Part of Work of Section 16101 – ELECTRICAL WORK FILED SUB-BIDS, Filed Sub-Bid Required)

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to perform the work in accordance with the plans and as specified herein.

B. This section includes requirements for electrical identification components including, but not limited to, the following:
1. Identification labeling for cables and conductors.
2. Operational instruction signs.
3. Warning and caution signs.
4. Equipment labels and signs.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions and Division 1 specification sections, apply to this section.

B. Related Sections.
1. Section 16050 Basic Electrical
2. Section 16110 Raceway
3. Section 16120 Wires and Cables

1.03 QUALITY ASSURANCE

A. National Fire Protection Association (NFPA) 70 "Massachusetts Electrical Code (MEC)."

B. American National Standards Institute (ANSI) Compliance.

1.04 SUBMITTALS

A. Submit manufacturer's technical product data sheets for each type of product specified.

PART 2 - PRODUCTS

2.01 PRODUCTS

A. Name Plates & Signs

1. Laminated Plastic Signs and Labels. Engraving stock melamine plastic laminate, 1/16 inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes; punched for mechanical fasteners.
2. Exterior Warning and Caution Signs. Weather resistant, nonfading, preprinted cellulose acetate butyrate signs with 20 gauge, galvanized steel backing, with colors, legend, and size appropriate to the location.
3. Interior Warning and Caution Signs. Aluminum signs with preprinted baked enamel finish and punched for fasteners. Colors, legend, and size appropriate to location.

A. Wire and Cable Markers
1. Underground Line Marking Tape. Permanent, bright colored, continuous printed, metal backed, plastic tape compounded for direct burial service not less than 6 inches wide. Printed legend indicative of general type of underground line below.
2. Wire Labels. Wires smaller than No. 4. Vinyl or vinyl cloth, self-adhesive, wraparound, wire markers with preprinted numbers and letters. Wire sizes No. 4 and larger and multi conductor cables shall be marked with one-piece, nylon locking marker ties equal to Panduit PLM Series.

2.02 Acceptable Manufacturers.

A. American Labelmark Co.
B. Almetek.
C. Brady.
D. Emed Co., Inc.
E. Ideal Industries, Inc.
F. Kraftbilt.
G. LEM Products, Inc.
H. Markal Corp.
I. Panduit Corp.
J. Seton Name Plate Co.
K. Standard Signs, Inc.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

3.02 INSTALLATION

A. Warning Signs. Install warning or caution signs where required by MEC, where indicated, or where reasonably required to ensure safe operation and maintenance of electrical systems and of the items to which they connect.

B. Equipment Name Plates

1. Install engraved plastic laminate identification labels on each major unit of electrical, communication and signaling equipment. Black lettering on a white field to match terminology and numbering on the Contract Documents and shop drawings.
2. Provide labels with 1/2 inch high lettering on 1 1/2 inch high label (2 inches high where two lines are required) for each unit of the following categories of equipment.
   a) Panelboards, electrical cabinets, and enclosures.
   b) Access doors and panels for concealed electrical items.
   c) Motor starters.
   d) Power transfer equipment.
   e) Contactors.
   f) Transformers.
   g) Control stations.
   h) Frequency converters.
   i) Power generating units.
   j) Enclosed circuit breakers.
   k) Disconnect switches.
   l) Control panels.
   m) Motor control centers.
3. Provide a framed, typed circuit schedule for each panelboard.

C. Junction and Pullbox. Where required by codes, install pressure sensitive, self-adhesive labels on box cover to indicate system voltage. Black on orange background.

D. Underground Electrical Line. Install continuous underground plastic line markers, directly above all underground lines and conduits at 6 to 8 inches below finished grade.

E. Wire and Cable Markers

1. Tag control circuit conductors at both ends and at junction box splices using wire and cable markers with identification numbers as designated on equipment wiring diagrams. Provide typed listing to identify conductors by number and use.
2. Identify spare conductors, individually, at both ends and at junction box splices with number between 1 and 999. Do not duplicate numbers.
3. Identify wire numbers on terminal block marking strips.
4. Provide permanent plastic name tag indicating load for each feeder for all junction boxes, handholes and manholes. Label all process motor wires to yard equipment in handholes and manholes.

208/120 Volts	Phase	480/277 Volts
Black	A	Brown
Red	B	Orange*
Blue	C	Yellow
White	Neutral	White
Green	Ground	Green

*Where not permitted by inspecting authority, use purple.

END OF SECTION

SECTION 16210

STANDBY GENERATOR

(Part of Work of Section 16101 – ELECTRICAL WORK FILED SUB-BIDS, Filed Sub-Bid Required)

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install standby power generator system in accordance with the plans and as specified herein.

B. Extent of standby power generator system work is indicated by drawings and these specifications and shall include provision of all labor, materials, and incidentals required to provide and install the standby power generator system complete with transfer switch, including, but not limited to:
   1. Engine/generator set.
   2. Transfer switch.
   3. Batteries.
   4. Battery charger.
   5. Exhaust system.
   6. Weatherproof Enclosure.

