DETAILED SPECIFICATIONS
AND
CONTRACT DOCUMENTS

CITY OF BENTONVILLE, ARKANSAS

BENTONVILLE WATER RESOURCE RECOVERY FACILITY IMPROVEMENTS

VOLUME III

HWEI PROJECT NO. 2018143

MARCH 2025

BID SET

PREPARED BY

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WOOD LABORATORY CASEWORK AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. All cabinets and casework, including tops, ledges, supporting structures, and miscellaneous items of equipment as listed in these specifications, or equipment schedules including delivery to the building, setting in place, leveling, scribing to walls and floors as required. Furnish and install all filler panels, knee space panels and scribes as shown on drawings. Installation shall be completed by a factory certified installer.

2. Furnish and deliver all utility service outlet accessory fittings, electrical receptacles, and switches, as listed in these specifications, equipment schedules or as shown on drawings as mounted on the laboratory furniture. Items shall be furnished with supply tank nipples and lock nuts, loose in boxes and properly marked. All plumbing and electrical fittings will be packaged separately and properly marked for delivery to the appropriate contractor.

3. Furnish and deliver, packed in boxes for installation by the mechanical contractor, all laboratory sinks, cup sinks or drains, drain troughs, overflows and sink outlets with integral tailpieces, which occur above the floor and where these items are part of the equipment or listed in the specifications, equipment schedules or shown on the drawings. Integral tailpieces when required shall be in accordance with the manufacturer's standards. All tailpieces shall be furnished less the couplings required to connect them to the drain piping system.

4. Furnish service strip supports and set in place service tunnels, service turrets, supporting structures and reagent racks of the type shown on the details.

5. Remove all debris, dirt and rubbish accumulated as a result of the installation of the laboratory casework to an onsite container provided by others, leaving the premises clean and orderly.

B. Related Divisions:

1. Section 06100 Rough Carpentry
2. Division 14 Plumbing
3. Division 16 Electrical

C. Related Publications:

1. Architectural Woodwork Institute Quality Standards, 8th Edition
2. NFPA 30 – National Fire Protection Association
3. NFPA-45 – National Fire Protection Association

4. UL – Underwriters Laboratory
5. ASTM D552 – Bending Test
6. SEFA 8W – Laboratory Furniture

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 BASIS OF WORK

A. This specification uses Diversified Casework (www.diversifiedcasework.com) - Majestic Series (reveal overlay) OAK Cabinetry as the standard of construction for wood laboratory casework. The construction standards of this product line shall provide the basis for quality and functional installation. Pricing from other manufacturers must be submitted as an alternate in order to assure quality standards are maintained.

B. Supply all equipment in accordance with this specification. No alternates, deviations or exceptions to the specified construction or materials are allowed.

C. As a means of maintaining the desired level of quality, any and all other manufacturers shall be submitted as an alternate to the specified product provided by Diversified Casework.

D. The owner / owner representative reserves the right to reject qualified or alternate proposals and to award based on product value where such action assures the owner greater integrity of product.

1.04 QUALITY ASSURANCE

A. The following items are required components of this specification and cannot be modified:

1. The wood laboratory furniture contractor shall also provide work tops and fume hoods to assure proper staging, shipment, and single source responsibility.

2. Each cabinet shall be foam and shrink wrapped to ensure cabinet surfaces are protected until the time of installation. Blanket-wrap is not allowed because they do

not stay with the cabinets after delivery and because they are not assured of being grease and dirt- free.

3. SEFA Compliance and Assurance: Wood cabinets shall be capable of passing all tests contained in SEFA 8W. Documentation shall be provided showing independent testing and compliance with SEFA 8W.

4. MAS and/or Green Guard Certification: Manufacturer shall provide current documentation proving compliance and certification with either MAS or Green Guard small-scale chamber emissions test. Wood products shall be MAS Certified Green® and/or GreenGuard® Certified.

5. Casework shall be installed by a factory certified installer or Lifetime Warranty shall be negated to a 2-year warranty.

6. Cabinets shall be manufactured with dowel construction placed on a maximum 63mm on-center.

7. Cabinets shall use a minimum of 2 mechanical fasteners along with dowel construction in securing the toe-space panel.

8. Cabinets shall use a full sub-top construction composed of a minimum of 3/4" veneer core plywood.

9. Cabinet faces shall be vertically grain matched within door and drawer faces.

10. Wall cabinets shall be provided with 3/4” X 4” screw strips at both the top and bottom behind the cabinet back and doweled into both cabinet sides. Screws shall be applied via pocket hole fastener systems.

1.05 SUBMITTALS

A. Submit compliance statement with bid – see page 14 of this specification.

B. Casework samples will be required and reviewed per specification. Samples shall be delivered, at no cost to the architect or owner, to a destination set forth by the architect or owner. This must be done seven (7) days before quotation deadline as a condition of approval of each bidder. Samples shall be full size, production type samples, as will be delivered for the project. Furnish the following:

1. One (1) combination drawer and cupboard base unit, including one (1) shelf
2. One (1) sample of all top materials shown or called for
3. Sample of all mechanical service fittings, locks, door pulls, hinges, and interior hardware

C. Submit shop drawings for furniture assemblies showing plans, elevations, ends, cross-sections, service run spaces, location, and type of service fittings.

1. Coordinate shop drawings with other work involved.
2. Provide roughing-in drawings for mechanical and electrical services when required.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The basis of this specification is Diversified Casework (www.diversifiedcasework.com) Majestic Series. No exceptions, deviations or alternates to the specified construction or materials are allowed.

B. Lifetime warranty: The selected manufacturer must warrant for the life of the product in the application and location installed, starting at the date of acceptance or occupancy, whichever comes first, that all products sold under the contract referenced above shall be free from defects in material and workmanship. Purchaser shall notify the manufacturer's representative immediately of any defective product. The manufacturer shall have a reasonable opportunity to inspect the goods. The purchaser shall return no product until receipt by purchaser of written shipping instructions from the manufacturer.

C. All manufacturers must submit samples in accordance with this specification.

D. The architect will impound the above samples of the successful manufacturer or owner to ensure that material delivered to the jobsite conforms in every respect to the samples submitted.

2.02 MATERIALS

A. It is the intent of this specification to provide a high-quality wood cabinet specifically designed for the lab environment.

B. Hardwood shall be kiln-dried, clear, and free of defects and shall meet surface requirements as specified below.

C. Plywood shall be of balanced construction and 3/4" 7-ply veneer core hardwood plywood for shelves, cabinet ends, tops and bottoms of base and tall cabinets; 1" 9-ply veneer core hardwood plywood for shelves over 36", bottoms of wall and upper cabinets, and tops of wall, upper and tall cabinets; nominal 1/2" 9-ply veneer core plywood for drawer body; 3/4" 3-ply particleboard core plywood for cabinet doors and drawer heads. Plywood shall meet the standards of ANSI/HPVA HP-1-2009.

D. Casework parts shall be as defined in AWI Quality Standards, 8th Edition, 400-G-3.

E. Exposed surfaces shall be of plain-sliced, HPVA Grade A Northern Red Oak veneers and compatible clear, defect-free Red Oak hardwood lumber. Veneers shall be selected for golden wheat color and narrow hearts of no more than 5". No split hearts are allowed. Appalachian and Southern red oak veneers are not allowed.

F. Semi-exposed surfaces shall be plain sliced, HPVA Grade 1 Northern Red Oak veneers and compatible clear, defect-free Red Oak hardwood lumber. Appalachian and Southern red oak veneers are not allowed.

G. Concealed surfaces shall be no less than HPVA Grade D face or Grade 3 back veneers and compatible mill option, hardwood lumber, suitable for the application.

H. Edging for cabinet parts shall be 3 mm hardwood edging of compatible hardwood Red Oak.

I. Hardboard shall be 1/4” thick 55 lb. density hardwood chip fiberboard formed with heat and pressure into sheets providing a hard, smooth surface.

J. Glass used for framed sliding and swinging doors shall be 3/16" tempered glass. Glass used for unframed sliding doors, shall be 1/4" tempered glass.

K. Drawer and door pulls shall be satin finish, zinc coated wire type, 96 mm centers, offering a comfortable hand grip, and be securely fastened to doors and drawers. Two pulls shall be required on all drawers over 24" long.

L. Hinges shall be BHMA Grade 1 of stainless steel, five (5) knuckle institutional, .083" thick, offset type for all swinging doors. Hinges shall be 2-1/2” long, one (1) pair for doors under 4 ft. in height and 1-1/2 pair on doors over 4 ft. in height. Hinges are mounted with flathead screws, so applied to door and cabinet to withstand a weight load of 150 lbs. minimum.

M. Locks when shown or called for shall be a National Lock, 5-disc tumbler with heavy duty interchangeable cylinder. Exposed lock noses shall be dull nickel (satin). Locks shall

have capacity for 200 primary key changes. Master key one level with the potential of 200 different, non-interchangeable master key groups.

N. Roller catches shall be used on swinging doors. Catches shall have two spring-loaded polyethylene rollers and metal catch to secure doors. Double doors without locks shall have a catch on each door. Full height cases shall have 3-point latching devices. Magnetic catches are not allowed.

O. Leg shoes shall be provided on all table legs, unless otherwise specified, to conceal leveling device. Shoes shall be 2-1/2" high and made of pliable, black rubber material. Use of a leg shoe, which does not conceal leveling device, will not be acceptable.

P. Floor glides, where specified for movable open-leg tables, shall be a non-skid material at least 1" diameter to prevent indenting composition flooring and shall have at least a 5/8" height adjustment. Use of metal buttons will not be acceptable.

Q. Dowels used to join frames and panels shall be fluted hardwood not less than 8 mm in diameter. Dowels shall be spaced at a maximum of 64mm on center.

R. Shelf support clips shall be “seismic” twin pin type for mounting on interior of cabinet work. Clips shall be corrosion resistant and shall retain shelves from accidental removal. Shelves in all cabinets are adjustable on 32mm centers. Single pin support clips and surface mounted metal support strips and clips are not acceptable.

S. Base molding and stainless-steel corner clips shall be provided by others.

T. Upright rods, cross rods and ring support rods, where specified, shall be aluminum (1/2" or 3/4" dia., as required). Rod sockets shall be aluminum, secured through tabletops with

lock nut and washer. Rod clamps shall be heavy duty, designed to securely hold rod assembly in any position. Use of wood rod assemblies will not be accepted.

U. Label holders, where shown or called for, shall be stainless steel, brad-attached type with satin finish and designed for 2" x 1" cards.

V. Number plates, where shown or called for, shall be brass brad-attached type with satin finish and indented black lettering.

W. Sink supports, where required, shall be of a cradle type consisting of two 1-1/2” x 3/4” horizontal cleats and adjustable leveling bolts or glides. The horizontal cleats shall be supported by two 1/8” x 1-1/2” angle irons attached to the cabinet end panels.

2.03 CONSTRUCTION

A. Open-leg Tables: Legs shall be Red Oak hardwood construction, 2-1/4" square with 1/4” radius on all corners. Legs shall be secured to the apron frame by a heavy-duty corner bolt and a 13-gauge steel corner brace. Corner braces shall be locked into apron rails by accurately located grooves and shall be securely fastened with screws. All apron rails shall be 13/16" thick solid Red Oak. Top shall be attached using zinc coated screws through pocket holes in the apron. Leg stretchers, where required, shall be 7/8" x 2-1/2", secured with a 4" long through-bolt.

B. Base Cabinets shall consist of the following minimum construction:

1. Joinery must meet AWI Premium Grade requirements and these specifications.

2. End panels shall be multiple doweled and glued to top frame members, intermediate rails, and bottoms. Dowel spacing shall be a maximum of 64mm on center.

3. Cabinet bottoms shall be multiple doweled and glued to end panels. Dowel spacing shall be a maximum of 64mm on center.

4. Toe space shall be 4” high and fully enclosed. Toe space shall be attached with a minimum of 4 dowels and shall also be mechanically fastened to each end panel with screw fasteners.

5. Edging shall be provided on the front edges of ends, tops, bottoms, and shelves, and on all four edges of door and drawer fronts.

6. Cabinet top shall be composed of a single full sub-top composed of 3/4” veneer core plywood that has been doweled and glued to all end panels. A cutout in the top shall be provided in order to provide for ease of installation and leveling of tops.

7. Intermediate rails (3/4” x 2-1/2” hardwood per parts definition) shall be multiple doweled and glued to end panels at the front of the cabinet between drawers and between drawers and doors.

8. Screw strips (3/4” by 4” veneer core hardwood plywood) shall be located at the top and bottom behind the cabinet back and multiple doweled to the cabinet ends.

9. Hardboard cabinet backs shall be fully captured and dadoed into end panels and bottoms, with full perimeter gluing around the rear of the back. Where a removable back is indicated, it shall be an additional piece applied to cover an opening that is added to the fully captured back. (Backs are to meet the visual requirement of cabinet parts.)

10. Shelves shall be 3/4” thick in cabinets up to 36” wide, 1” thick in all cabinets over 36” wide. (Front edges of shelves are to meet the visual requirement of cabinet parts.)

11. Drawer box shall be four-sided (sub-front, sides and back), each panel made of nominal 1/2” thick, 9-ply Baltic Birch plywood and joined to adjacent panels by full glue and multiple dovetail joinery all four corners.

12. Drawer bottom (1/4” on drawers under 42” wide, 1/2" on larger drawers) shall be white faced hardboard (appearance to meet visual appearance of drawer box), dadoed into all four (4) drawer box sides with full perimeter gluing on the underside.

13. Door and drawer heads shall be 3/4" thick plywood with edging as specified to resist warping. Reveals shall be 1/8” vertically and 1/4” horizontally between door and drawer heads and 7/16” on end panels. Face veneers shall be vertically grain matched.

14. Drawer slides shall be easily removable with a 100 lb. dynamic load rating and nylon roller bearings, powder coated surfaces, self-closing and with a hold-open feature. Slides shall be attached to the drawer box both from below and the side. File drawers shall be full extension, 150 lb. dynamic load rating mounted to the drawer sides.

C. Full Height Sliding Door Cases:

1. Shall be designed and constructed for full enclosure to assure dust proofing of the interior.

2. Tops shall be 1" thick plywood, multiple doweled into end panels, secured with glue.

3. A double extruded aluminum track shall be attached to the case top for suspension system when sliding doors are called for. Doors shall be suspended from an adjustable hanger and glide on nylon roller wheels. An aluminum U-channel is located on the case bottom to guide the bottom of the doors.

4. Solid panel doors shall be 3/4" thick plywood with edging as specified.

5. Glazed doors shall have 2-3/4" x 7/8" thick framing, mortised, tenoned, and glued. Glass shall be set into door frame and secured with a plastic retainer.

6. Doors shall be removable without use of tools, and so designed to prevent by-passing.

7. Shelves shall be 3/4" thick in cabinets up to 36” wide, 1” thick in all cabinets over 36” wide.

8. To assure a rigid case, the center shelf is structurally joined to the end panels and glued.

9. Case bottoms shall be 3/4" thick plywood, multiple doweled and glued securely to end panels.

10. A 3” full width strip shall be doweled and mechanically fastened into the side panels of the cabinet at both top and bottom of the back and used for attaching the cabinet to wall.

11. Toe space, 2-1/4” deep x 4” high, shall be totally enclosed by a 3/4" x 4" plywood rail.

12. Backs in open and glazed door cases shall be 1/4" plywood; backs not exposed to view shall be 1/4" high-density fiberboard.

13. Case interior shall be flush.

D. Full Height Swinging Door Cases: General construction features shall be the same as for sliding door cases except for the following:

1. Doors shall overlap opening on all four sides.

2. A 3” full width strip shall be doweled and mechanically fastened into the side panels of the cabinet at both top and bottom of the back and used for attaching cabinet to wall.

3. Hardwood door rails shall be mitered at corners.

4. Astragal applied to left hand door shall provide further dust proofing.

E. Wall-Hung Sliding Door Cases: General construction features shall be the same as for full height type cases with the following exception:

1. A 3” full width strip shall be doweled and mechanically fastened into the side panels of the cabinet at both top and bottom of the back and used for attaching the cabinet to wall.