1.02 RELATED DOCUMENTS

A. Division 16 Electrical

1.03 QUALITY ASSURANCE

A. Reference Standards.
   1. Massachusetts Electrical Code (MEC) Compliance. MEC Article 702.
   2. American National Standards Institute National Electrical Manufacturers Association (ANSI/NEMA) Compliance. ANSI/NEMA MG 1.
   3. Institute of Electrical and Electronic Engineers (IEEE) Compliance. IEEE Standard.
   4. State and Local Code Compliance. All applications, permits, fees, and licenses for the installation shall be submitted, secured, and paid for by the Contractor.

B. Qualifications
   1. Firms regularly engaged in manufacture of engine driven standby generator systems of types, ratings, and characteristics required, whose products have been in satisfactory use in similar service for not less than 10 years.

C. System Responsibility
   1. The engine generator set and accessories described herein shall be furnished by a single supplier who shall be responsible for the performance of the equipment to this specification in its entirety. The responsibility shall not be divided among suppliers of individual components. The supplier shall maintain maintenance service shop within 100 miles from the project site.

D. Testing
   1. Factory Tests. Prior to shipment, the unit shall be factory performance tested under full load with all accessories for one hour. All test measurements shall be made by a light beam oscillograph. The full block load test shall demonstrate no more than a 15 percent RMS voltage dip and 15 percent frequency deviation measured during the fourth complete cycle following application of the load. Both voltage and frequency shall return to within +3 percent of rated in less than 5 seconds following the application of the block load. The tests shall be performed in accordance with the manufacturer's standards. A written report of this test shall be forwarded to the Engineer for acceptance prior to shipment.
   2. Field Test. The complete installation shall be tested for compliance with the plans and specifications following completion of all site work. Testing shall be conducted by a representative of the supplier. Upon completion of the installation of this unit, a test run for three hours shall be conducted by equipment manufacturer's factory trained servicemen, utilizing reactive load banks to attain full generator rating. At this time, adjustments shall be made for correct operation of the equipment. The tests to be conducted on site shall be as follows:
      a) Cold Start Test. Perform a cold start test on the generator using the generator's actual load as a test load. A power failure shall be simulated by opening the normal power disconnect and the following information shall be recorded.
         1. Time delay on start.
         2. Time required to reach full speed.
         3. Voltage and frequency overshoot.
         4. Time to achieve steady state.
         5. Voltage, frequency, and amps at standby state.
         6. Oil pressure, water temperature, and battery charge rate at 5 minute intervals for the first 15 minutes and at 15 minute intervals thereafter for 2 hours.
         7. Time delay on retransfer after return of normal power.
         8. Cool down time delay.
      b) Full Load Test. Immediately after cooling time from cold start test, perform a one step full load test using a load bank. Record the same data as in the cold start test except for time delays on transfer and retransfer.
      c) Safety Shutdowns. Test all the generator safety shutdowns.

1.04 SUBMITTALS

A. Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Submit the following in accordance with conditions of contract and Division 1 specification sections:
   1. Submit a list of materials giving quantities, manufacturer's name, and catalog numbers.
   2. Submit manufacturer's technical product data sheets on all equipment to be furnished.
   3. Submit drawings which show dimensional layouts of the engine/generator set and its spatial relationship to associated equipment. Fabrication and installation shall be in accordance with the approved shop drawings.
   4. Submit wiring diagrams for the engine/generator set and transfer switch showing connections to feeders, and accessory equipment. Clearly differentiate between portions of the wiring that are manufacturer installed and portions to be field wired.

5. Submit all required information as necessary for Owner to prepare and submit the application to the Massachusetts DEP for approval of the proposed generator set with regard to the emission regulations.
6. Factory Test Report. Results of the required factory test shall be submitted to and approved by the Engineer prior to shipment.
7. Field Test Report. Certified copies of the field test procedures and results shall be forwarded to the Owner's Representative.

1.05 WARRANTY

A. Provide manufacturer's guarantee or warranty with no deductibles and including travel time, service hours, repair parts and expendables (oil, filters, antifreeze and other items required for the complete repair) with Owner named as beneficiary, in writing, as guarantee. Special guarantee shall provide for correction of the Work specified in this Specification section found defective during a period of 5 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in the General Conditions.

B. The Engine Generator Package Manufacturer shall certify that the system complies with Massachusetts Air Regulations 310CMR7 in terms of emission limitations for the first 3 years of operation. This certification is a prerequisite for the approval of the complete package.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General
1. Provide one 600 KW diesel fueled engine/generator set for standby service as shown on the drawings. Any changes to ventilation, fuel system, exhaust system, and electrical connections required for proper operation of an engine/generator set other than the specified unit shall be the responsibility of the Contractor, with no additional cost to the Owner.
2. The unit shall be capable of producing a minimum of 600 kilowatts (KW) of electrical power at 0.8 power factor for continuous standby operation. In addition, the engine/generator set shall have a minimum motor starting capability of 750 kilovolt amperes (KVA) with no more than 15 percent RMS voltage dip as measured during the fourth complete cycle following the application of the load in five steps as follows:

   - Step 1: One 112.5KVA dry type transformer (combined resistive and inductive loads) plus 80KW of misc. resistive/inductive loads.
   - Step 2: One 150HP high lift pump with VFD.
   - Step 3: One 60HP intermediate pump with VFD plus two 15HP well pumps with VFDs.
   - Step 4: One 30HP BW pump with VFD plus two 10HP recirc. pumps with VFDs.
   - Step 5: One 15HP supernatant pump with VFD plus one 15HP compressor plus one 15HP blower both with FVNR starters.

   These ratings shall be met after application of all applicable demand factors for operation at 1,000 feet above sea level and in an ambient temperature of 120 degrees F maximum and – 20 degrees F minimum.

3. The operation of the units shall be automatic and upon the closing of a remote starting contact in the automatic transfer switch, start the engine and attain rated voltage and frequency within ten (10) seconds. All necessary accessories shall be provided to assure starting within the time described above under the ambient condition.

B. Engine
   1. The engine shall be industrial type, a liquid cooled, four-stroke cycle, full compression, engine for use with diesel fuel. The engine speed shall not exceed 1,800 rpm at normal full load operation and shall be certified by the manufacturer as capable of developing sufficient brake horsepower at this speed to drive the generator under the connected loads and environmental conditions on a continuous standby basis. All moving parts shall be properly guarded.
   2. Governor. The engine shall be equipped with a fully enclosed electronic speed sensing isochronous governor, capable of providing accurate speed control. Frequency regulation shall be within +0.5 percent of rated frequency during steady state conditions and frequency dip during full load application shall not be greater than 10 percent.
   3. Starting System. Furnish an electric starting motor with starter solenoid switch for operation at 24 volts dc.
   4. Engine Fuel System. The engine fuel system shall include all equipment normally supplied and recommended by the generator set manufacturer for standby generator service. The engine fuel system shall include (but not limited to the following):
      a) Flexible fuel connector.
      b) Fill and vent lines.
      c) Primary and secondary fuel filters.
      d) UL listed 1,000 gallon base mounted day tank, double wall construction complete with leak detection system. The tank shall be designed for direct mounting of engine/generator set skid with fill and vent lines as required. Provide an integral mounted fuel transfer pump and level controls with low fuel alarm system.
      e) Overfill prevention valve.
      f) 5 gallon spill containment at the fill.
      g) Clock style fuel gauge.
      h) Audible/visual high level alarm that is near the point of fill.
      i) Specific tank markings.
      j) All other accessories as required by the state and the local codes.
   5. Air Cleaners. One or more engine mounted, replaceable element, dry type air cleaners of sufficient capacity to protect working parts of the engine from dust and grit shall be provided.
   6. Lubrication System. Lubricating oil shall be supplied by a positive displacement, mechanical, lubricating oil pump and lube oil system. Full flow, replaceable element, oil filters, liquid cooled oil cooler, and dip stick oil level indicator shall also be provided.

C. Engine Cooling System.
   1. Radiator. The engine shall be furnished with a unit mounted radiator and sufficient capacity to keep the engine within normal operating temperature when running at full load on a continuous standby basis. The radiator shall be provided with a duct adapter flange to allow the attachment of an air discharge duct to direct air discharge through the wall.
   2. Coolant. The engine coolant system shall be filled with a 50 percent solution of antifreeze and water.
   3. Coolant Heater. The engine shall be furnished with a coolant heating system. The heating element shall be 208 volt, single phase, 60 hertz, and shall be of sufficient wattage to

maintain the specified coolant temperature. A thermostat shall control the temperature of the coolant as required. The heater shall be mounted on the engine and shall be disconnected when the engine starts by an oil pressure switch mounted on the engine.

D. Safety Switches.
   1. Safety switches shall be provided on the engine to initiate the following alarms and engine shutdowns:
      a) Low coolant temperature alarm.
      b) Low oil pressure alarm.
      c) Low oil pressure shutdown.
      d) High coolant temperature alarm.
      e) High coolant temperature shutdown.
      f) Overspeed shutdown.
      g) Overcrank lockout.

E. Generator.
   1. The generator shall be engine driven drip proof, single bearing, self-aligning, continuous duty salient pole, synchronous unit. The insulation shall be NEMA Class F. The generator shall be rated for 480 volt, 3 phase, 60 hertz operation. The generator shall be directly connected to the engine through a flexible coupling.
   2. Exciter. The generator shall have a brushless rotating exciter with a temperature compensated, solid state full wave rectifier. The exciter shall have the capacity to provide 150 percent of the required excitation of rated load and voltage.
   3. Voltage Regulator. The voltage regulator shall be solid state and shall provide no load to full load regulation within +0.5 percent at rated voltage during steady state conditions.
   4. Provide engine driven battery charger.