2. Case bottoms shall be 1” thick plywood, multiple doweled and glued securely to end panels.

F. Wall Hung Swinging Door Cases: Construction and materials shall be the same as for sliding door cases with the following exceptions:

1. Panel or glass framed doors shall be hung on 1 pair of offset institutional type hinges under 48" in height. Doors on cases 48" high shall have 1-1/2 pair of offset institutional type hinges.

2. All doors shall overlap opening four sides.

3. A 3” full width strip shall be doweled and mechanically fastened into the side panels of the cabinet at both top and bottom of the back and used for attaching the cabinet to wall.

4. Glass doors shall use mitered corners for the hardwood stiles and rails.

5. Astragal applied to left hand door shall provide further dust proofing.

2.04 FINISH AND PERFORMANCE REQUIREMENTS

A. Wood Surface Preparation: Prior to application of the wood finish, case and cabinet surfaces shall be smoothly sanded to remove loose fibers, scratch marks and abrasions, with all dust thoroughly removed by compressed air. Finish shall be applied to cabinet parts prior to assembly in order to assure uniform coverage.

B. Wood Stain Color: Selected from Manufacturer’s standard selection.

C. Wood Finish Application: Finishes shall be applied and cured under controlled atmospheric conditions, aided by infrared radiant heaters. Finish must be VOC-free. Finish shall be applied via a flat line, roller applied system prior to cabinet assembly in order to assure uniform coverage.

D. Interior Wood Casework Finish: Interior surfaces shall receive a triple application of an acid, alkali, solvent, water, and abrasion resistant finish meeting AWI requirements.

E. Exterior Wood Casework Finish: Exposed exterior surfaces, including interiors of glazed cases and open shelving, shall be provided with an acid, alkali, solvent, water, and abrasion resistant finish meeting both AWI section 1500 and SEFA 8 requirements. Finish shall be applied to cabinet parts prior to assembly in order to assure uniform coverage.

2.05 WORKSURFACES

A. SOLID EPOXY RESIN:

1. Sheets cast from modified 1” epoxy resin and non-asbestos inert fillers; compounded mixture cured and thermoset specifically from formulation to provide exceptional physical and chemical resistance required in medium to heavy duty laboratory environments. Color shall be black.

B. ACCESSORIES:

1. Provide solid epoxy resin laboratory shelving, laboratory fume hood base work surfaces, pegboards, and reagent racks where indicated.

2. Installation Materials: Manufacturer's joint adhesive, panel adhesive, and sealants as required to suit project conditions.

C. FABRICATION:

1. Fabricate tops and accessories in accordance with manufacturer's recommendations, approved Shop Drawings, and SEFA 8.

2. Epoxy Resin Worksurfaces:

a. Thickness:

1) 1 inch (25 mm) unless otherwise indicated

a) Check each sheet at factory for required thickness

b) Maximum variation in thickness: plus or minus 1/16 inch (1.6mm) from corner to corner

b. Warpage:

1) Inspect tops for warpage prior to fabrication by placing on true flat surface

a) Maximum allowable warpage: 1/16-inch (1.5 mm) in 36-inch (900 mm) span or 3/16-inch (4.5 mm) in 96-inch (2400 mm) span

c. Fabrication:

1) Shop fabricates in longest practical lengths

a) Bond joints with highly chemical resistant cement with properties and color similar to base material

b) Provide 1/8-inch (3 mm) drip groove at underside of exposed edges, set back 1/2 inch (13 mm) from face

c) Finish exposed edges

d. Edge treatment:

1) Standard 1/8 inch (2 mm) chamfered edge

e. Corner treatment:

1) Exposed corners shall be eased slightly for safety

f. Back and end splashes:

1) Supplied loose for field installation
2) Same material and thickness as worksurfaces
3) 4 inches high unless otherwise indicated
4) Top-mounted end splash where worksurfaces abut adjacent construction and locations indicated on Drawings

g. Joints:

1) Maximum 1/8 inch (2 mm), bonded with epoxy grout
2) Make joints between two benches level
3) Locate joints away from sinks and over or near supports

h. Sink cutouts:

1) Routed for drop-in sink

i. Allowable tolerances:

1) Square

a) Plus, or Minus 1/64 inch (0.4 mm) for each 12 inches (300 mm) of length

2) Location of cutouts and drilled openings

a) Plus, or Minus 1/8 inch (3 mm) of design dimension

3) Size of cutouts and drilled openings

a) Plus 1/8 inch (3 mm) or minus 0 inches (0 mm)

3. Epoxy Resin Sinks:

a. Mold sinks from thermosetting epoxy resin
b. Mold interior corners to radius and slope sink base to drain outlet

1) Provide 1-1/2 inch (38 mm) outlet with open ended standpipe

a) Standpipe overflow 2 inches (50 mm) shorter than depth of sink

c. Unless otherwise indicated fabricate sinks of drop-in design supported by upper flange from worksurface:

1) Color

a) Match adjacent worksurface

2.06 SERVICE FITTINGS AND ACCESSORIES

A. MATERIALS:

1. Laboratory Service Fittings: Service fittings shall be laboratory grade, and water faucets and valve bodies shall be cast red brass alloy or bronze forgings, with a minimum content of 85%. All fittings shall be chromium plated unless specified otherwise.

2. Plastic Coated Finish (Sepia Bronze): When specified, laboratory service fittings shall have an acid resistant plastic coating applied over a fine sand-blasted surface. Surfaces shall be sprayed and baked three times with a minimum thickness of .0005 to .0010 mils. (See Performance Ratings).

3. Service Indexes: Fittings shall be identified with service indexes in the following color coding:

Hot Water ...	Red
Cold Water	Dark Green
Gas..... .	Dark Blue
Air..... .	Orange
Vacuum	Yellow
Distilled Water….	White
Steam..... .	Black
Nitrogen..... .	Brown
Oxygen..... .	Light Green
Hydrogen..... .	Pink
Special Gases….	Light Blue

B. CONSTRUCTION:

1. Water Fittings: Water fittings shall be provided with a renewable unit containing all operating parts which are subject to wear. The renewable unit shall contain an integral volume control device, and all faucets shall be capable of being readily converted from compression to self-closing, without disturbing the faucet body properly. Four (4) arm forged brass handles shall contain plastic screw-on type colored service index buttons.

2. Steam Fittings: Steam fittings shall have a black, heat-resistant composition handle, and shall be the heavy pattern design with stainless steel removable seat and flat Teflon seat disc.
They shall have Teflon impregnated packing and shall be so constructed that they can be repacked under pressure.

3. Distilled Water Fittings: Distilled water fittings shall be chromium plated cast bronze with tin lined interior and self-closing type or shall be made of aluminum and not be the self-closing type. Handles shall be furnished with tamper-proof and vandal resistant service indexes.

4. Laboratory Ball Valves: Laboratory ball valves shall have a forged brass valve body with a non-removable serrated hose end and a forged brass lever-type handle with a full view color-coded index button. Valves shall have a floating chrome plated brass ball and molded TFE seals. Valves shall be certified by CSA International for use with natural gas under ANSI Z21.15./CGA9.1

5. Needle Valve Hose Cocks: Needle type valves shall have a stainless steel replaceable floating cone, precision finished and self-centering. Cone locates against a stainless-steel seat, easily removable and replaced with a socket wrench. Valve shall have "TEFLON" impregnated packing and designed so unit can be repacked while under pressure.

6. Gooseneck Type Outlets: Gooseneck outlets shall have a separate brazed coupling to provide a full thread attachment of anti-splash, serrated tip or filter pump fittings.

7. Remote Control Valves: All valves for remote control use shall be as previously specified, but shall be complete with aluminum extension rods, escutcheon plates, brass forged handles and screw-on type colored service index button.

8. Tank Nipples: Tank nipples shall be provided with locking nut and washer for all fixtures where fittings are anchored to equipment.

9. Sink Outlets: Unless otherwise specified, sink outlets for other than stainless steel sinks shall be sin, with integral cross bars, tapered for overflow and be complete with gasket and lock nut with 1-1/2" I.P.S. male straight thread outlet. Overflows shall not be furnished for sink outlets unless specifically called for.

10. Crumb Cup Strainers: Crumb cup strainers shall be stainless steel or chromium plated brass, as specified, and shall be furnished for stainless steel sinks, and be complete with gasket, lock nut and 4" long unthreaded tailpiece outlet in 1-1/2" size.

11. Vacuum Breakers: Vacuum breakers where required shall be "Nidel" or "Watts" unless otherwise specified or identified to be an integral part of the water fixture assembly.

12. Aerator Outlets: Aerator type outlets shall be furnished for all gooseneck water faucets not furnished with serrated hose connectors.

13. Waste Lines: Waste lines shall be furnished by other trades.

14. Traps: Traps shall be furnished by other trades.

15. Electrical Fittings: Electrical fittings shall contain 20 Amp., 125 Volt AC, 3-wire polarized grounded receptacles, unless otherwise specified. Pedestal and line-type boxes shall be of aluminum, metallic finish with stainless steel flush plates. Receptacle boxes shall be of plated steel. All electrical or conduit fittings called for or to be furnished under these specifications shall meet the requirements of the National Electrical Code.

C. PERFORMANCE:

1. Maximum Line Pressures:
   Laboratory Ball Valves (Gas and Air) …75 PSI
   Needle Point Cocks (Gas and Air). 65 PSI
   Vacuum 28.5" Mercury
   Hot and Cold Water 80 PSI
   Steam 30 PSI

2. Sepia Bronze Finish Performance: Finish shall show no rupture, other than a slight discoloration or possible softening when subjected to the following fumes for approximately six (6) days: Plastic coated fittings shall be suspended in a container, 6 cu. ft. capacity 12" above open beakers, each containing 199 cc. of 70% Nitric

Acid, 94% Sulphuric Acid, 37-38% Hydrochloric Acid, respectively. Finish shall also withstand direct contact of reagents dropped from a burette at a rate of 60 drops/min. for a period of 10 minutes. Chemicals are shown below:

Concentrated Hydrochloric Acid 37-38%*
Concentrated Nitric Acid 70%*
Concentrated Sulphuric Acid 94%
Glacial Acetic Acid 99.5%*
Ethyl and Other Alcohols
Toluene and Other Hydrocarbons
Carbon - Tetrachloride Mineral Oil

*Percentages are by weight.

2.07 TECHNICAL PRODUCTS

A. 80032 Sheldon Unimix Combination Hot & Cold Water Fixture

1. UNIMIX COMBINATION HOT AND COLD WATER VANDALGARD FIXTURE - (Specifically designed to provide extra protection against student vandalism). Water fitting shall have the main body cast in one (1) piece of 5A-ASTM-30 brass. Tubing shall not be a part of its structure.

2. BODY - Body shall be carefully machined using standard valve seat, composition washer, operating screw-threads and stem for cold or hot water.

3. OPERATING HANDLE - Operating handle shall be of Delrin plastic fitted with cold or hot water index. Entire fixture shall have a beige color, baked plastic coating resistant to cleaning abrasions and reagent fumes. ADA fixtures to be provided with wrist blade handles.

4. FIXTURE - Shall be fitted with a rectangular, Semi-resilient neoprene gasket and serviced from below with tailpieces through the mounting surface, secured with lock nuts. Aerator outlet included.

5. VANDALGARD FITTING FINISH – Matte Black - Powder epoxy coating applied to sandblasted surface of all fixtures.

B. EH-111-72 – Air Foil Fume Hood:

1. Air foil type fume hood: Features shall include a 45-degree angle around the fascia opening, flush-mount radiused air foil across the bottom, upper front panel with louvered air bypass grille for constant volume with vertical sliding sash, and rear upper and lower fixed exhaust baffle, all resulting in minimized turbulence and increased performance for removal of exhaust fumes, vapors, and particulate matter within the enclosure.

2. Superstructure: Provide full frame construction, 16” and 18” gauge steel, rigid, self-supporting assembly with 5” wide, double walls and front posts. Walls consist of a sheet steel outer shell and a corrosion resistant full inner liner, and houses electrical services and remote operating service fixtures. Access to fixture valves is provided

by two removable panels with a PVC gasket. Top of the hood contains a 10” round, 20- gauge stainless steel exhaust duct collar. Hood shall be UL 1805 Classified.

3. Sash frame: Steel frame includes a 16-gauge, 1-1/2” bottom sash rail with a full width pull closing on rubber bumper stops, and 7/32” thick laminated safety glass housed into sash frame and set into PVC glazing channels.

    a. Powder-coated sash frame is raised and lowered with a counterbalance system consisting of a single weight, 2” pulleys, and cable that prevents sash tilting by means of a shaft driven mechanism. This permits one finger operation at any point along full width of pull. Sash cable is 7 x 7 steel, 1/8” diameter, coated to 5/32” dia.

    b. The powder-coated, flush-mount, bottom horizontal air foil shall provide a 1” bypass to ensure a clean sweep of air to minimize eddies along the work surface when sash is in the closed position.

4. Standard features of the hood shall include:

    a. Black powder coat finish, white 3/16” Poly Resin liner and baffles, T-8 rapid start fluorescent light fixture with two (2) lamps, 1-1/4” thick, black Shelresin, molded, dished, epoxy resin work surface, base cabinet, kneespace frame, and removable access panel.

    b. Superstructure shall be pre-wired and pre-piped by manufacturer.

    c. Service rough-ins and trap not included.

    d. Provide a metal enclosure panel from top of hood to ceiling.

    e. SEFA 1-2010 hood design shall be ADA Compliant with work surface height, kneespace clearance, and access to services.

5. Hood Exhaust Ratings:

    a. 100 FPM recommended face velocity. 1367 CFM exhaust and.34-inch static pressure at 29” sash height. Exhaust duct and blower not included.

6. Source Quality Control Testing of Fume Hoods:

    a. Evaluation of a manufacturer’s proposed product shall take place in their own test facility with no cost to the Owner. Provide third party, independent test reports to Architect for approval.

    b. Fume Hood shall be tested as described in SEFA 1-2010 in accordance with latest edition of ASHRAE 110 method of testing performance of laboratory fume hoods, As Manufactured (AM). Hoods shall achieve a rating of 4.0 AM 0.05 ppm or less.

7. Standard services and accessories included:

    a. Remote control CW downspout
    b. 85101 GFI duplex electrical outlets
    c. 85106 Light switch
    d. 85106 Exhaust blower switch
    e. TS04 Epoxy resin cup sink

PART 3 EXECUTION

3.01 SITE EXAMINATION

A. The owner and/or his representative shall assure all building conditions conducive to the installation of a finished goods product; all critical dimensions and conditions previously checked have been adhered to by other contractors (general, mechanical, electrical, etc.) to assure a quality installation.

B. Site conditions shall be in compliance with AWS Edition 1, Section 2.

3.02 INSTALLATION

A. Installer: Installer shall be certified by the factory as having the necessary skills and equipment to install the casework so as not to void the warranty.

B. Installation shall be to the standards set forth in SEFA 2 -2010 Installation.

C. Preparation: Prior to beginning installation of casework, check and verify that no irregularities exist that would affect quality of execution of work specified.

D. Coordination: Coordinate the work of the Section with the schedule and other requirements of other work being performed in the area at the same time both with regard to mechanical and electrical connections to and in the fume hoods and the general construction work.

E. Performance:

    1. Casework:

        a. Set casework components plumb, square, and straight with no distortion and securely anchor to building structure. Shim as required using concealed shims.

        b. Screw continuous cabinets together with joints flush, tight and uniform, and with alignment of adjacent units within 1/16" tolerance.

        c. Secure wall cabinets to solid supporting material, not to plaster, lath or gypsum board.

        d. Abut top edge surfaces in one true plane. Provide flush joints not to exceed 1/8" between top units.

2. Work surfaces:

   a. Where required due to field conditions, scribe to abutting surfaces.

   b. Only factory prepared field joints, located per approved shop drawings, shall be permitted. Secure the joints in the field, where practical, in the same manner as in the factory.

   c. Secure work surfaces to casework and equipment components with materials and procedures recommended by the manufacturer.

3. Adjust and Clean:

   a. Repair or remove and replace defective work, as directed by owner and/or his representative upon completion of installation.

   b. Adjust doors, drawers and other moving or operating parts to function smoothly.

   c. Clean shop finished casework; touch up as required.

   d. Clean work surfaces and leave them free of all grease and streaks.

   e. Casework to be left broom clean and orderly.

F. Protection:

1. Provide reasonable protective measures to prevent casework and equipment from being exposed to other construction activity.

2. Advise owner and/or his representative of procedures and precautions for protection of material, installed laboratory casework, and fixtures from damage by work of other trades.

END OF SECTION

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SECTION 12490

ROLLER SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manually operated, roll-up fabric interior window shades including mounting and operating hardware to be installed on all exterior windows.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 06100 – Rough Carpentry

B. Section 09255 – Gypsum Board Assemblies

C. Section 09511 – Acoustical Panel Ceilings

1.04 REFERENCES

A. NFPA 701-99 - Fire Tests for Flame-Resistant Textiles and Films, latest edition

B. GREENGUARD Environmental Institute Gold, latest edition

1.05 SUBMITTALS

A. Submit under provisions of Section 01300 – Submittals:

B. Product Data: Manufacturer's data sheets on each product specified, including:

1. Preparation instructions and recommendations

2. Installation and maintenance instructions

3. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions

4. Storage and handling requirements and recommendations

5. Mounting details and installation methods

C. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, and relationship to adjacent work.

D. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings, field verified window dimensions, quantities, type of shade, controls, fabric, and color, and include opening sizes and key to typical mounting details.

1. Selection Samples: For each finish product specified, two complete sets of shade cloth options and aluminum finish color samples representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two complete sets of shade components, unassembled, demonstrating compliance with specified requirements. Shade fabric sample and aluminum finish sample as selected, representing actual product, color, and patterns. Mark face of material to indicate interior faces.

F. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware.

G. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years' experience in manufacturing products comparable to those specified in this section.

B. NFPA Flame-Test: Passes NFPA 701. Materials tested shall be identical to products proposed for use.

C. Mock-Up: Provide a mock-up of one of each type roller shade assembly specified for evaluation of mounting, appearance and accessories.

1. Locate mock-up in window(s) designated by Architect.

2. Do not proceed with remaining work until mock-up is accepted by Architect.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver window shades until building is enclosed and construction within spaces where shades will be installed is substantially complete.

B. Deliver products in manufacturer's original, unopened, undamaged containers with labels intact.

C. Label containers and shades according to Window Shade Schedule.

D. Store products in manufacturer's unopened packaging until ready for installation.

1.08 SEQUENCING

A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.

B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.09 PROJECT CONDITIONS

A. Install roller shades after finish work and ambient temperature, humidity and ventilation conditions are maintained at levels recommended for project upon completion.

1.10 WARRANTY

A. Hardware and Shade Fabric: Draper's standard twenty-five (25) year limited warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer: Draper, Inc., 411 S. Pearl PO Box 425; Spiceland, IN 47385-0425. ASD. Toll Free Tel: 800-238-7999; Tel: 765-987-7999; Fax: 866-637-5611; Web:www.draperinc.com., or equal.

B. Manually Operated Window Shades with Independent Control: Manually operated, vertical roll-up, fabric window shade with components necessary for complete installation; Manual FlexShade as manufactured by Draper, Inc.

1. Operation: Bead chain and clutch operating mechanism allowing shade to stop when chain is released. Designed never to need adjustment or lubrication. Provide limit stops to prevent shade from being raised or lowered too far.

a. Clutch mechanism: Fabricated from high carbon steel and molded fiberglass reinforced polyester or injected molded nylon. White or Black color as selected by Architect

b. Bead chain loop: Stainless steel bead chain hanging at side of window

c. Idler Assembly: Provide roller idler assembly of molded nylon with adjustable or spring-loaded length idler pin to facilitate easy installation, and removal of shade for service

d. Bead Chain Hold Down: P-Clip (standard)

2. Roller Tube: Fabricated from extruded aluminum, galvanized steel, or enameled steel. Diameter, wall thickness, and material selected by manufacturer to accommodate shade type and size. Fabric connected to the roller tube with LSE (low surface energy) double sided adhesive specifically developed to attach coated textiles to metal. Adhesive attachment to eliminate horizontal impressions in fabric.

3. Bottom Slat:

   a. Open pocket elliptical slat: 1" (25mm) aluminum elliptical slat with plastic ends inside of a 1 5/8" (41mm) pocket

4. Mounting:

   a. Mounting brackets
   b. Endcaps and fascia

5. Brackets: Plated stamped steel. Provide size compatible with roller size:

   a. Mounted to jamb

6. Endcaps: Stamped steel with universal design suitable for mounting to ceiling, wall, and jamb. Provide size compatible with roller size.

   a. Endcap covers: To match fascia or headbox color

7. Fascia: L shaped aluminum extrusion to conceal shade roller and hardware.

   a. Attachment: Snaps onto endcaps without requiring exposed fasteners of any kind. Fascia can be mounted continuously across two or more shade bands. No notching is required

   b. Shape: Square Fascia Panel

   c. Finish: Custom powder coat as selected by the Architect

2.02 FABRIC

A. Light-Filtering Fabrics

1. SheerWeave Series SW2400 by Phifer: VOC Emissions: GREENGUARD Gold - certified as a low emitting fabric. Manufacturer to supply GREENGUARD Gold. 500 denier fiberglass, vinyl coated and woven into a 2 x 2 basket weave. Fire rating: NFPA 701. Bacteria and Fungal Resistance: ASTM G 21 and ASTM G 22. Series SW2400, 3 percent open, .019 inches thick

B. Color and pattern: As selected by Architect from manufacturer's standard range

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Coordinate requirements for blocking and structural supports to ensure adequate means for installation of window shades.

B. Coordinate requirements for blocking, construction of shade pockets, and structural supports to ensure adequate means for installation of window shades.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install roller shades level, plumb, square, and true. Allow proper clearances for window operation hardware.

C. Install the following items to conceal roller and operating mechanism. Do not use exposed fasteners.

1. Fascias
2. Closure panels
3. Endcaps

D. Position shades level, plumb, and at proper height relative to adjacent construction. Secure with fasteners recommended by manufacturer.

3.04 TESTING AND DEMONSTRATION

A. Test window shades to verify that interface to other building systems and other operating components are functional. Correct deficiencies.

B. Test window shades to verify that operating mechanism, fabric retainer, and other operating components are functional. Correct deficiencies.

C. Demonstrate operation of shades to Owner's designated representatives.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

3.06 SCHEDULES

A. Refer to Drawings for shade types and locations.

END OF SECTION

SECTION 13121

PREFABRICATED FIBERGLASS ENCLOSURES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials and incidentals to install a complete and operational pre-engineered, prefabricated fiberglass enclosure for the Effluent Sampler Building as shown on the drawings and as specified herein.

B. All necessary and desirable accessory equipment and auxiliaries whether specifically mentioned in this Section or not shall be furnished and installed as required for an installation incorporating the highest standards for this type of service.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTION

A. Sections 01300 - Submittals

1.04 SUBMITTALS

A. Submit copies of all materials required to establish compliance with the specifications in accordance with the provisions of Section 01300, and including the following:

1. Shop Drawings – Indicate assembly dimensions, locations of structural members, connections, attachments, openings, loads and insulation.

2. Indicated anchor bolt sizes and locations.

3. Submit statement showing builders’ experience (reference 1.08 below).

4. Manufacturer's Installation Instructions – Indicate preparation requirements, assembly sequence, and special equipment required.

B. In the event that it is impossible to conform to certain details of the specifications due to different manufacturing techniques, describe completely all non-conforming aspects.

C. Operation and Maintenance Data:

1. Furnish copies of operation and maintenance instructions to the Engineer as provided for in Section 01782, Operation and Maintenance Data.

2. Prepare instructions specifically for this installation and include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

1.05 REFERENCE STANDARDS

A. ASTM International (ASTM), latest edition:

1. ASTM C 518 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat flow Meter Apparatus

2. ASTM D 256 Standard Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics

3. ASTM D 638 Standard Test Methods for Tensile Properties of Plastics

4. ASTM D 732 Standard Test Method for Shear Strength of Plastics by Punch Tool

5. ASTM D 790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

6. ASTM D 792 Standard Test Method for Specific Gravity (Relative Density) and Density of Plastics by Displacement

7. ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics

8. ASTM D 2583 Standard Test Method for Indentation Hardness of Rigid Plastics by means of a Barcol Impressor

9. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

1.06 SYSTEM DESCRIPTION

A. Pre-engineered, prefabricated fiberglass enclosure with interior and exterior resin-fiberglass laminate finish, lockable door with window, and 2-inch foam core insulation.

B. Building Size – 8′W x 8′D x 8′ Tall (sidewall)

C. Roof Slope – 12 to 17 degrees, hip design

D. Enclosure to be supplied complete with switched LED interior light and six (6) waterproof receptacles prewired to a common 120/240V 1P 100 A Panelboard with 100 A Main Breaker.

1.07 DESIGN REQUIREMENTS

A. Thermal resistance of foam core – Minimum insulation R-value of 14.

B. Enclosure to withstand dead load, snow loads, and design loads due to pressure and suction of wind calculated in accordance with the Standard Building Code.

1. Roof live load 20 psf

2. Wind loading 115 mph

C. Enclosure shall include three (3) walls reinforced to support wall mounted equipment over 10 pounds.

1.08 PROJECT RECORD DOCUMENTS:

A. Submit under provisions of Section 01300, Submittals.

1.09 QUALIFICATIONS:

A. Manufacturer – Company specializing in manufacturing the products specified in this section with minimum 10 years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Provide products manufactured by Shelter Works, St. Louis, MO or approved equal.

2.02 MATERIALS

A. Molded composite: Exterior and interior resin-fiberglass laminated with foam core.

1. Laminated: Polyester resin and chopped strand fiberglass; minimum glass content of 25 percent (25%)

a. Exterior surface: White gel coat with low luster finish, smooth and free from fiber pattern, roughness, or other irregularities

b. Exterior laminate: 1/8-inch thick, minimum, chemically bonded to gel coat. Interior laminate to be 1/8-inch thick, minimum

c. Interior laminate: White color, encapsulate core in place.

d.	Tensile Strength (ASTM D 638)	16,000 (psi)
e.	Flexural Strength (ASTM D 790)	33,700 (psi)
f.	Flexural Modulus (ASTM D 790)	1,160,000 (psi)
g.	Tensile Modulus (ASTM D 638)	1,300,000 (psi)
h.	Barcol Hardness	45
i.	Izod Impact – Notched ((ft.-lbs)/in)	16.30
j.	Izod Impact – Unnotched ((ft.-lbs)/in)	21.79

2. Foam Insulation Core.

a. Rigid closed cell, polyisocyanurate foam with a density of 1.5 to 1.9 pounds per cubic foot. 2-inch thick with a minimum insulating value of R 14.

b.	Flame Spread (ASTM E 84)	<75
c.	Smoke Development (ASTM E 84)	<450

2.03 COMPONENTS

A. Door: One-piece, resin transfer molded (RTM) in matched metal molds to produce an industrial quality door, which exhibits a smooth finished, seamless, monolithic, warp-free composite consisting of a gelcoat, fiberglass reinforcement, polyester resin, insulating core, and internal reinforcements with all mortises, openings, recesses, and pockets molded in place.

1. Double door shall be 6’-0” wide by 6’-8” high and include a ½” tall low-profile aluminum threshold

2. Both doors shall include a nominal 15” by 15” tempered safety glass window. Window shall be fixed (non-opening)

3. Mount door with continuous stainless-steel hinge or three (3) separate hinges

4. Door gasket: Neoprene or EPDM sponge rubber bulb type gasket with flexible lock to retain permanent grip

B. Latch:

1. Provide single-point keyed stainless steel cylindrical latch and hydraulic closer.

2. Provide doors with stainless steel panic hardware.

C. Base Mounting Flange Gasket: 1/4-inch thick by 4 inches wide closed cell neoprene or buytyl sponge rubber or to provide weather tight seal around the building perimeter.

D. Lifting Eye Bolts: Providing 3/4-inch stainless steel eyebolts in roof or at the corners.

2.04 ACCESSORIES

A. Lamp: LED providing an average of 50 lumens per square foot

B. Lamp switch: Interior weatherproof switch

C. Receptacles: Six (6) Duplex GFCI outlets

D. Electrical wiring in Schedule 40 PVC conduit

E. Ventilation: Thermostatically controlled exhaust Fan with gravity louver, insect screen, and weather-tight fiberglass hood. An intake louver sized to match the exhaust fan shall also be provided.

F. Heat: Thermostatically controlled, wall mounted 240 V 1P electric heater. 2 Kw minimum capacity

2.05 FINISHES

A. Color shall be selected by the Owner based on samples provided by the Manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that concrete is level and true to plane and of correct dimensions to receive structure. Correct any deficiencies before proceeding.

3.02 INSTALLATION

A. Layout anchor bolt pattern according to drawings. Drill holes of depth and diameter required by anchor bolt manufacturers.

B. Install structure in accordance with manufacturer’s instructions.

C. Erect structures true to line and plumb, free of twist and warp.

D. Install and test accessories in accordance with manufacturer’s instructions.

E. Caulk and seal the wall-to-floor seam and all penetrations.

3.03 ADJUST AND CLEAN

A. Adjust components for proper operation.

B. Leave project site clean and free of debris.

END OF SECTION

SECTION 13125

METAL BUILDING SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes two (2) new single-story, single-span, rigid-frame-type pre-engineered metal buildings of the nominal length, width, eave height, and roof pitch indicated.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Division 3 – Concrete

B. Division 4 – Masonry

C. Section 05500 – Miscellaneous Metal

D. Division 7 – Thermal and Moisture Protection

E. Section 08410 – Aluminum Doors, Windows, and Frames

F. Section 08710 – Door Hardware

G. Section 08800 – Glazing

H. Division 9 – Finishes

I. Section 10522 – Fire Extinguishers, Cabinets and Accessories

J. Section 15051 – Piping – General Requirements

1.04 REFERENCE STANDARDS

A. ASTM International (ASTM), latest edition:

1. ASTM A36 Standard Specification for Carbon Structural Steel

2. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

3. ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile

4. ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength **(Withdrawn 2016, Replaced with ASTM F3125)**

5. ASTM A366 Standard Specification for Commercial Steel (CS) Sheet, Carbon (0.15 Maximum Percent) Cold-Rolled **(Withdrawn 2000, Replaced with ASTM 1008)**

6. ASTM A500 Standard Specification for cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

7. ASTM A501 Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

8. ASTM A529 Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality

9. ASTM A569 Standard Specification of Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial **(Withdrawn 2000, Replaced with ASTM 1011)**

10. ASTM A570 Standard Specification for Structural Steel, Sheet and Strip, Carbon, Hot-Rolled **(Withdrawn 2000, Replaced with ASTM 1011)**

11. ASTM A572 Standard Specification for High-Strength Low-Alloy Columblum-Vanadlum Structural Steel

12. ASTM A607 Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Columblum or Vanadlum, or Both, Hot-Rolled and Cold-Rolled (**Withdrawn 2000, Replaced with ASTM A1011)**

13. ASTM A1008 Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable **(Replaced ASTM A 366)**

14. ASTM A1011 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength **(Replaced ASTM A 569, ASTM A 570, and ASTM A607)**

15. ASTM F3125 Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength **(Replaced ASTM A325)**

B. Metal Building Manufacturers Association (MBMA), latest edition:

1. Design Practices Manual

C. American Institute of Steel Construction (AISC), latest edition:

1. Manual of Steel Construction

D. American Iron and Steel Institute (AISI), latest edition:

1. Cold Formed Steel Design Manual
2. Light Gage Cold-Formed Steel Design Manual

E. American Welding Society (AWS), latest edition:

1. Structural Welding Code – Steel

F. International Code Council (ICC), latest locally adopted edition:

1. International Building Code

G. Underwriters Laboritory (UL), latest edition:

1. UL 580

H. The Society for Protective Coatings (SSPC), latest edition

1. SSPC SP3
2. SSPC Paint

1.05 DEFINITIONS

A. Building Width -- Measured from outside to outside of sidewall girts.

B. Building Length -- Measured from outside to outside of endwall girts.

C. Building Line -- Outside face of horizontal steel girt.

D. Building Eave Height -- Measured from the intersection of the top of the roof framing and the outside of the wall framing to the bottom of the sidewall column base plate.

E. Bay Spacing -- Measured from centerline to centerline of primary frames for interior bays and from centerline of the first interior frame to outside of endwall girts for endbays.

F. Roof Pitch -- The ratio of the vertical rise to the horizontal run.

1.06 SUBMITTALS

A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.