F. Controls.
   1. General. The engine/generator control shall be mounted on the generator end of the set, shall be a rigid metal enclosed structure. The panel shall be furnished with the necessary fuses, transformers, and other accessories required for the following equipment.
      a) Engine oil pressure gauge.
      b) Coolant temperature gauge.
      c) Engine oil temperature gauge.
      d) Engine hourmeter.
      e) Voltmeter, selector switch, and potential transformers.
      f) Ammeter, phase selector switch with "Off" position, and current transformers.
      g) Frequency meter.
      h) Low engine oil pressure alarm light.
      i) Low engine oil pressure shutdown light.
      j) High coolant temperature alarm light.
      k) High coolant temperature shutdown light.
      l) Low coolant temperature alarm light, red.
      m) Overcrank lockout light.
      n) Audible alarm and reset button.
      o) Battery charger fail alarm.
      p) Generator output circuit breaker with solid-state trip assembly. Size as indicated on the drawing.
      q) Maintained contact emergency stop push button.

r) Output voltage adjustment potentiometer.
s) Automatic start-stop cranking controls.
t) Auxiliary dry contacts rated 10 amperes at 120V for operation of louvers and remote "run" indication.
u) Common alarm contact for external use.
v) Remote alarm annunciator panel to be mounted at the main gear, generator circuit breaker section. Provide the required signal/communication wiring.
w) Remote EMG STOP control switch in an NEMA 4X enclosure.

G. Mounting
1. The engine/generator set shall be mounted on a suitable structural steel base capable of maintaining proper alignment between components during shipment, installation, and operation. Provide spring type vibration isolators with rubber backing between the structural steel base and its foundation. The vibration isolators shall provide a minimum of 90 percent isolation.

H. Battery System
1. Batteries shall be pocket plate nickel cadmium or lead plant storage with sufficient capacity to crank the engine for at least 45 seconds at firing speed in the ambient temperatures specified and with capacity for starting the engine a minimum of three times. Provide suitable unit mounted rack for battery mounting and battery cables of adequate size to prevent voltage drop problems during cranking cycle. Batteries shall be heavy duty rated at 225 amp/hour.
2. Battery Charger. Provide a fully automatic solid state battery charger with both float and equalize charge rates, automatic alternating current (ac) line voltage compensation, and dc voltage regulation. The charger shall be capable of fully recharging batteries within 24 hours.

I. Exhaust System
1. Furnish an exhaust system consisting of a minimum 24 inch long flexible l connecting pipe, side inlet exhaust silencer, necessary additional exhaust pipe, and a flanged condensate drain and petcock. The exhaust silencer shall be of multichambered construction and shall provide critical silencing suitable for residential installation.

J. Weather Proof Enclosure
1. A drop over style, soundproof weather protective and weatherproof enclosure shall be furnished with the engine generator set by the engine generator supplier. The sound level shall not exceed 76dB(A) at 23 feet. The housing shall enclose the complete unit and all related equipment (e.g., battery, battery charger, engine controls and panel, etc.). All components shall be pre-wired and piped within the enclosure by the engine generator supplier. The enclosure is to be in compliance with the National Electrical Code (NEC), and the National Fire Protection Association (NFPA) (NFPA 37 and NFPA 100). The enclosures shall consist of a pre-painted, maintenance-free aluminum stressed-skin-monocoque construction. The enclosure finish shall be selected by the Owner.

2.02 ACCEPTABLE MANUFACTURERS ONLY

A. Caterpillar
B. Cummins.
C. Kohler.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The engine/generator sets shall be shipped from the manufacturer completely assembled with weatherproof enclosure and ready to operate. The Contractor shall furnish all necessary equipment as required. Provide equipment grounding connections for engine generator unit as indicated and as required.

3.02 SERVICE AGREEMENT

A. The supplier shall include in the base price, an 18-month service agreement. The maintenance shall be performed by factory authorized service technicians capable of servicing the engine generator set. This agreement shall include the following:
   1. Generator supplier shall have an in-house rental fleet with equipment sized to back up this project site.
   2. All engine maintenance as recommended by the service manual.
   3. All electrical controls maintenance and calibrations as recommended by the manufacturer.
   4. All auxiliary equipment as a part of the emergency systems.
   5. The supplier shall guarantee emergency service.
   6. All expendable maintenance items are to be included in this agreement.
   7. A copy of this agreement and a schedule shall be given to the Owner at the time of his acceptance, showing what work is to be accomplished and when.

3.03 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by Owner for minimum person-days (8-hour per person day) listed below, travel time excluded:
   1. 2 person-days for installation assistance and inspection.
   2. 2 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
   3. 1 person-day for facility startup.
   4. 1 person-days for post-startup training. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Engineer.

END OF SECTION

SECTION 16400

SERVICE ENTRANCE

(Part of Work of Section 16101 – ELECTRICAL WORK FILED SUB-BIDS, Filed Sub-Bid Required)

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to provide service entrance work in accordance with the plans and as specified herein. The extent of service entrance work is indicated by drawings and schedules.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions, and Division 1 specification sections, apply to this section.

B. Related Sections.
1. Section 16050 Basic Electrical

1.03 QUALITY ASSURANCE

A. Reference Standards.
1. Massachusetts Electrical Code (MEC), including Articles 230, 250, and 338.
2. National Electrical Manufacturers Association (NEMA) Compliance.
3. Underwriters' Laboratories, Inc. (UL) Compliance.
a. UL 50 Electrical Cabinets and Boxes.
b. UL 854 Service Entrance Cables.
c. UL 869 Electrical Service Equipment.
4. Institute of Electrical and Electronic Engineers (IEEE) Compliance.
5. American National Standards Institute (ANSI) Compliance.

1.04 SUBMITTALS

A. Furnish manufacturer's product data, test reports, and materials certification as required.

B. Submit the following in accordance with Conditions of Contract and Division 1 specification sections:
1. Product Data. Submit manufacturer's data on service entrance equipment and accessories.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General. Provide service entrance equipment and accessories; of types, sizes, ratings and electrical characteristics indicated, which comply with utility and manufacturer's standard materials, design and construction.

B. Meter Sockets. Provide meter sockets which comply with requirements of local utility company supplying electrical power to service entrance equipment of building project.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Provide and install required conduit wire, pullboxes, and accessory items to accomplish the work involved in providing the electrical service as shown on the Drawings. Service shall be 480Y/277 volts, 3 phase, 4 wire, 60 Hertz.

B. Coordinate service work with the Owner and utility company.

C. Obtain all permits and provide all materials and labor necessary for interfacing with utility equipment to install electric service.

D. Furnish and install all electrical conduit for low voltage cables and low voltage wire and accessory items necessary to accomplish the work detailed herein and as specifically identified on the Drawings.

E. Furnish and install metering conduit, wiring and meter base.

3.02 UTILTY CHARGES

A. The Owner shall be responsible to cover the electric utility’s charges associated only with the utility work for furnishing and installing the pad mounted transformer, primary conductors, and the primary wiring terminations. The Owner will pay these charges directly to the utility company. All other work including riser pole conduits, primary underground conduits and trenching, secondary service conduits, secondary service conductors, metering, temporary power for the site, etc. shall be carried under the Contractor’s filed sub-bid.

END OF SECTION

SECTION 16425

SWITCHBOARD

(Part of Work of Section 16101 – ELECTRICAL WORK FILED SUB-BIDS, Filed Sub-Bid Required)

PART - 1 GENERAL

1.01 SCOPE

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install switchboard in accordance with the plans and as specified herein.

B. This section includes low voltage power service and distribution switchboard and associated auxiliary equipment rated 600 volts (V) or less.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. Related Sections. The following sections contain requirements that relate to this section:
1. Section 16050 - Basic Electrical
2. Section 16195 - Electrical Identification, for identification and warning signs for switchboard and switchboard components.
3. Section 16430 - Arc Flash Hazard Analysis

1.03 QUALITY ASSURANCE

A. Reference Standards:
1. Provide switchboard assemblies that are listed and labeled as defined in the MEC, Article 100 National Fire Protection Association (NFPA) 70 “NEC”.
2. National Electrical Manufacturers Association (NEMA) Standard PB2, "Deadfront Distribution Switchboard.”
3. Underwriters' Laboratories, Inc. (UL) Standard 891, "Deadfront Switchboard."
4. Product Selection for Restricted Space. The drawings indicate maximum dimensions for switchboard equipment including clearances between switchboard and adjacent surfaces and items. Switchboards having equal performance characteristics and complying with indicated maximum dimensions may be considered.

B. Qualifications:
   1. The switchboard shall be the product of a manufacture who shall be responsible for all components installed in the switchboard.
   2. The switchboard's dimensions indicated on the drawings are maximum allowable and shall not be exceeded. Switchboard shall be aligned at the rear and shall be front accessible only.
   3. The switchboards shall be suitable for use as service entrance equipment.

1.04 SUBMITTALS

A. Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Submit the following in accordance with Conditions of Contract and Division 1 specification sections.
   1. Product data for each product and component specified.
   2. Shop drawings for each switchboard including dimensioned plans and elevations, component and device lists, and a single line diagram showing main and branch bus current ratings and short time and short circuit ratings of switchboard.
   3. Shop drawings or other descriptive documentation of optional barriers specified for electrical insulation and isolation.
   4. Shop drawings of utility company metering provisions with indication of approval by utility company.
   5. Schedule of features, characteristics, ratings, and factory settings of individual protective devices.
   6. Manufacturer's schematic wiring diagram in ladder diagram form. Label each rung and each device in plain English. Label shall describe intended function. Label each rung and each device in plain English. Label shall describe intended function.
   7. Point to Point Control Wiring Diagram. Differentiating between manufacturer installed and field installed wiring (may be submitted upon delivery of switchboard).
   8. Mimic Bus Diagram and Color Samples. Submit updated version of diagram reflecting field changes after final switchboard load connections have been made.