B. Product data consisting of metal building system manufacturer's product information for building components and accessories.

C. Shop drawings for metal building structural framing system, siding and roofing panels, and other metal building system components and accessories that are not fully detailed or dimensioned in manufacturer's product data.

1. Structural Framing: Furnish complete fabrication and erection drawings prepared by or under the supervision of a Professional Engineer legally authorized to practice in the state of Arkansas and bearing his/her seal and signature. Include details showing fabrication and assembly of the metal building system. Show anchor bolts settings and sidewall, endwall, and roof framing as well as wind bearing and purlin bracing provisions. Include transverse cross-sections. Submit anchor bolt layout plan showing which condition is used at each column.

2. Foundation loads: Submit foundation loads to the Engineer for review prior to installation of footings.

3. Building Accessory Components: Provide details of metal building accessory components to clearly indicate methods of installation including the following:

1. Sheet Metal Accessories: Provide layouts at 1/4" per foot scale. Provide details of ventilators, louvers, gutters, downspouts, and other sheet metal accessories at not less than 1-1/2" per foot scale showing profiles, methods of joining, and anchorages.

D. Samples for selection purposes in form of manufacturer's color charts or chips showing full range of colors, textures, and patterns available for metal roofing with factory-applied finishes.

E. Professional Engineer's certificate prepared and signed by a Professional Engineer, legally authorized to practice in the state of Arkansas, verifying that the structural framing and covering panels meet indicated loading requirements and codes of authorities having jurisdiction.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer to erect the pre-engineered metal building who has specialized in the erection and installation of types of metal buildings systems similar to that required for this project and who is certified in writing by the metal building system manufacturer as qualified for erection of the manufacturer's products.

B. Manufacturer's Qualifications: Provide pre-engineered metal buildings manufactured by a firm experienced in manufacturing metal buildings systems that are similar to those indicated for this project and have a record of successful in-service performance using new, unused materials, free from defect and of American manufacturers.

C. Single-Source Responsibility: Obtain the metal building system components, including structural framing, and accessory components, from one source from a single manufacturer.

D. Design Criteria: The drawings indicate size, profiles, and dimensional requirements of the pre-engineered metal buildings and are based on the specific type and model indicated. Metal building systems having equal characteristics by other manufacturers may be considered provided that deviations in dimensions and profiles are minor and do not change the design concept or intended performance as judged by the Engineer. The burden of proof of equality is on the proposer.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver prefabricated components, sheets, panels, and other manufactured items so they will not be damaged or deformed. Package panels for protection against transportation damage.

B. Handling: Exercise care in unloading, storing, and erecting roof covering panels to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering. Store metal panels so that water accumulations will drain freely. Do not store panels in contact with other materials that might cause staining, denting or other surface damage.

PART 2 PRODUCTS

2.01 SYSTEM PERFORMANCE REQUIREMENTS

A. General: Engineer, design, fabricate and erect the pre-engineered metal building system to withstand loads from winds, gravity, seismic, structural movement including movement thermally induced, and to resist in-service use conditions that the building will experience, including exposure to the weather, without failure. Calculations shall be submitted with shop drawings. All shop drawings and calculations shall be sealed by a Professional Engineer registered in the state of Arkansas and employed by the Contractor.

B. Design Standard and Criteria: Design each member to withstand stresses resulting from combinations of loads that produce the maximum allowable stresses in that member as described in the following standards and criteria. The most recent issue shall be used where applicable in the structural design of the building covered by this specification.

1. “Design Practices Manual”, Metal Building Manufacturers Association

2. “Manual of Steel Construction”, American Institute of Steel Construction

3. “Cold Formed Steel Design Manual”, American Iron and Steel Institute

4. “Structural Welding Code – Steel”, American Welding Society

5. International Building Code as amended by the state of Arkansas

6. Light gage Cold – Formed Steel Design Manual, American Iron and Steel Institute

C. Design Loads: Basic design loads and collateral loads are indicated on the drawings.

1. Basic design loads include live load, wind load, and seismic load, in addition to the dead load.

2. Collateral loads include additional dead loads over and above the weight of the metal building system such as sprinkler systems and roof-mounted mechanical systems.

3. The building shall be designed for the load combinations as set forth in the International Building Code.

4. Design roof live load shall be 20 psf with no load reductions allowed for any member. Dead loads and special loads shall be as shown on the Drawings.

5. Design wind loading shall be in accordance with the International Building Code. Comply with UL 580 for Class 90.

6. Design earthquake loading shall be for Zone 1, using the seismic design data shown on the Drawings.

7. The roof panels do not have adequate diaphragm strength to provide lateral support for the roof purlins or to transfer wind or seismic forces to the structure. The roof purlins and their bracing system shall be designed accordingly.

8. Deflection limits (For the design live, wind and seismic loads listed above).

a. Roof Frames – L/240
b. Roof Purlins – L/240
c. Girts – L/240
d. Roof Panels – L/240

2.02 MATERIALS (GENERAL)

A. Hot-Rolled Structural Steel Shapes: Comply with ASTM A36 or ASTM A529.

B. Steel Tubing or Pipe: Comply with ASTM A500 Grade B, ASTM A501, or ASTM A53, Type E or S, Grade B.

C. Steel Members Fabricated from Plate or Bar Stock: Provide 42,000 psi minimum yield strength. Comply with ASTM A529, ASTM A570, or ASTM A572.

D. Steel Members Fabricated by Cold Forming: Comply with ASTM A607 Grade 50.

E. Cold-Rolled Carbon Steel Sheet: Comply with requirements of ASTM A366 or ASTM A568.

F. Hot-Rolled Carbon Steel Sheet: Comply with requirements of ASTM A568 or ASTM A569.

G. Bolts for Structural Framing: Comply with ASTM A307 or ASTM A325 as necessary for design loads and connection details.

H. Electrodes for Welding: Comply with AWS Code.

I. Non-Shrink Grout: Master Builders Co., Masterflow 713, or equal.

J. Mastic: Non-staining saturated vinyl polymer as recommended by panel manufacturer for sealing laps.

K. Shop Primer for Ferrous Metal: Fast-curing, lead-free, universal primer, selected by the manufacturer for resistance to normal atmospheric corrosion, compatibility with finish paint systems, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

L. Shop Primer for Galvanized Metal Surfaces: Zinc dust-zinc oxide primer selected by the manufacturer for compatibility with substrate.

2.03 STRUCTURAL FRAMING

A. Rigid Frames: Fabricate from hot-rolled structural steel shapes. Provide factory-welded, shop-painted, built-up "I-beam"-shape or open-web-type frames consisting of tapered or parallel flange beams and tapered or straight columns. Furnish frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide length of span and spacing of frames indicated.

B. Primary Endwall Framing: Provide primary endwall framing members fabricated for field-bolted assembly.

1. Endwall Beams and Columns: Manufacturer's standard shop-painted, built-up factory-welded "I"-shape.

C. Secondary Framing: Provide the following secondary framing members:

1. Roof Purlins, Sidewall and Endwall Girts: "C"-or "Z"-shaped sections fabricated from min. 16 ga. shop-painted roll-formed steel. Purlin spacers shall be fabricated from min. 14 ga. cold-formed galvanized steel sections with a min. yield of 50,000 psi.

2. Eave Struts: Unequal flange "C"-shaped sections formed to provide adequate backup for both wall and roof panels. Fabricate from min. 14 ga. shop-painted roll-formed steel with a min. yield of 50,000 psi.

3. Flange Bracing: Angle members fabricated from min. 16 ga. shop-painted roll-formed steel. The compression flange of all frames shall be braced laterally so that the allowable compressive stress is adequate for the design load combinations.

4. Base or Sill Angles: Fabricate from min. 14 ga. cold-formed galvanized steel sections.

5. Secondary endwall structural members, except columns and beams, shall be the manufacturer's standard sections fabricated from min. 14 ga. cold-formed galvanized steel.

D. Wind Bracing: Provide adjustable wind bracing using threaded steel rods; comply with ASTM A36 or ASTM A572, Grade D. Locate bracing only where indicated.

E. Bolts: Provide shop-painted bolts except when structural framing components are in direct contact with roofing panels. Provide zinc-plated or cadmium-plated bolts when structural framing components are in direct contact with roofing panels.

F. Shop Painting: Clean surfaces to be primed of loose mill scale, rust, dirt, oil, grease, and other matter precluding paint bond. Follow procedures of SSPC-SP3 for power-tool cleaning.

1. Prime structural steel primary and secondary framing members with the manufacturer's standard rust-inhibitive primer.

2.04 METAL WALL PANELS

A. Architectural Metal Wall Panels: See Section 07410 Architectural Metal Wall Panels.

2.05 THERMAL INSULATION FOR FIELD-ASSEMBLED METAL PANELS

A. Metal Building Insulation: See Section 07213 Pre-Engineered Building Insulation.

2.06 METAL ROOF PANELS

A. Metal Roof Panels: Pinnacle D-Lok or SBI TSS-324, or equal. 24” wide panel with 3” high trapezoidal ribs, mechanically seamed, concealed fastener roof system.

1. Finish: Kynar 500.
2. Thickness: 24 ga.
3. Length: Up to 50 ft.

B. Closure shall be fabricated from die cast metal at all ridge and high eave transitions using tape sealant, fasteners, and 16 ga. performance backer plate for compression joint as recommended by the metal roof manufacturer. Continuous angles butted to panel ends are not acceptable.

C. Provide all accessories for a complete metal roofing system including panels, clips, trim/flashings, fascias, ridges, closure, sealants, fillers, and any other required item.

D. All outside closures shall be fabricated from bare galvalume sheet steel, 24 gauge, embossed. Closure finish shall match roof color

E. All tape sealant shall be pressure sensitive of a type recommended by the metal roof panel manufacturer. All joint sealant shall be of a type recommended by the roof panel manufacturer.

F. Roof jacks shall be prefabricated, one piece EPDM with aluminum flanged base ring, for installation in the flat portion of the panel only.

2.07 MISCELLANEOUS MATERIALS

A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.

1. Fasteners for Metal Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws with nylon or polypropylene washer.

2. Fasteners for Metal Roof and Wall Panels: Self-drilling Type 410 stainless-steel or self-tapping Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal panels.

3. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.

4. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint, compounded for 15-mil dry film thickness per coat. Provide inert-type non-corrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.08 SHEET METAL ACCESSORIES

A. General: Provide coated steel sheet metal accessories with coated steel roofing panels. Same metal and finish as roof panels.

B. Gutters: Form in 8' long sections of manufacturer’s standard profile of general size shown on the Drawings, 24 ga. metal, complete with end pieces, outlet tubes, and other special pieces as required. Size as shown on the Drawings. Join sections with riveted and soldered or sealed joints. Provide expansion-type slip joint at center of runs. Furnish gutter supports spaced 36” o.c., constructed of same metal as gutters. Provide bronze, copper, or aluminum wire ball strainers at outlets. Finish to match metal siding.

C. Downspouts: Form in 10' long sections, complete with elbows and offsets. Join sections with 1-1/2” telescoping joints. Provide fasteners designed to hold downspouts securely 1" away from walls; locate fasteners as shown on the Drawings. Finish to match wall panels. Size shall be as shown on the Drawings. Finish to be selected by Architect.

D. Wall Louvers: See mechanical drawings and specification.

2.09 FABRICATION

A. General: Design prefabricated components and necessary field connections required for erection to permit easy assembly and disassembly. All structural steel members shall be factory cut, formed, punched, welded, cleaned and painted for bolted field assembly.

1. Fabricate components in such a manner that once assembled, they may be disassembled, repackaged, and reassembled with a minimum amount of labor.

2. Clearly and legibly mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals for easy field identification.

B. Structural Framing: Shop-fabricate framing components to indicated size and section with base plates, bearing plates, and other plates required for erection, welded in place. Provide holes for anchoring or connections shop-drilled or punched to template dimensions.

1. Shop Connections: Provide bolted or welded shop connections

2. Field Connections: Provide bolted field connections

C. All welding shall be done in accordance with the American Welding Society Structural Welding Code.

1. Flanges and webs of built-up welded members shall be joined by a continuous automatic submerged arc welding process on one side of the web.

2. Certification of welder qualification shall be supplied when required or specified. Operators shall be qualified as prescribed in the “Standard Qualification Procedure of the American Welding Society”.

PART 3 EXECUTION

3.01 ERECTION

A. Framing: Erect framing true to line, level, plumb, rigid, and secure. Temporary bolting and bracing must be introduced to safely carry all loads to which the structure may be subjected including equipment and the operation of same. Individual columns must be braced as long as may be required for safety. No bolting or welding shall be done until as much of the structure as will be stiffened thereby has been properly aligned. Level base plates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use a non-shrinking grout to obtain uniform bearing and to maintain a level base line elevation. Moist cure grout for not less than 7 days after placement.

B. Purlins and Girts: Provide rake or gable purlins with tight-fitting closure channels and fascias. Locate and space wall girts to suit heights. Secure purlins and girts to structural framing and hold rigidly to a straight line by sag rods.

C. Bracing: Provide diagonal rod or angle bracing in roof and sidewalls as indicated.

D. Drift pins may be used only to bring together the several parts. They shall not be used in such a manner as to distort or damage the metal. The use of gas-cutting torch in the field for correcting fabrication error shall be permitted only on minor members when the member is not under stress and then only after approval of the Engineer has been obtained. Ream holes that must be enlarged to admit bolts.

E. All bolts for field assembly of primary structural members shall be high strength bolts conforming to ASTM A325 unless higher strength bolts are specified by the manufacturer. Connectors for primary structural members shall not be less than 5/8" diameter. Connectors for secondary structural members shall be 1/2" cadmium plated machine bolts conforming to ASTM A307 unless larger bolts or bolts of higher strength are specified by the building manufacturer.

F. Framed Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to building structural frame.

G. Install insulation continuously over roof framing. Seal all joists and penetrations air tight. Torn and repaired material is not acceptable.

H. Install metal roof panels and accessories watertight and in accordance with UL Class 90 requirements. Install materials using the longest lengths possible to suit design and UL requirements.

I. Conceal all fasteners to the greatest degree possible.

J. Install panels plumb, level and with panel ribs parallel.

3.02 WARRANTIES

A. Provide manufacturer’s written 20-year warranty against cracking, peeling, and fade (not to exceed 5 N.B.S. units for metal siding, metal trim and flashing.

B. Weathertightness Warranty: Provide manufacturer’s standard 20-year weathertightness warranty for the roofing system including trim.

1. Contractor shall furnish a 2-year written warranty for material and workmanship plus any extension required (due to repairs that are required) as stated in the manufacturer’s 20-year warranty.

END OF SECTION

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SECTION 13310

SCADA AUTOMATION PRODUCTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide, install, configure, and test the SCADA hardware and software as specified in this Section.

B. All computer equipment and programmable logic controllers provided for this project must meet the requirements of this Section, including equipment supplied by manufacturers of packaged equipment utilized on the project.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 13320 – SCADA Control Panels

B. Section 13330 – Instrumentation Products

C. Division 16 – Electrical

1.04 SUBMITTALS

A. Submit in accordance with Section 01300, Submittals for all equipment specified herein.

1.05 O&M MANUALS

A. Include in the O&M Manuals a copy of the Allen Bradley CompactLogix PLC Catalogs and Flex5000 Remote I/O catalogs.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. The Owner has standardized on PLCs from Allen Bradley. The PLC installed during the project shall be Allen Bradley CompactLogix or approved equal as defined in the Drawings.

2.02 CompactLogix PLC

A. RACKS

1. All racks on the project shall be of the CompactLogix type as shown on the Drawings or approved equal.

2. Protective covers shall be supplied for all unoccupied positions.

B. POWER SUPPLY

1. Each rack shall be provided with a power supply as shown on the Drawings. The power supply input power shall be 120 VAC. The power supplies shall provide 10A at 24 VDC.

C. PROCESSOR

1. The PLC processor shall have integrated dual Ethernet ports, CompactLogix 5380 controllers, with 3MB memory, 31 local I/Os, and 60 Ethernet I/P connections, model number 5069-L330ER.

2. Each processor shall be supplied with a flash memory card installed for program and data.

D. DIGITAL INPUT MODULES

1. 120 VAC input modules shall be 16 inputs (5069-IA16).
2. 24VDC input modules shall be 16 inputs (5069-IB16).