C. Protective Devices Coordination. The switchboard manufacturer shall provide a complete electrical distribution system protective devices coordination study including the arc flash hazard analysis per NFPA 70E and IEEE std. 1582-2002 per specs, section 16430. The Study shall include the utility company's protective devices, facility's switchboard mains and feeder breakers, motor control centers, VFDs, power and lighting panels in the distribution section. Graphic indication of coordination shall be furnished in the form of a composite drawing showing time-current curves of system protective devices. Time current curves of each protective device shall be provided. Maximum available three phase and ground fault values shall be shown on the curves.

D. The results of the coordination study and arc flash hazard analysis study shall be summarized in a final report and submitted. The report shall include the following:
   1. Executive Summary.
   2. Descriptions, purpose, basis and scope of the study.
   3. Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
   4. Details of the incident energy and flash protection boundary calculations.
   5. Recommendations for system improvements, where needed.
   6. One-line diagram.
   7. Arc flash labels shall be provided in hard copy only.

E. Instructions shall be provided with the switchboard for performance testing of the ground-fault protection system.

1.05 JOB CONDITIONS

Not used.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

B. Store so condensation will not occur on or in switchboard. Provide temporary heaters if storage building is not adequately heated to ensure avoiding condensation.

C. Handle switchboard in accordance with NEMA Standard PB2.1, "General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboard." Use factory installed lifting provisions.

1.07 SPECIAL WARRANTY

Not used.

PART - 2 PRODUCTS

2.01 MATERIALS

A. General
   1. Front accessible sections, totally enclosed, dead front.
   2. The switchboard physical dimensions shall not exceed those shown on the drawings
   3. Insulation and isolation barriers for main and vertical buses of feeder sections and for main bus of main section and main and vertical bus of feeder sections.

B. Standard Features

1. Switchboards shall be fully self-supporting structures with 90 inch tall vertical sections (excluding lifting eyes and pull boxes) bolted together to form required arrangement.
2. Switchboard frame shall be die formed, 12 gauge steel with reinforced corner gussets. Frame shall be rigidly bolted to support cover plates (code gauge steel), bus bars and installed devices during shipment and installation.
3. All sections may be rolled, moved or lifted into position. Switchboards shall be capable of being bolted directly to the floor without the use of floor sills.
4. All switchboard sections shall have open bottoms and removable top plate(s) to install conduit.
5. All covers shall be fastened by hex head bolts.
6. Provide hinged doors over metering compartments and individually mounted device compartments. All doors shall have concealed hinges and be fastened by hex head bolts.
7. Switchboard protective devices shall be furnished as listed on drawings and specified herein, including interconnections, instrumentation and control wiring. Switchboards and devices shall be rated for the voltage and frequency listed on the drawings.
8. Switchboard current ratings, including all devices, shall be based on a maximum ambient temperature of 40 degree C per UL Standard 891. With no derating required, temperature rise of switchboards and devices shall not exceed 65 degrees C in a 40 degree C ambient environment.
9. Switchboard Service Entrance sections shall comply with UL Service Entrance requirements including a UL service entrance label, incoming line isolation barriers, and a removable neutral bond to switchboard ground for solidly grounded wye systems.
10. The group mounted feeder breaker and/or main devices within switchboards shall be circuit breakers as indicated on the drawings. Mounting for the group mounted circuit breakers shall be by bolted connections.
11. Bus bars shall be silver-plated copper. The bus bars shall have sufficient cross sectional area to meet UL 891 temperature rise requirements. Phase and neutral bus ampacity shall be as shown on the plans. The neutral bus shall have the same ampacity as the phase bus.
12. Bus bars shall be mounted on high impact, non-tracking insulated supports. Joints in the vertical bus are not permitted.
13. Bus bars shall be braced to withstand mechanical forces exerted during short circuit conditions as indicated in drawings, but in no case less than 42KA RMS SYM.
14. Ground Bus shall be sized to meet UL 891. Ground bus shall extend full length of switchboard. Ground bus shall be copper.
15. All feeder device line and load connection straps shall be rated to carry current rating of device frame (not trip rating).
16. The main incoming bus bars shall be rated for the main protection device frame size or main incoming conductors, if there is no main device.

C. Enclosure and Accessories

1. Enclosure. Steel. NEMA Class 1 with NEMA 1 gasketed doors, metal enclosed, free standing, dead front cabinet fabricated from formed sheet steel. The finish coat of paint shall be ANSI Z55.1 No. 49, light gray enamel.
2. Metering Compartment. Fabricated compartment.
3. Removable Hinged Rear Covers. Secured by captive thumb screws, for access to rear interior of switchboard.
4. Hinged Front Panels. Provide to allow access to switch, metering, accessory, and blank compartments.
5. Buses and Connections. Three phase, four wire except as otherwise indicated. Features as follows:
    a. Phase and Neutral Bus Material. Hard drawn copper of 98 percent conductivity with feeder circuit breaker line connections.
    b. Ground Bus. 1/4 inch by 2 inch minimum size, hard drawn copper of 98 percent conductivity, and equipped with pressure connector terminations for feeder and branch circuit ground conductors. For busway feeders extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
    c. Supports and Bracing for Buses. Adequate strength for short circuit currents of 42,000 amps (RMS) symmetrical.
6. Conduit Space. Adequate conduit space shall be provided for entrance and exit of service and feeder conduits and cables as required.