E. DIGITAL OUTPUT MODULES

1. Relay output modules shall be 16 outputs (5069-OW16).
2. Isolated relay output modules shall be 4 outputs (5069-OW4I).

F. ANALOG INPUT MODULES

1. Analog input modules shall be eight channel (5069-IF8).
2. Analog input modules shall be 16-bit resolution in current mode.

G. ANALOG OUTPUT MODULES

1. Analog output modules shall be eight channel (5069-OF8).
2. Analog output modules shall be 16 bit resolution.

2.03 DISTRIBUTED REMOTE I/O PANELS

A. GENERAL

1. Remote I/O control panels shall use Allen Bradley's Flex5000 remote I/O system or approved equal.

2. Control panels with direct fiber connections shall have dual embedded fiber SFP Ethernet ports in the communication module (5094-AENSFPR) for establishing a DLR type network topography with connection of the distributed I/O panels directly into the ring without use of a network switch as detailed in the Drawings.

3. Control panels with direct Ethernet network connections shall have dual embedded RJ45 copper Ethernet ports in the communication module (5094-AENTR) for connection to the plant network through the use of an unmanaged switch as detailed in the Drawings.

4. Each input module requires one (1) mounting base (5094-MB) and one (1) terminal block (5094-RTB3) for each module connected to the remote I/O assembly.

B. DIGITAL INPUT MODULES

1. Digital input modules shall be 16-point, 120 VAC (5094-IA16).
2. Digital input modules shall be 16-point 24VDC (5094-IB16)

C. DIGITAL OUTPUT MODULES

1. Digital output modules shall be 8 point isolated relay output (5094-OW8I).

D. ANALOG INPUT MODULES

1. Analog input modules shall be 8 channel (5094-IF8).

E. ANALOG OUTPUT MODULES

1. Analog output modules shall be 8 channel (5094-OF8).

2.04 ELECTRONIC RACK AND SERVER EQUIPMENT

A. ELECTRONIC RACK

1. The Contractor shall provide and install one (1) SCADA server electronic rack, similar or equal to Hoffman PS1SPE21612B with 19" rack spacing, 45 rack units, and locking panels.

2. Locate the rack in the Operations Building in a location directed by the Engineer.

B. SERVERS

1. Provide and install two (2) SCADA servers in the electronic rack. The servers shall be similar or equal to a 2U Dell PowerEdge with 8x2.5" drive chassis, Intel Xeon 6th generation processor, 128GB memory, four (4) 8TB SATA hard drives in a RAID 5 configuration with a hot spare, dual hot plug mixed mode power supplies, quad port gigabit Ethernet, and Windows Server 2022 Standard or latest version compatible with Ignition SCADA software standard pre-installed.

C. UNMANAGED ETHERNET SWITCH

1. Provide and install one (1) managed Ethernet switch, similar or equal to Tripp-Lite NGS24C2POE, with 2 SFP slots for fiber and 24 10/100 Base TX RJ-45 POE+ ports.

D. ONLINE UNINTERRRUPTIBLE POWER SUPPLY (UPS)

1. Provide and install one (1) 120V 2.2kVA double-conversion online UPS, 2U rack/tower mount with network card, similar or equal to Tripp-Lite SU2200RTXLCD2U.

2.05 MISCELLANEOUS EQUIPMENT

A. OPERATOR DISPLAYS

1. The Contractor shall provide six (6) 55" diagonal 4K (2160P) LED display screens with full motion articulating mounting bracket and hardware, to be installed at locations as directed by the Engineer. The operator displays shall have two (2) HDMI inputs.

2.06 SCADA SOFTWARE

A. IGNITION BY INDUCTIVE AUTOMATION

1. The Contractor shall provide an Ignition license for the project SCADA software. The software shall be the Ultimate Unlimited package.

2. The software shall be provided to operate on both servers for seamless licensing and redundancy.

3. Provide and install three (3) Ignition Edge licenses for operation on the PLC Control Panel touchscreen workstations.

PART 3 EXECUTION

3.01 GENERAL

A. Control panels that house equipment in this Section are covered in Section 13320, SCADA Control Panels.

B. Network communications and equipment that link equipment in this Section are covered in Section 13340, SCADA Networking Products.

END OF SECTION

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SECTION 13320

SCADA CONTROL PANELS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide, install, configure, and test all control panels, control stations, and instrumentation panels as specified in this Section and shown on the Instrumentation Drawings.

B. This Specification is intended to provide material standards for major components that are used in the project for all custom-built control panels except for equipment OEMs.

C. The Contractor shall supply the following control panels, parts lists, layouts, locations, and panel ratings are shown on the Drawings.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 13310 – SCADA Automation Products

B. Section 13330 – SCADA Instrumentation Products

C. Section 13340 – SCADA Networking Products

D. Division 16 – Electrical

1.04 SUBMITTALS

A. Submit in accordance with Section 01300, Submittals for all equipment specified herein.

PART 2 PRODUCTS

2.01 ENCLOSURES

A. Corrosion Resistant Enclosures (Control Stations and Instrumentation Panels)

1. NEMA 12 mild painted steel or NEMA 4X 304 stainless steel
2. Seams continuously welded and ground smooth
3. Stainless steel lift off style hinges
4. Hinges are shielded by cover edges
5. 210-degree door opening
6. Slanted flange trough collar prohibits pooling of fluids at the top edge of the enclosure opening
7. Stainless steel quarter turn latches with full slotted insert
8. Seamless foam in place gasket
9. Accessories and panels as shown on the Drawings
10. Hoffman Concept Wall Mount or equal

B. Instrumentation Enclosures (Control Stations and Instrumentation Panels)

1. NEMA 4X aluminum
2. Seams continuously welded and ground smooth
3. Hinges are shielded by cover edges
4. 210-degree door opening
5. Solar shield top
6. Stainless steel quarter turn latches with full slotted insert
7. Seamless foam in place gasket
8. Accessories and panels as shown on the Drawings
9. Hoffman Comline Wall Mount or equal

2.02 UNINTERRUPTIBLE POWER SUPPLY

A. The UPS shall be as manufactured by Sola, model SDU 850A with SDUCFRELAYCARD monitor module or approved equal.

2.03 DC POWER SUPPLIES

A. 24VDC power supplies shall be switching type with less than one percent (1%) deviation and shall be UL508 listed. The power supply shall mount on DIN rail. The power supply shall be internally fused. The power supply shall be equal to Sola Hevi-Duty SDN series.

2.04 PUSHBUTTON CONTROLS

A. UL Types 4, 4X, 12, 13.

B. Corrosion resistant.

C. 22 or 30-millimeter diameter

D. White phenolic pushbutton legend plates with black letters

2.05 ANALOG TVSS

A. All analog signals, inputs and outputs shall be protected by transient voltage surge suppression devices.

B. The analog TVSS shall be as manufactured by Citel DLA-24D3, no equal.

2.06 CONTROL RELAYS

A. All control relays shall be Form C, with the number of contacts as shown on the Drawings.

B. All control relays shall have an LED indication light and a manual test feature.

C. Control relays shall be equal to Square D RPM series with RPZ base.

2.07 TERMINAL BLOCKS

A. All terminal blocks shall be screw-terminal design.

B. Feed through terminal blocks for discrete signals shall be similar or equal to Phoenix Contact MBK line or Automation Direct DN line. Terminal blocks shall be gray for 120-volt signals. Terminal blocks shall be blue for 24-volt DC signals. Terminal blocks shall be capable of accepting two (2) #12 AWG wires under each screw terminal.

C. Feed through terminal blocks for analog signals shall be similar or equal to Phoenix Contact MBKKB line. Terminal blocks shall be blue.

D. Circuit breaker terminals shall be similar or equal to Phoenix Contact TMC line. Ratings shall be as indicated on the Drawings.

E. Fuse terminals shall include a disconnect lever and be similar or equal to Phoenix Contact UKK line. Ratings shall be as indicated on the Drawings.

2.08 MISCELLANEOUS

A. The Contractor shall install all wiring inside wireway with cover, similar or equal to Tyton SL slotted wire duct.

B. Shielded cable shall be similar or equal to Belden 8760.

C. Control wire shall be #14 MTW. Colors shall be as noted below:

1. 120 VAC Power – Black
2. 120 VAC Control – Red
3. 120 VAC Neutral – White
4. 24 VDC Positive – Blue
5. 24 VDC Negative – Gray
6. Ground – Green

PART 3 EXECUTION

3.01 GENERAL

A. The fabricated control station or control panel assembly shall utilize only UL Listed components. The complete assembly shall be UL508 Listed. Assemblies without the UL 508 label installed will be rejected.

END OF SECTION

SECTION 13330

INSTRUMENTATION PRODUCTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide, install, configure, and test all instrumentation products and equipment as specified herein.

B. Provide all mounting devices and hardware required not specifically named in this Specification.

C. Coordinate installation of products with other trades as required.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED WORK

A. Section 13310 – SCADA Automation Products

B. Section 13320 – SCADA Control Panels

C. Division 16 – Electrical

1.04 SUBMITTALS

A. Submit in accordance with 01300, Submittals.

B. In addition to manufacturer data sheets, submittals are required for the equipment installation and operation manual and user manual prior to purchase by the Contractor.

C. Field instruments are grouped together in several locations. Refer to the Drawings for manufacturing and installation details in these areas.

PART 2 PRODUCTS

2.01 LOOP POWERED RADAR LEVEL TRANSMITTER

A. General

1. The Contractor shall supply and install loop powered radar level transmitters. as shown on the Drawings. Applications include Lift Station No. 3, Lift Station No. 1, Lift Station No. 4, Surface Wasting Pump Station, and Effluent Pump Station. Provide two (2) spares.

B. Radar Transmitter

1. The radar transmitter shall use frequency-modulated continuous-wave (FMCW), V-Band 63 GHz, and shall be 24VDC loop powered.

2. The radar transmitter body shall be Valox, rated at IP68/NEMA 6P submersion, with a 1" NPT rear thread and optional 1.5" front thread arrangement.

3. The radar transmitter shall utilize visible LED red/yellow/green indication of device status.

4. The radar transmitter beam angle shall be 6 degrees, with 2mm accuracy.

5. The radar transmitter shall be rated for operation between -40 to 80 degrees C.

6. The radar shall be rated for the following explosion proof atmospheres: ATEX/IECEx/UKEx: Zones 0, 1, 2: Ex II 1G Exia IIC T4 Ga, Tamb.= -40°C to +80°C. Zones 20, 21, 22 : Ex II 1D Exia IIIC T100°C Da, Tamb.= -40°C to +80°C. cFMus: Intrinsically safe for Class I, Div 1, Groups A,B,C,D T4; Class II, Div 1,Groups E,F,G, T4; Class III, T4.

7. The radar transmitter shall be programmable via mobile Bluetooth (website or app), or Hart modem.

8. The radar transmitter measurement range shall be 8m (26.2’) and supplied with 20m (65.5’) of cable.

9. The radar transmitter shall be Pulsar Reflect or Krohne Optiwave, or equal.

2.02 BAR SCREEN RADAR LEVEL CONTROL

A. General

1. The Bar Screen equipment manufacturer shall provide upstream and downstream level sensing for control of the operation. The level sensing may be loop powered radar level transmitters, as specified in paragraph 2.01 of this specification, or transducer/controller as described in this paragraph 2.02. The bar screen manufacturer shall provide four (4) loop powered radar level transmitters or four (4) radar transducers with two (2) controllers. Provide one (1) spare transmitter or one (1) spare transducer with one (1) spare controller.

B. Controller

1. The controller unit shall be of wall mount design, mounted in the bar screen control panel interior. The display shall be visible through the door, or the measurements shall be displayed on the main control panel HMI.

2. The controller shall accept two (2) transducer inputs and provide two (2) isolated 4-20mA outputs.

3. The controller shall have six (6) form C relays for status and alarm signals.

4. The controller shall be Pulsar UltraTWIN, standard wall mount, with 0.25% accuracy and 0.1% resolution of the measured range. The unit shall be provided with PC programming software and programming cable

C. Radar Transducer

1. The transducer shall be equal to Pulsar dBR16, range 0.25 – 52.5’

2. The transducer frequency shall be V-Band

3. The transducer beam angle shall be <10 degrees

2.03 PARSHALL FLUME RADAR FLOW TRANSMITTER

A. Controller

1. The controller unit shall be of wall mount design, mounted on or near the local PLC control panel.

2. Input Voltage shall be 120VAC

3. The controller shall have one (1) 4-20mA output programmed for flow through the open channel effluent Parshall flume

4. The controller shall be Pulsar Ultra4, standard wall mount, with 0.25% accuracy and 0.1% resolution of the measured range. The unit shall be provided with PC programming software and programming cable

B. Radar Transducer

1. The transducer shall be equal to Pulsar dBR16, range 0.25 – 52.5’

2. The transducer frequency shall be V-Band

3. The transducer beam angle shall be <10 degrees

2.04 PROCESS ANALYTICAL INSTRUMENT CONTROLLER/TRANSMITTER

A. General

1. Provide and install instrument networked controller/transmitters for all analytical instruments defined herein. The analytical sensors shall communicate over a two-wire network to the controller/transmitter.

2. Four (4) controller/transmitters shall be provided for the project. One unit will be installed in control panel PLC-INF and will connect to sensors for the influent and BNR/anoxic, and north end of the aeration basins. Two (2) units shall be installed in Remote I/O control panels for the Aeration Basins. One unit will be installed in the Remote I/O control panel in the auto sampler building and will connect to sensors for the filtration/UV/post aeration/effluent flow.

3. The controller shall be AC powered, 120VAC.

4. The controller shall include a backlit graphic color display.

5. The controller shall have the capability to communicate to twenty (20) sensors and shall be “plug and play” for sensor additions.

6. The controller shall have isolated 4-20mA outputs assignable to each connected sensor.

7. The controller shall have a real time clock and output relays for alarms as necessary.

8. The controller shall be NEMA 4X/IP 66 rated but will be installed indoors in conditioned space.

9. The controller shall be IQ SensorNet 2020 3G or approved equal.

2.05 TSS SENSOR

A. General

1. The Contractor shall supply and install Total Suspended Solids (TSS) sensors in the locations shown on the Drawings. Provide and install 2105-BNR1-TSS in BNR Basin #1 and 2205-BNR2-TSS in BNR Basin #2. Provide and install 6406-TSS-EFF in the inlet chamber of the Parshall Flume. Connect the sensor to the modular sensor interface boxes. Provide and install all required mounting hardware and accessories. Provide one (1) spare sensor.

B. Sensor

1. Measurement principle shall be optical based on the reflectance of light from a near infrared light source. The sensor shall include detectors for measuring the intensity of scattered light and backscatter.

2. The sensor shall be factory-calibrated for low concentration (effluent) and high concentration (mixed liquor, return activated sludge) applications. The sensor shall have capability for automatically selecting the optimal resolution for each measured value.

3. The sensor shall have a non-mechanical integrated ultrasonic cleaning system.

4. The sensor shall have a digital output signal.

5. The sensor shall detach from sensor cable allowing for easy replacement or repair.

6. Each sensor shall be provided with a sensor cable with an IP-68 waterproof rating and have cable length as required to connect to the modular sensor connection point.

7. The sensor shall be provided with a mounting system that secures to handrail and of sufficient length to immerse the sensor.

8. The sensor shall be YSI Digital ViSolid for the IQ SensorNet system or approved equal.

2.06 AMMONIA/NITRATE SENSOR

A. General

1. The Contractor shall supply and install AMMONIA/NITRATE (NO3) sensors in the locations shown on the Drawings. Provide and install 6405-NO3-EFF in the inlet chamber of the Parshall Flume. Connect the sensor to the modular sensor interface box. Provide and install all required mounting hardware and accessories. Provide one (1) spare sensor.

B. Sensor

1. Measurement principle shall be potentiometric by means of an ion selective electrode. The sensor shall include detectors for measuring the intensity of scattered light and backscatter.

2. The sensor shall be factory-calibrated for low concentration (effluent).

3. The measuring system shall include an ammonia electrode, a nitrate electrode, a potassium electrode, a chloride electrode, and a reference electrode.

4. The sensor shall have a digital output signal.

5. The sensor shall detach from sensor cable allowing for easy replacement or repair.

6. Each sensor shall be provided with a sensor cable with an IP-68 waterproof rating and have cable length as required to connect to the modular sensor connection point.

7. The sensor shall be provided with a mounting system that secures to handrail and of sufficient length to immerse the sensor.

8. The sensor shall be YSI Digital VARiON for the IQ SensorNet system or approved equal.

2.07 PH AND TEMPERATURE SENSOR

A. General

1. The Contractor shall supply and install pH and temperature sensors in the locations shown on the Drawings. Provide and install 6404-PH-EFF in the inlet chamber of the Parshall Flume and 1800-PH-INF in the influent channel of the Influent Building. Each pH and temperature analyzer shall consist of a digital sensor probe with integral cable into the instrumentation network. Provide one (1) spare sensor.

B. Sensor

1. The measurement principle shall be potentiometry by means of an ion selective electrode.

2. The sensor shall include an integrated NTC thermistor, pre-amplification of the electrode signal, and digital signal processing with calibration value storage.

3. The sensor shall have a convertible body style featuring 1-inch NPT threads on both ends to mount into a standard 1-inch pipe tee, into a adapter pipe for union mounting with a standard 1-1/2-inch tee, or onto the end of a pipe for immersion into a vessel.

4. The sensor shall include self-diagnostics for monitoring glass electrode breakage.

5. The sensor shall detach from sensor cable allowing for easy replacement or repair.

6. The sensor shall be supplied with integral cable to connect to the instrument network without splices. Verify lengths on the Drawings.

7. The sensor signal shall have an integral temperature sensor to automatically compensate measured values for changes in process temperature.

8. The sensor shall include a titanium ground electrode (standard) to eliminate ground loop currents in the measuring electrodes.

9. The sensor shall be YSI style 700 IQ or approved equal.

10. Provide mounting accessories and extension cable footage as detailed on the Drawings.

2.08 ORP SENSOR

A. General

1. The Contractor shall supply and install four (4) oxidation reduction potential (ORP) sensors in the locations shown on the Drawings. Provide and install 2104-BNR1-ORP, 2204-BNR2-ORP, 2106-BNR1-ORP, and 2206-BNR2-ORP in the BNR basins. Each ORP sensor shall consist of a digital sensor probe with integral cable into the instrumentation network. Provide one (1) spare sensor for a total of five (5) sensors.

B. Sensor

1. The measurement principle shall be potentiometry by means of an ion selective electrode.

2. The sensor shall include an integrated NTC thermistor, pre-amplification of the electrode signal, and digital signal processing with calibration value storage.

3. The sensor shall have a convertible body style featuring 1-inch NPT threads on both ends to mount into a standard 1-inch pipe tee, into an adapter pipe for union mounting with a standard 1-1/2-inch tee, or onto the end of a pipe for immersion into a vessel.

4. The sensor shall include self-diagnostics for monitoring glass electrode breakage.

5. The sensor shall detach from sensor cable allowing for easy replacement or repair.

6. The sensor shall be supplied with integral cable to connect to the instrument network without splices. Verify lengths on the Drawings.

7. The sensor signal shall have an integral temperature sensor to automatically compensate measured values for changes in process temperature.

8. The sensor shall include a titanium ground electrode (standard) to eliminate ground loop currents in the measuring electrodes.

9. The sensor shall be YSI style 700 IQ or approved equal.

10. Provide mounting accessories and extension cable footage as detailed on the Drawings.

2.09 DISSOLVED OXYGEN SENSOR

A. General

1. The Contractor shall supply and install dissolved oxygen (DO) sensors at the locations shown on the Drawings. Provide and install two (2) DO sensors, 6403-DO-EFF and 6407-DO-EFF at the inlet chamber for the Parshall Flume. Provide and install four (4) DO sensors at the aeration basins, 3100-DO-N, 3101-DO-S, 3200-DO-N, and 3201-DO-S. These sensors shall analyze dissolved oxygen in the

aeration basin to monitor the DO level and adjust aeration and mixing times. Provide and install all required mounting hardware and accessories for connection to the instrumentation network. Provide one (1) spare DO sensor, for a total of seven (7) DO sensors.

B. Sensor

1. The DO sensor shall be of Optical Luminescent Dissolved Oxygen Technology (LDO) for the IQ SensorNet system or equal.

2. The sensor shall require no calibration. Maintenance shall be replacement of the DO sensor cap annually.

3. Each sensor shall be an optical dissolved oxygen sensor with a factory calibrated sensor cap using an energy green light excitation technology for extending the sensor cap lifetime. Sensor shall include a digital signal output, lightning protection, an IP-68 rating and an operating temperature of 23 to 122°F. Range shall be 0 to 20 mg/L and a DO resolution concentration of 0.01 mg/L and saturation of 0.1%.

4. Each sensor shall be provided with a sensor cable with an IP-68 waterproof rating and have cable length as required to connect to the modular sensor connection point.

5. The sensor shall be provided with a mounting system that secures to handrail and of sufficient length to immerse the sensor.

6. The sensor shall be YSI IQ SensorNet FDO, or equal.

2.10 ORTHOPHOSPHATE ANALYZER

A. General

1. Install one (1) Orthophosphate analyzer in the Sampler Building adjacent to the Parshall Flume. The sampling line shall be installed within the 4-inch sample line conduit.

2. Ortho-phosphate measurement system shall be a component of a process monitoring system capable of monitoring up to 20 parameters simultaneously on each controller. Measurement locations shall be networked together in a linear, star, or branched topology with a single 2-wire cable that distributes 12 V power and communications.

3. Measurement principle shall be colorimetry by means of the vanadomolybdate method (yellow method).

B. Analyzer

1. The Orthophosphate analyzer shall be a complete unit in a dedicated enclosure capable of independent operation or as part of a multi-sensor monitoring network

2. The sensor shall be easily calibrated in place and capable of automatic calibration.

3. Each unit shall have a user adjustable sampling interval and monitoring range of 0.02 mg/L to 15 mg/L PO_4-P.

4. Each unit shall include a DC power supply, colorimetric sensor, reagent storage, syringe pump, filtration pump, filter membrane module, overflow vessel, and a communications interface.

5. The unit shall be provided with a mounting system that secures the unit to a wall and with sufficient sample line to immerse the inlet within the inlet chamber of the Parshall Flume.

6. The unit shall be YSI Alyza PO_4-111 or approved equal.

C. Spare Parts

1. Provide sufficient reagent, standard, and cleaning solution for one (1) year of operation at 10-minute intervals to the Owner as spare parts.

2.11 PRESSURE TRANSMITTER

A. The pressure transmitter shall be similar or equal to the Dwyer Series 3400 smart pressure transmitter with integral digital display, pushbutton configuration for zero and span.

B. The pressure transmitter shall have internal electronics to convert the signal to a 4-20mA output, with 4mA corresponding to zero depth (atmospheric pressure) and 20mA to rated depth for the selected range.

C. The transmitter shall be powered by a DC power supply with a range of 12.5 to 35 VDC.

D. The transmitter shall have accuracy of +/- 0.075% percent (0.075%).

E. The transmitter shall include fail-mode process function and automatic ambient temperature compensation.

F. Wetted materials shall be 316L stainless steel.

G. The electrical connection shall be two (2) ½” NPT female conduit with screw terminal connections for cable.

H. The process connection shall be ½” NPT.

I. The enclosure shall be rated NEMA4X IP66/67.

J. Provide four (4) transmitters for the applications outlined in the Drawings.

K. Provide one (1) spare transmitter.

2.12 COMBUSTIBLE GAS DETECTOR

A. The combustible gas detector shall be installed in the Equipment Area of the Influent Building and monitor for H2S combustible gas.

B. The gas detector instrument shall include a local display, with 4-20mA output, and include an enclosure rated for Class 1 Division 1 and 2 locations.

C. The transmitter shall be powered by a DC power supply with a range of 12.5 to 35 VDC.

D. The transmitter shall measure 0-100 ppm for H2S, with response time less than 60 seconds.

E. Accuracy shall be +/- 5% or less.

F. The gas detector shall have a useful life of two (2) years.

G. The gas detector shall be equal to RKI 65-2645RK-05.

H. Provide one (1) spare transmitter.

2.13 FLOAT SWITCH

A. The Contractor shall supply and install float switches for each loop radar level transmitter used for pumping applications as high level and low level floats as shown on the Drawings. Applications include Lift Station No. 3, Lift Station No. 1, Lift Station No. 4, Surface Wasting Pump Station, and Effluent Pump Station.

B. The float switch shall be 5.5" large diameter, mercury free, and 316 stainless steel construction.

C. The float switch shall be provided with a form C contact.

D. The float switch shall have an 8” operating differential and capable of cable or pipe mounting.

E. The float switch shall be provided with 50’ of integral cable, and shall be routed to the local control station for the pumps to terminals. The float switch shall be equal to Contegra FS 90-0205-C.

F. Provide one (1) spare.

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall install the instruments in strict accordance with the manufacturer’s instructions and recommendations.

B. Factory authorized startup and training services shall be required for the following instruments:

1. Instrumentation Networked Controller/Transmitters
2. TSS Sensor
3. pH and Temperature Sensor
4. Dissolved Oxygen Sensor
5. Orthophosphate Analyzer

3.02 INSTALLATION

A. See the Drawings for general instrument elevations and mounting.

B. The Contractor shall be given latitude in the arrangement of the field instruments to meet the Engineer's intent. See section 1.04 for submittal requirements.

3.03 SERVICE PLAN

A. The instrumentation identified in this section shall be supplied with a Service Plan. As part of that Service Plan, an experienced, competent, and authorized representative of the instrumentation supplier shall perform quarterly site visits starting at the date of Substantial Completion for a period of no less than three (3) years. During these site visits, the representative shall inspect the equipment to ensure that it is operating properly, identify any components that need to be replaced or serviced in the upcoming year, replace consumable components based on the supplier's recommended replacement schedule, perform any calibrations needed, and address any questions from the Owner. The Service Plan shall cover the following instruments:

1. Total Suspended Solids (TSS)
2. Ammonia/Nitrate
3. pH/Temperature
4. Oxidation Reduction Potential (ORP)
5. Dissolved Oxygen (DO)
6. Orthophosphate

END OF SECTION

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SECTION 13340

SCADA NETWORKING PRODUCTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide, install, configure, and test a fiber optic based Local Area Network (LAN) between control panels with Ethernet processors or equipment.

B. The Division 13 Contractor shall provide under this section of the Specifications all materials, labor, equipment, tools and supplies for the installation of fiber optic cable, connectors, fiber terminations, and testing for a complete installation.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 13310 – SCADA Automation Products

B. Section 13320 – SCADA Control Panels

C. Division 16 Electrical

1.04 SUBMITTALS

A. Submit in accordance with Section 01300, Submittals for all equipment specified herein.

1.05 O&M MANUALS

A. Upon completion of project installation, provide copies of the Ethernet switch user manuals in the project O&M manual. Provide printouts of each fiber optic pair signal test for use in future fiber optic system troubleshooting.

PART 2 PRODUCTS

2.01 LOCAL AREA NETWORK

A. Fiber Optic Cable

1. The fiber optic cable shall be stranded loose tube, indoor/outdoor rated with PVC jacketed UV resistant exterior.

2. The 62.5 micron multimode cable shall have maximum attenuation of 3.5/1.0 db/km at 850/1300nm and minimum bandwidth of 160/500 MHz-km at 850/1300nm.

3. The cable shall use dry-block technology to seal ruptures against moisture seepage and gel-filled buffer tubes to halt moisture migration.

4. The cable shall be suitable for lashed aerial, conduit, duct, and indoor/outdoor riser applications. The cable shall not require a splice point when transitioning indoors and directly accept fiber optic connectors.

5. Maximum cable load during installation shall be 600 lbs-f.

6. Crush resistance shall be 55 lb per inch for ten (10) minutes minimum.

7. The cable shall have twelve (12) fibers minimum.

B. INDUSTRIAL UNMANAGED ETHERNET SWITCH

1. Provide and install Industrial Unmanaged Ethernet Switches at each control panel as shown on the Drawings for SCADA LAN communications, including connection to a minimum of two (2) fiber optic segments. The switches shall be N-Tron/Red Lion, models as shown on the Drawings or equal.

2. The switches shall have ports as noted on the Drawings, with SC fiber connections where the model of the switch calls for as noted.

3. Each switch requiring fiber connection shall do so using SC fiber connections to the fiber patch panels in each control panel.

4. The operating voltage for the unmanaged SCADA switches shall be 24VDC.

5. The operating voltage for the POE switches shall be 48VDC.

6. The switch shall have diagnostic LEDs for power, link, status, data, and error.

7. The switch shall be DIN rail mount, listed to UL508.

8. The switch shall conform to IEEE 802.3.

C. COMPACT FIBER OPTIC PATCH PANEL

1. Provide and install a compact fiber optic patch panel for each enclosure with fiber optic cable entrance. The patch panel enclosure shall be equal to RLH Industries PWS2A333300001D.

2. The patch panel shall have 6 ea SC duplex internal connector adapters.

3. The patch panel shall be DIN rail mounted as detailed in the Drawings.

D. LARGE FIBER OPTIC PATCH PANEL

1. Provide and install a fiber optic patch panel in the CP-PLC-MAIN enclosure. The patch panel enclosure shall be equal to Hubbell FTU4SP with four (4) patch panels Hubbell model FSPNSTSS6.

2. The patch panel shall have 12 ea SC duplex internal connector adapters.

3. The patch panel shall be panel mounted as detailed in the Drawings.

E. FIBER OPTIC PATCH CABLES

1. Provide and install LC-SC fiber optic patch cables for all connections between the patch panels and Ethernet switches with SFPs, length as required for the control panel construction and layout.

2. Provide and install SC-SCfiber optic patch cables for all connections between the patch panels and Ethernet Media Converters, length as required for the control panel construction and layout.

F. ETHERNET PATCH CABLES

1. Provide and install Cat 5e Ethernet patch cables with RJ45 connectors for connections between the Ethernet switch and devices inside the control panel, length as required for the control panel construction and layout.

G. BULK ETHERNET CABLE

1. Provide and install Cat 5e industrial Ethernet cable with site installed RJ45 connectors for connections between control panels and equipment within buildings. The Ethernet cable shall be industrial rated, equal to Belden 7922A.

PART 3 EXECUTION

3.01 GENERAL

A. The fiber optic cable network shall be installed by a certified Contractor.

B. The fiber optic cable shall be 100 percent (100%) attenuation tested.

C. The fiber optic cable manufacturer shall be ISO 9001 registered.

3.02 PACKING AND SHIPPING

A. The completed cable shall be packaged for shipment on non-returnable wooden reels.

B. Top and bottom ends of the cable shall be available for testing.

C. Both ends of the cable shall be sealed to prevent the ingress of moisture.

D. Each reel shall have a weather resistant reel tag attached identifying the reel and cable.

3.03 INSTALLATION

A. The fiber optic cable shall be installed in locations as shown on the Drawings.

B. All fibers shall be polished and provided with SC connectors. The fibers shall be terminated into the patch panels as shown on the Drawings.

C. Testing of the fiber optic cable must be completed in the presence of the Owner and/or Engineer. Schedule testing with one (1) week advance notice minimum.

D. Upon completion of fiber installation, including SC connector installation at each end, the Contractor shall test each fiber pair using a certified fiber tester. The tester shall have capability of storing results and uploading to a computer for report generation. The fiber report shall include data on the attenuation, return loss, graded refractive index, propagation delay, and time-domain relectometry for each fiber pair. Provide a certified written report to the Engineer. Testing must be performed in the presence of the Engineer and the Owner.

END OF SECTION

SECTION 13400

SITE SECURITY

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide, install, configure, and test site security equipment as defined herein.

B. The section includes all site video and site access systems.

C. Site security system installation and setup shall be provided under this section.

D. Raceway and cable shall be provided under Division 16.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTION

A. Section 13310 – SCADA PLC Control Panels

B. Section 13320 – SCADA Control Panels

C. Division 16 – Electrical

1.04 SUBMITTALS

A. Submit in accordance with 01300 for all equipment in this section.

B. Submit the O&M Manual after completion of installation and testing.

PART 2 PRODUCTS

2.01 NETWORK VIDEO RECORDER (NVR)

A. Provide and install a network video recorder (NVR), Axis model S1116 or equal inside the server rack in the operations building.