D. Main & Feeder Circuit Breakers Standard Features

1. Provide indicated features, ratings, characteristics, and settings for circuit breakers as shown on the drawings. All main service breakers shall be provided with service entrance label. Provide ground fault interrupt function for all main service disconnects 1,000 amps, 3 phase, 4 wire or larger. The interrupting rating shall meet or exceed bracing requirements.
2. The breakers shall be a solid-state trip insulated case power circuit breaker 100 percent rated, draw-out type for mains (normal power main and standby power main), electrically operated, and 80 percent rated, fixed mounted type, manually operated for the distribution section feeder breakers. Solid-state trip devices shall include ground-fault, long time, short time, and instantaneous, short time pickup and zone interlock (field adjustable) features to provide for proper selectivity.
3. The switchboard's main breakers and feeder breakers shall be provided with **Arc Flash reduction maintenance mode switch** to limit total clearing time to 0.04 seconds (2.5 cycles).
4. The trip and sensing devices shall be microprocessor-based, true RMS sensing design.

E. Main Circuit Breakers

1. Insulated case circuit breakers shall be individually mounted.
2. Main breakers shall be electrically operated, fixed mounted.

3. Breakers shall be constructed of a high dielectric strength, glass reinforced insulating case. The interrupting mechanism shall be arc chutes. Steel vent grids shall be used to suppress arcs and cool vented gases. Interphase barriers shall to isolate completely each pole.
4. Breakers shall contain a true two-step stored energy operating mechanism which shall provide quick make, quick break operation with a maximum five cycle closing time. Breakers shall be trip free at all times. Common tripping of all poles shall be standard.
5. Breakers shall be rated to carry 100 percent of their frame ampacity continuously.
6. A charging handle, close push-button, open push-button, and Off/On/Charge indicator shall be located on the breaker escutcheon and shall be visible with the breaker compartment door closed.

F. Digital Electronic Trip Unit Features
1. Each main and feeder circuit breaker shall be equipped with a digital electronic trip unit. The trip unit shall provide protection from overloads, short circuits and ground faults. The protective trip unit shall consist of a solid state, microprocessor based programmer; tripping means; current sensors; power supply and other devices as required for proper operation.
2. The protective trip unit shall consist of a solid state, microprocessor based programmer; tripping means; current sensors; power supply and other devices as required for proper operation.
3. Long time and short time protective functions shall have true RMS sensing technology for harmonic rich currents including up to the 19th harmonic.
4. Noise immunity shall meet the requirements of IEEE C37.90.
5. The trip unit shall display trip targets for long time, short time, and ground fault, if included.
6. Provide visual illuminated indication of the trip unit (normal, pickup, trip, error).
7. The trip unit shall be provided with a ten event trip history log. Each trip event shall be recorded with type, phase and magnitude of fault that caused the trip.
8. As a minimum, the trip unit shall have the following protective functions:
    a. Current setting or long time pickup, adjustable from 50% to 100%.
    b. Adjustable long time delay with typical inverse time characteristics (minimum of 10 bands). In addition, a set of straight line fuse shaped long time delay bands shall be provided to facilitate selectivity with downstream fuses (minimum 7 bands).
    c. Instantaneous pickup, adjustable from 2.0 to 10 times the rating plug in 0.5 increments
    d. Short time pickup and delay. Short time pickup shall be adjustable from 1.5 to 9 times the long time pickup setting in 0.5 increments with an OFF option. Provide minimum of 12 short time delay bands with three selectable I^2t bands.

e. Adjustable ground fault pickup and delay. Ground fault pickup shall be adjustable from 0.4 to 1.0 times the breaker sensor rating in 0.05 increments. Provide a minimum of 15 ground fault delay bands with three selectable I^2t bands.

f. Reduced Energy Let-Through (RELT) Instantaneous trip. When specified this feature shall be provided on all main and feeder breakers to provide a temporary setting for the instantaneous trip setting of the breaker. Setting shall be adjustable down to 1.5X of the rating plug and shall be enabled through a switch mounted on front of the switchboard. The switch shall be combined with an indicating light that positively indicates that the RELT is enabled or disabled.

9. The trip unit shall display rms current, each phase, on the LCD.

10. The following monitored values shall also be displayed on the trip unit LCD:
    a. Voltage, rms, line - to - line, or line - to - neutral;
    b. Energy, KWH, total;
    c. Demand KWH, over an adjustable time period of 5 to 60 minutes;
    d. Peak demand, KW, user resettable;
    e. Real power, KW, line - to - line, line - to - neutral;
    f. Total (apparent) power, KVA, line - to - line, line - to – neutral;
    g. Reactive Power, KVAR, line - to - line, line - to – neutral;
    h. Power Factor (%);
    i. Frequency (Hz).