B. Provide and install software required to access live and recorded video stored on NVR.

C. The NVR shall have 8TB of local storage space built in, with a minimum of two (2) expandable storage spaces, with a minimum expansion of 24TB.

D. The NVR shall support RAID level 1.

E. The NVR shall not require a subscription service fee to access footage.

F. The NVR shall connect to no less than sixteen (16) IP cameras via POE.

G. The NVR shall have features such as area search, automatic hard drive management, and multiple recording modes such as continuous, scheduled, or movement detection.

H. The NVR shall have high efficiency video encoding to maximize storage space without loss of video quality.

I. The NVR shall have auto-recovery after a power failure.

J. The NVR shall come with Axis Camera Station, the software used for monitoring and alerting within the Axis camera system.

K. The NVR shall be compatible with the entry gate access keypad/camera combination unit and shall be used to control access to the plant site through the gate using the Axis Camera Station software.

2.02 IP NETWORK VIDEO CAMERAS

A. Fourteen (14) IP cameras shall be supplied and installed on the project, Axis model P1448-LE or equal.

B. The camera enclosure shall be IP67/NEMA 4X outdoor weatherproof.

C. Resolution shall be 4K, 8MP resolution.

D. The camera shall be capable of nighttime recording, up to 80ft in complete darkness.

E. The lens shall be wide angle, with 109° field of view.

F. The camera shall have automatic day/night mode switching.

G. Network connection shall be Ethernet.

H. Event recording via motion detector shall be utilized.

I. The camera shall be power over Ethernet (POE). POE shall be used for all camera connections.

J. The camera shall utilize H.264 (Zipstream) video compression to reduce file size and video bandwidth usage.

K. The camera shall integrate with Axis video management software.

2.03 SITE GATE ACCESS CONTROL KEYPAD

A. At the north end plant site entry gate, supply and install a network keypad/video/intercom combination unit to control access to the plant site, Axis model A8207-VE Mk II, or approved equal.

B. The unit shall be network ethernet capable.

C. Power shall be supplied from power over Ethernet (POE).

D. The unit shall provide all door and gate control functions in one unit. The unit shall supply a 2A relay contact to control an electric door lock, a 1A relay contact for an alarm output, monitor a normally closed-door contact, and accept a Request to Exit (RTE) signal.

PART 3 EXECUTION

3.01 GENERAL

A. Provide and install one (1) recording system, cameras, and network video door station as shown in the drawings.

B. Conduit and wire will be provided under Division 16.

END OF SECTION

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SECTION 13421

ELECTROMAGNETIC FLOW METER

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, and incidentals to install complete and operational electromagnetic flow meters as shown on the drawings and as specified herein.

B. All necessary and desirable accessory equipment and auxiliaries whether specifically mentioned in this Section or not shall be furnished and installed as required for an installation incorporating the highest standards for this type of service.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 01300 – Submittals

B. Section 01782 – Operation and Maintenance Data

C. Division 2 – Site Work

D. Division 3 – Concrete

E. Section 15072 – Ductile Iron Pipe and Fittings

F. Section 15100 – Valves and Appurtenances

G. Division 16 – Electrical

1.04 REFERENCE STANDARDS

A. ASTM International (ASTM)

B. National Electrical Manufacturer's Association (NEMA)

C. National Electrical Code (NEC)

D. In reference to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 SUBMITTALS

A. Submit copies of all materials required to establish compliance with the specifications in accordance with the provisions of Section 01300, Submittals, and including the following:

1. Manufacturer's drawings showing all details of construction and dimensions

2. Descriptive literature, bulletins and/or catalogs of equipment

3. Data on the characteristics and performance of meters, including performance limitations

4. Weight of the electromagnetic flow meter

5. A complete bill of materials for all equipment

6. A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item

B. In the event that it is impossible to conform to certain details of the specifications due to different manufacturing techniques, describe completely all non-conforming aspects.

C. Operation and Maintenance Data:

1. Furnish copies of operation and maintenance instructions to the Engineer as provided for in Section 01782, Operation and Maintenance Data.

2. Prepare instructions specifically for this installation and include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

3. Provide the services of a technical representative from the electromagnetic flow meters' manufacturer, who has complete knowledge of proper operation and maintenance, for one (1) day to instruct the Owner's representative and the Engineer on proper operation and maintenance.

a. If possible, conduct this instruction and training in conjunction with the inspection of the electromagnetic flow meter and testing as provided under Paragraph 3.02.

b. Correct difficulties in operation of the equipment due to manufacturer's design or fabrication at no additional cost to the Owner.

1.06 QUALITY ASSURANCE

A. The electromagnetic flow meters covered by these Specifications are intended to be standard electromagnetic flow measuring equipment, of proven ability, and manufactured by a single manufacturer having long experience in the production of such meters.

B. Contractor is responsible for revisions to the design and/or construction of structures, piping, appurtenances, electrical work, etc. to accommodate approved substitute equipment, at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 GENERAL

A. Electromagnetic flow meters shall be Optiflux series as manufactured by Krohne or approved equal. Meters that are not suitable and rated for submersion for indefinite periods of time are not acceptable.

B. When required by existing or proposed pipe configurations, a meter designed for accurate measurement of flow with connecting piping with one (1) diameter or less of straight pipe shall be supplied.

C. The instrument shall be manufactured in an ISO 9001 approved facility.

2.02 PRIMARY METERING TUBE ASSEMBLY

A. Provide the following with each electromagnetic flow meter:

1. Meter size and liner type shall be a designated in Part 4 – Equipment Schedules

2. Pipe flanges – ANSI Class 150/300 for meter sizes up to 24-inch, AWWA, Class B, D, or FF for meters larger than 24-inch

3. Measuring tube – 304 Stainless Steel with nonconductive liner suitable for liquid being measured

4. Metering Housing – Epoxy coated steel, welded at all joints. Bolted coil enclosures shall not be acceptable

5. Measuring, Electrodes – Shall be 316 Stainless Steel or Hastlelloy C

6. Accuracy – +/- 0.30% of actual flow rate

7. Certificates – Pipe, flanges, accuracy, 3-point Factory Calibration Certificate Traceable to NIST. The calibration facility shall be certified to 0.02% accuracy

8. Application – Non-hazardous location

9. Grounding – 316 Stainless Steel Grounding rings required on each flange

10. Submergence Rating – IP-68, Submersible for indefinite periods of time

11. Calibration data and related meter performance values during calibration shall be stored in permanent memory in each signal converter for future in-situ primary element flow calibration verification

2.03 FLOWMETER CONVERTER ASSEMBLY

A. The electromagnetic flow meter converter shall be remote mounted and provide precisely controlled and regulated, bipolar DC primary field excitation pulses at a keyed frequency of 1/6, 1/16, or 1/32 of line frequency. It shall convert the primary flowmeter signal into a standard linear analog or pulse/frequency output directly proportional to the volume flow rate or total.

B. The converter shall be wall mountable, rated at IP65, NEMA 4X.

C. The converter shall have an accuracy of +/- 0.3% of actual flow rate +/- 0.0066 ft/sec (2 mm/sec) for velocities of 1.0 - 40 ft/sec.

D. The converter shall contain internal self-diagnostics, automatic data integrity checking, and be completely interchangeable with other converters of the same type without need for recalibration. No auxiliary test meter or primary simulator shall be required for commissioning, zeroing, or interchanging of flow meter/converter.

E. The converter shall have a counter that is assignable as Positive, Negative or Sum total. Counter shall be password protected to prevent unauthorized resetting. The counter shall maintain the accumulated value with power loss and continue counting when power resumes.

F. The converter shall have repeatability of +/-0.1% of rate.

G. The converter shall be provided with LCD back lit display, for local indication of Volume Flow, Total, and Status Messages.

H. Programming of the flow converter with the optional local display shall be done by the integrated HHT, accessible under the converter cover.

I. The converter shall be supplied with one (1) 4-20mA output for instantaneous flow, scalable in gallons per minute (GPM), or million gallons per day (MGD). The output shall have a configurable time constant of 0.2 to 99 seconds.

J. The converter shall provide a user adjustable low flow cutoff to force readings to zero on decreasing flow and de-activate on increasing flow, settable from 0% to 20% of full-scale setting, with the decreasing flow setting < increasing flow setting (providing hysteresis).

K. The converter shall be supplied with one (1) pulse output, configured for one pulse per 100 gallons.

L. The converter shall have capability to handle solids content up to 3% by volume.

M. The converter shall provide the capability to test all outputs for proper operation to assist in commissioning.

N. The signal converter shall be Krohne Model IFC300 or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install the electromagnetic flow meters in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings.

3.02 INSPECTION AND TESTING

A. After the electromagnetic flow meters' installation, conduct in the presence of the Engineer and Owner, such tests as necessary to verify the operation and accuracy of the meters.

B. Submit manufacturer's written reports with details and results of the tests and meter calibration.

C. If the electromagnetic flow meters' performance does not meet the Specifications, correct deficiencies or remove the meter and replace with a meter that satisfies the specified conditions.

D. Replace and retest any component parts, damaged as a result of testing or that fail to meet the requirements of these Specifications, at no additional cost to the Owner.

3.03 WARRANTY

A. A written manufacturer's warranty shall be provided for materials and labor extending for two (2) years from the established date of substantial completion.

3.04 OPERATOR TRAINING

A. Provide operator training for the electromagnetic flow meters in accordance with paragraph 1.05.C.

B. Coordinate with the Owner and Engineer prior to scheduling electromagnetic flow meters' testing and operator training and provide written confirmation a minimum of two (2) days prior the date(s) of testing and training.

3.05 SYSTEM REQUIREMENTS

A. Electromagnetic flow meter schedule:

Equipment Descriptor	Service	Meter Size (in.)	Liner Material	Location	Average Flow Rate (GPM)	Maximum Flow Rate (GPM)	Maximum Operating Pressure (PSI)
1101-FM-24MCK	Raw Sewage, McKissic Force Main	24”	Hard Rubber	Pumped Influent Meter Vault	2,020	10,500	10 PSI
1102-FM-12NOR	Raw Sewage, North Lift Station	12”	Hard Rubber	Pumped Influent Meter Vault	840	2,800	10 PSI
1103-FM-4LS4	Raw Sewage, Lift Station No. 4	4”	Hard Rubber	Pumped Influent Meter Vault	100	100	20 PSI
1400-FM-24INF1	Raw Sewage, Influent Meter No. 1	24”	Hard Rubber	Plant Influent Meter Vault	5,560	7,630	5 PSI
1403-FM-24INF2	Raw Sewage, Influent Meter No. 2	24”	Hard Rubber	Plant Influent Meter Vault	5,560	7,630	5 PSI
1404-FM-30WW	Wet Weather Raw Sewage	30”	Hard Rubber	Wet Weather Meter Vault	3,000	12,500	5 PSI
1303-FM-4GP01	Grit Classifier No. 1	4”	Ceramic	Influent Structure	300	300	10 PSI
1313-FM-4GP02	Grit Classifier No. 2	4”	Ceramic	Influent Structure	300	300	10 PSI
4410-FM-12SC1	Existing RAS No. 1	12”	Hard Rubber	Existing RAS No. 1 Meter Vault	1,260	2,100	20 PSI
4420-FM-12SC2	Existing RAS No. 2	12”	Hard Rubber	Existing RAS No. 2 Meter Vault	1,260	2,100	20 PSI
4530-FM-12SC3	RAS No. 2	12”	Hard Rubber	RAS No. 2 Meter Vault	1,260	2,100	20 PSI
4700-FM-6WAS-SW	Surface Wasting Pump Station	6”	Hard Rubber	Surface Wasting Pump Station Valve Vault	440	440	20 PSI
4701-FM-8WAS-SC	Waste Activated Sludge from Clarifiers	8”	Hard Rubber	Waste Meter Vault	200	600	20 PSI
4702-FM-6WAS-FLT	Filter Backwash	8”	Hard Rubber	Waste Meter Vault	400	1200	20 PSI

END OF SECTION

SECTION 14552

SCREW CONVEYORS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Equipment furnished under this section shall be fabricated and assembled in full conformity with Specifications, engineering data, instructions, and recommendations furnished by the equipment manufacturer unless exceptions are noted by Engineer.

B. Unless otherwise indicated, power supply to the equipment shall be 480volts, 60Hz, 3phase.

C. Welding Certification

1. Shop and field welding procedures, welders, and welding operators shall be qualified and certified in accordance with the applicable provisions of the Structural Welding Code, AWSD1.1, of the American Welding Society.

D. Qualifications

1. The conveyor supplier shall have installed similar equipment conveying the specified materials at wastewater facilities for at least five (5) years.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 01300 – Submittals

B. Section 01171 – Electric Motors

C. Section 01782 – Operation and Maintenance Data

D. Section 01783 – Product Warranties

E. Section 01810 – Equipment Startup and Testing

F. Division 3 – Concrete

G. Section 11331– Mechanical Bar Screens Without Bottom Sprockets

H. Section 11333 – Screenings Washer/Compactor

1.04 SUBMITTALS

A. Drawings and Data

1. Complete assembly and installation drawings, schematic and wiring diagrams, together with detailed specifications and data covering material used, parts, devices, and other accessories forming a part of the equipment furnished, shall be submitted in accordance with Section 01300, Submittals. The data and specifications for each conveyor shall include, but shall not be limited to, the following:

a. Screw Conveyors and Accessories:

1) Calculations for conveyor sizing, spiral strength (elongation), torque, and horsepower
2) Specifications for materials of construction
3) Detailed general arrangement drawings of conveyor system
4) Dimensions and weight of overall unit
5) Dimensions and weight of components (if shipped as components)
6) Locations of lift points and tie-down points
7) Details of all supports to be used by the unit when in place
8) Dead and live load details for all support locations
9) Rotating speed(s)
10) Detailed shop drawings of screw conveyors and trough body
11) Details of end and intermediate bearings
12) Details of shaft seal system
13) Location and size of all connections
14) Water inlet requirements; flow rate, pressure, temperature, and quality
15) Water discharge properties including pressure and temperature

b. Drive

1) Name of manufacturer
2) Type and model
3) Type of bearings and lubrication
4) Input/output speed(s)
5) Net weight
6) Service factor at installed horsepower

c. Motors

1) As specified in Section 01711, Electric Motors

B. Operation and Maintenance Data and Manuals

1. Operation and maintenance information shall be submitted as required in Section 01300, Submittals, and Section 01782, Operations and Maintenance Data. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

1.05 SPARE PARTS AND ACCESSORIES

A. The following spare parts and accessories shall be furnished in substantial wooden boxes with identifying labels and delivered to the Owner as directed. Spare parts shall be provided for each different type or size of conveyor.

Spare Part	Quantity, per screw
Packing gland sets	1 complete set
Bearings	1 set
Trough liner	1 complete set
Drive Shaft	1 set
Gearbox seals	1 set

1.06 WARRANTY

A. The manufacturer shall provide a warranty on the equipment specified herein in accordance with Section 01783, Product Warranties.

PART 2 PRODUCTS

2.01 SERVICE CONDITIONS

A. Screenings from the discharge of the bar screens into an inlet hopper directly above the screw conveyors, using a shaftless screw conveyor as specified. The conveyor shall transport the screenings to a washer/compactor.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

A. Conveyors shall be designed for the following performance and design requirements:

1. Design Capacity: 90 Cubic Feet/Hour
2. Type of Solids Screenings
3. Screw Diameter (Minimum): 12 inches
4. Maximum Allowable Fill: 40%
5. Screw Conveyor Type: Shaftless
6. Screw Speed (Maximum): 20 rpm
7. Angle of Incline (Maximum): 8 degrees
8. Reversing: No
9. Conveyor HP (Minimum) 2 Hp
10. Conveyor Motor Safety Factor 2.8

2.03 ACCEPTABLE MANUFACTURERS

A. Shaftless screw conveyor manufactures shall be JMS, Schwing, Spirac, Custom Conveyor, or approved equal.

2.04 MATERIALS

Flights	ASTM A514 steel with a minimum Brinell hardness of 235
Trough and cover	Type 304L stainless steel
Conveyor supports	Type 304L stainless steel
Discharge chute	Type 316L stainless steel

2.05 CONSTRUCTION

A. Each screw conveyor shall consist of troughs, covers, bearings, shaft seals, drive units, and support structure.

B. Conveyor manufacture shall provide safety equipment and safety guards as required by OSHA and as indicated in ASMEB20-1, Safety Standards for Conveyor and Related Equipment.