11. Trip shall be provided with serial communications using Modbus RTU protocol. Manufacturer's literature shall provide full register map.

12. Trip unit shall provide waveform capture capability for fault events. Capture data shall include 4 cycles before and 4 cycles after the event or can be initiated through a Modbus command.

13. If a manufacturer's trip unit cannot incorporate the above specified metering functions, separate device(s) with equal function shall be provided for each breaker.

G. Automatic Transfer Switch

1. Refer to section 16490.

H. Other Circuit Control and Protective Devices

1. Provide factory installed and tested devices of types listed below, with indicated ratings, settings, and features.

2. Provide TVSS as specified in IEEE C62.11, "Standards for Metal Oxide Surge Arresters for AC Power Circuits," or IEEE C62.1 "Surge Arresters for Alternating Current Power Circuits."

3. The TVSS shall as a minimum conform to the following standards.
   UL 1449
   ANSI/IEEE C62.41 Category C3
   ANSI/IEEE C62.45
   NEMA LS-1

4. The TVSS shall meet or exceed the following criteria:
   a. Maximum single impulse current shall be 200 KA per mode.
   b. UL 1449 suppression voltage ratings for service voltage of 480Y/277 volts shall not exceed the following:
      L-L 1500V
      L-N 800V
      L-G 1500V
      N-G 800V
   c. The ANSI/IEEE C62.41 Category C3 let through voltages for service voltage of 480Y/277 volts shall not exceed the following:
      L-N 900V
      L-G 900V
      N-G 900V
5. The TVSS system shall include a display panel giving complete visual and audible system status monitoring diagnostics. The system shall continually monitor the operational status of the TVSS. Alarm shall be activated upon fault condition. An alarm silencing switch as well as a dry contact for remote monitoring shall be provided. Installation shall be by switchboard manufacturer.

I. Instrumentation
1. Instrument Transformers. NEMA Standard EI 21.1, "Instrument Transformers for Revenue Metering 110 [Kilovolt] kV BIL and Less," IEEE Standard C57.13, "Requirements for Instrument Transformers," and the following:
   a. Potential Transformers. Secondary voltage rating of 120 volts and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
   b. Current Transformers. Ratios as indicated and accuracy class suitable for connected relays, meters, and instruments.
2. Multifunction Digital Metering Monitor. (See Section 16430) UL listed or recognized microprocessor based unit suitable for three or four wire systems and with the following features:
   a. The system shall measure true RMS values. The quantities to be monitored shall include current, demand current, voltage, real power, reactive power, apparent power, demand power, power factor, energy use, total harmonic distortion and K-factor.
   b. The system shall include a non-volatile memory to enable data retention during a system-power or control-power interruption.
   c. The system shall have a communication port cable of being connected to a small PC.
   d. Waveform-capture capabilities shall be provided.
   e. Harmonic-analysis capabilities shall be provided that will resolve the harmonics into their components.
   f. An alarm/event log shall be provided that shall have the capacity for storing an adequate number of alarm and events.
   g. The alarms available shall include: over/under voltage, current imbalance, current sag/swell, voltage sag/swell, phase loss, over/under frequency, over demand and phase reversal.

h. Isolated 4-2 OMADC output proportional to the kW usage.
i. Ethernet port for connection to the plant wide SCADA system.
j. Display and control unit flush or semiflush mounted in instrument compartment door.

J. Ratings
1. Provide nominal system voltage, continuous main bus amperage, and short circuit current ratings as indicated on the drawings.

K. Extra Material
1. Spare Fuses. Six spares of each type and rating of fuse and fusible devices used. Include spares for:
a. Potential transformer fuses.
b. Fuses for fusible switches.
2. Spare Indicating Lights. Six of each type installed.
3. Touch-Up Paint. Three half-pint containers.
4. One spare 1,200A, electric operated breaker complete with electronic trip units capable of replacing any of the main breakers within the system.
5. One lifting device for installation/removal of breaker to/from its compartment.
6. Rubber Mats: A three foot wide rubber mat shall be furnished and installed on the floor and in front of each new switchboard assembly. The mat shall be long enough to cover the full length of the equipment line-up. The mat shall be 1/4 inch thick with beveled edges, canvas back, solid type with corrugations running the entire length of the mat. The mat shall be guaranteed extra quality, free from cracks, blow holes or other defects detrimental to their mechanical or electrical strength. The mat shall meet OSHA requirements and the requirements of ANSI/ASTM D 178 J6-7 for Type 2, Class 2 insulating matting.

L. Identification
1. Refer to Division 16 section "Electrical Identification." Identify units, devices, controls, and wiring with factory applied labels and signs.
2. Provide engraved laminated plastic or metal nameplate for each compartment, mounted with corrosion resistant screws.

2.02 MANUFACTURERS

M. General Electric Co.

N. Cutler Hammer-Eaton Corp.

O. Square D/Group Schneider

PART - 3 EXECUTION

3.01 INSTALLATION