C. Conveyor Supports

1. Each conveyor shall be furnished complete with supports suitable for mounting and as required by the manufacturer's design and Supplier requirements. At a minimum, each screw conveyor trough shall have supports at the drive end and the tail end of the trough plus intermediate supports at a maximum of 12-foot intervals. All shop welding shall conform to the latest standards of American Welding Society (AWS). The supports shall be designed to avoid interference with other equipment or equipment supports. The supports shall be designed to prevent excessive vibration of any portion of the conveyor unit under all loading conditions.

2. Conveyor supports shall be designed for a minimum live load as specified herein. All structural supporting members shall be designed such that the ratio of the untraced length to least radius of gyration (slenderness ratio) shall not exceed 120 for any compression member and shall not exceed 240 for any tension member (of angles about Z-Zaxis). In addition, all structural members and connections shall be designed so that the unit stresses will not exceed the AISC allowable stresses by more than1/3when subject to loading of twice the maximum design operating torque of the screw conveyor drive motors.

D. Flighting

1. Shaftless screw conveyors shall consist of spiral flighting only attached to a flanged connecting plate. Spiral flighting for the shaftless screw conveyors shall be designed to convey material without a center shaft or hanger bearings.

2. Each screw conveyor shall be provided with inner and outer spirals to increase axial strength and capacity. Conveyors shall have an inner flight thickness shall not be less than 3/4 inch and outer flight thickness shall not be less than one inch. Minimum cross-sectional area for conveyors having a diameter smaller than 15 inches shall

be 2.9 in2 and conveyors having a diameter of 15 inches and larger shall be 4.3 in2. The spiral flights shall be designed for the maximum torque requirements of the equipment specified. The "spring effect" of the spiral shall not exceed 30 mils per foot of length assuming the conveyor is completely full (100% fill factor) of the material specified herein. Flights shall be formed from cold spring steel having a minimum 72,000 psi tensile strength and a minimum 220 Brinell hardness.

3. Spiral flighting shall have full penetration welds at all splice connections. The flights shall be aligned to assure true alignment when assembled and shall be made according to the manufacturer's recommendations. The connection of the spiral to the drive system shall be through a flanged connection plate that is welded to the spiral and shall form a smooth and continuous transformation from the flange plate to the spiral. The drive shaft shall have a mating matching flange and shall be bolted to the spiral connection plate.

E. Troughs

1. Troughs shall be U-shaped and shall conform to Conveyor Equipment Manufacturers Association (CEMA)300. Troughs shall be minimum 1/4-inch thick and shall be equipped with inlet and discharge flanged connections where indicated on the drawing. The outlet openings in the trough bottom shall be sized to prevent screw conveyor plugging. The portion of each trough that is not covered by the inlet opening shall be covered. Covers shall conform to CEMA 300 and shall be bolted and gasketed to the conveyor. The covers shall be manufactured in less than 4 foot lengths to allow for access. Stiffeners shall be placed across the top of the trough and fastened to both sides of the trough to maintain trough shape and act as a seal face for the covers. A continuous neoprene gasket shall be applied to entire top face of trough top flange and stiffeners. Support saddles shall be provided on the bottom of the troughs where indicated on the Drawings or as recommended by the manufacturer. Maximum spacing shall be 12 feet. Troughs shall be segmented in 10’ to 12’ sections.

2. Wear liners shall cover the bottom 180degrees of the trough. Wear liners shall be ultra-high molecular weight (UHMW) polyethylene. The wear liners shall be manufactured in sections 4 feet or less to allow for replacement.

F. Fasteners

1. All bolts, nuts, washers, and other fasteners shall be constructed of stainless steel.

G. Fabrication

1. All stainless steel shall be pickled in accordance with ASTMA380 at the mill before being shipped.

2. All stainless-steel surfaces shall be adequately protected during fabrication, shipping, handling, and installation to prevent contamination from iron or carbon steel objects or surfaces. Particulate matter shall be removed from piping and welds. Welds shall be either mechanically cleaned or pickled or passivated.

2.06 DRIVE UNITS

A. Each conveyor shall be driven by an electric motor through a direct drive gear reducer. Drive units shall be designed for 24-hour continuous service.

B. Gear Reducers

1. Gear reducers shall be a totally enclosed unit with oil or grease lubricated, rolling element, antifriction bearings throughout. Gear reducers shall be AGMA Class II, single or double reduction, helical gear units with high-capacity roller bearings. Bearings shall be designed for the maximum thrust during startup of a conveyor completely full (100 percent fill factor) of the material specified herein, and shall have a minimum ABMA L10 Life Rating of 100,000 hours. The reducers shall be standard air-cooled units with no auxiliary cooling allowed. The gear housing shall be of 30,000 psi [207 MPa] cast iron, with removable inspection cover(s), oil breather(s), oil level indication, fill and drain holes with plugs; gearing lubricated through an oil bath for the mounting position and inclination required. The gear reducer shall be sized with a torque service factor of 1.5 based on motor nameplate, at the driven (output) shaft speed, whichever is greater. Gear motors in which the motor is integral with the gear reducer is not acceptable.

C. Electric Motors

1. The design of the electric motors shall be as specified in Section 01711, Electric Motors. When required, reversing type motors shall be provided. Maximum motor speed shall be 1800 rpm.

2.07 ACCESSORIES

A. Chutes

1. An inlet and discharge chute shall be provided. Chutes shall be a minimum of 10-gauge Type 315 stainless steel. Chute shall be flanged to match the conveyor connection.

B. Flexible Connections

1. Connections between screw conveyors and equipment shall be provided with flexible connections where indicated on the Drawings. The flexible connections shall be flanged, fabricated from reinforced neoprene or Hypalon and shall have a minimum 6-inch laying length. Stainless steel bolts with stainless steel retainer plates shall be provided at each end of flexible connections. Flexible connections shall be designed to accommodate lateral and vertical movements of not less than 3/8 inch.

C. Automatic Lubrication

1. Each conveyor bearing shall be served with its own separate automatic grease lubrication system. The grease system shall automatically provide a continuous supply of lubricant to each bearing. Lubricant for intermediate bearings shall enter

the bearing from the top with the lubrication line enclosed within the intermediate bearing support housing to prevent damage. Tubing shall be1/4-inch stainless steel.

2.08 CONTROLS

A. The screw conveyor shall be powered and controlled by the Bar Screen and Screenings/Washer Control Panel PLC and operate based on an energized timer signal from the Bar Screen.

B. The I/O signals listed below shall be the minimum required for controls interface with the SCADA system:

1. Conveyor motor running forward
2. Conveyor motor running in reverse
3. Zero speed
4. Emergency stop switch activated
5. Remote control selected
6. Motor high temperature or overload fault

C. The conveyor motor space heater shall be energized when the motor is not operating. The zero-speed switch shall be powered from the control panel and shall de-energize the motor starter if energized while the conveyor is not running. The conveyor shall shut down when the emergency stop switch is activated. Shut down by any safety or equipment protection devices shall require reset at the control panel.

D. Terminals for all control signal and 120VAC connections shall be sized for minimum No.14 AWG wire.

E. Conveyor Mounted Switches

1. All conveyor mounted switches shall be furnished for Class 1 Division 2 hazardous location or shall be intrinsically safe circuits from the control panel. Each switch shall be furnished and mounted as an integral part of the conveyor equipment and framework. All switches shall have 10-amp, 115/120 volts AC, 60Hz, rating.

2. Zero-Speed Switch

a. A zero-speed switch shall be provided on the conveyor to detect loss of speed. The zero-speed switch shall be of the non-contacting type. The zero-speed switch shall provide a contact output which opens to indicate zero speed and automatically resets or closes when the machine is operating. The zero-speed switch shall be coordinated to properly operate over the full speed range of the driven equipment. The zero-speed switch shall be furnished for Class 1 Division 2 hazardous location or shall be intrinsically safe circuits from the control panel.

3. Emergency Stop Switches

a. Screw conveyors shall be equipped with two (2) emergency stop safety switches, each with two (2) normally closed double break contacts. Contacts shall be manually reset. Switches shall be equipped with a latching mechanism and a weight and cable along the length of the conveyor for operation of the switch.

Switches shall be opened by cable linkage mounted on all sides of the conveyor. Cables shall be plastic covered metal cable (blaze orange color) and shall be located along the conveyor within easy reach of operating personnel who may be maintaining or observing the operating conveyor. The switches Class 1 Division 2 hazardous location or shall be intrinsically safe circuits from the control panel.

F. Electronic Shear Pins

1. Electronic shear pins shall be provided for each screw conveyors. Units shall provide overload protection with built-in reset button, test button, and fail-safe contacts. Electric shear pins shall be Tsubaki “Shock Relay TWBSS” or equal. Electronic shear pins shall be delivered to the electrical subcontractor for installation in the conveyor motor starter.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. Installation Check

1. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation in accordance with Section 01810, Equipment Startup and Testing, and shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

2. The manufacturer’s representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

3. All costs for these services shall be included in the contract price.

B. Installation Supervision

1. Installation supervision by the manufacturer is not required.

3.02 PERFORMANCE TEST

A. The performance test shall be conducted by the Contractor to demonstrate that the screw conveyors are operating properly and capable of meeting the specified performance and design requirements.

3.03 TRAINING

A. The manufacturer shall provide training for the Owner in the proper operation and maintenance of the equipment. The Owner has the option of recording all tests and trainings on video for future use.

B. Manufacturer's representatives who will provide training shall be factory trained, articulate in the English language, and knowledgeable in the installation, operation, and maintenance.

C. Operations Training

1. The manufacturer shall provide operations training to the Owner's operations personnel. Time for training shall be for four hours for each of the two shifts. The training will be scheduled for normal shift times. The training shall cover all components of the pumps, including instructions on startup, shutdown, normal operating procedures, emergency conditions, and use of the control system.

D. Maintenance Training

1. Training shall also include maintenance training for the Owner's mechanical, and instrumentation and control maintenance personnel. Maintenance training shall include onsite review of equipment maintenance requirements for four hours for one shift.

END OF SECTION

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SECTION 14900

MONORAIL AND HOIST SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required and install, test, paint, and place in satisfactory operation the monorail system and hoist as shown on the Drawings and as specified herein.

B. The system shall be complete with track, trolley, hoist, hangers, clips, stops, fittings, bracing, supporting steel (other than main structural system), festoon cable system, and all appurtenances necessary to complete the installation.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 05120 – Structural Steel

B. Section 05500 – Miscellaneous Metal

C. Section 09902 – Finish Painting

D. Division 16 – Electrical

1.04 SUBMITTALS

A. Shop drawings shall be submitted to the Engineer in accordance with Section 01300, Submittals. Drawings shall show erection methods and details.

B. Six (6) copies of a certificate of compliance with the Department of Labor Occupational Safety and Health Standards, Part 1910, Subpart N, Section 1910.179, Overhead and Gantry Cranes shall be submitted at the time that shop drawings are submitted.

C. Operating and Maintenance information shall be furnished to the Engineer as provided in Section 01782, Operation and Maintenance Data.

1.05 QUALITY ASSURANCE

A. All of the monorail track equipment on monorail track shall be products of single, experienced, reputable, and qualified manufacturer who is a member of the Monorail Manufacturers Association. Carrier equipment for hoists on the monorail track shall be provided by the hoist manufacturer.

B. All of the hoisting equipment shall be the product of a single, experienced, reputable, and qualified manufacturer who is a member of the Hoist Manufacturers Institute (HMI). All hoisting equipment shall be HMI service classification H-3, or better, and fully compatible with monorail track and carrier equipment.

C. It is the responsibility of the Contractor to guarantee that the monorail and hoisting equipment shall be completely operational in the locations shown on the Drawings.

D. All structural steel members of the handling system shall be designed in accordance with the specifications of the American Institute of Steel Construction, current edition and any welded construction shall be in accordance with the standards of the American Welding Society and comply with Section 05120, Structural Steel.

E. Castings, forgings, stampings, and other structural elements shall have a safety factor of 5.

F. All equipment shall meet or exceed the requirements of OSHA.

G. A manufacturer’s factory representative who has complete knowledge of proper startup, installation, and operation and maintenance shall be provided for 2 hours (minimum) to instruct representatives of the Owner and Engineer on proper startup and operation and maintenance. This work may be done in conjunction with the inspection of the installation and test run as provided under Part 3.

1.06 SYSTEMS DESCRIPTION

A. One (1) monorail and hoist system shall be installed underneath the Tertiary Filter Canopy over the Tertiary Filters.

1. Service Classification – Class A

2. Hoist – Low Headroom, Electric, Pendant Push Button Operated

a. Lift Capacity – 1 ton
b. Minimum Lift – 30 feet
c. Lift Speed – Single (8 fpm)
d. Minimum HP – 1.0

e. Chain Container is required
f. Variable Frequency Drive

3. Carrier (Trolley) – Manual

a. Supplier – Hoist Manufacturer

4. Electrification and Control

a. Electrification Type – Festoon Cable System

b. Control Station – Pushbutton Pendant Station

c. 120v 1-Phase power supply for the festoon cable system shall be terminated in a junction box within 10-feet of the end of the trolley

B. One (1) monorail and hoist system shall be installed underneath the Tertiary Filter Canopy over the Post-Aeration Blowers.

1. Service Classification – Class A

2. Hoist – Low Headroom, Electric, Pendant Push Button Operated

a. Lift Capacity – 1 ton
b. Minimum Lift – 30 feet
c. Lift Speed – Single (8 fpm)
d. Minimum HP – 1.0
e. Chain Container is required
f. Variable Frequency Drive

3. Carrier (Trolley) – Manual

a. Supplier – Hoist Manufacturer

4. Electrification and Control

a. Electrification Type – Festoon Cable System

b. Control Station – Pushbutton Pendant Station

c. 120v 1-Phase power supply for the festoon cable system shall be terminated in a junction box within 10-feet of the end of the trolley

PART 2 PRODUCTS

2.01 GENERAL

A. These specifications call attention to certain features, but do not purport to cover all details of construction of the units.

B. All equipment shall have a minimum service classification of Class A (Infrequent or Standby).

C. All hoisting and trolley equipment shall be manufactured by Columbus McKinnon Corporation CM Industrial Products, Amherst, NY; Eaton Corporation (Yale) Hoisting Equipment Division, Forrest City, AR; Harnischfeger (P & H), Milwaukee, WI, or equal.

2.02 RUNWAY AND MONORAIL TRACK (NOT USED)

2.03 SUSPENSION FITTINGS

A. All necessary clamps, hanger rods and other fittings from which a track or runway is supported shall be provided as part of the system. Hanger shall be spaced as shown on the Drawings to support the load resulting from the maximum loading condition.

B. The Contractor shall coordinate with the monorail equipment to determine type and sizes of connections required to fasten the suspension fittings to the supporting structure.

C. Means shall be provided, on flexible type rod suspensions, to allow for minimum 1-inch vertical adjustment of the track both before and after the system has been put in operation so that the track can be erected and maintained level.

D. Where the track is suspended from hanger rods, lock nuts or other means shall be provided to prevent the nuts from backing off the rods.

E. Where track system is suspended by flexible type rod suspensions, the system shall be braced laterally and longitudinally to prevent excessive sway. All bracing is to be provided by the monorail erector.

F. All suspension fittings shall be furnished with S. A. E. Grade 5 or ASTM A325 mounting bolts.

G. In the design of hanger rods, the allowable stress shall be 20 percent of the ultimate strength of the material used and shall be determined from the root area of the rod.

2.04 CARRIERS OR TROLLEYS

A. Wheels shall be drop-forge steel, induction hardened to a minimum of 425 Brinnel. Bearings shall be double row, combination radial and thrust anti-friction precision type. They shall be pre-lubricated and sealed and have a minimum B-10 bearing life of 5,000 hours.

B. Motor propelled carriers shall have a travel speed as specified in Paragraph 1.05.

C. Drive motors for carriers shall be totally enclosed non-ventilated duty rated for the application and shall conform to all applicable portions of Division 16. Motor power circuits shall be powered by a variable frequency drive to provide smooth and uniform acceleration.

2.05 HOISTS

A. Electric chain hoists shall be 1-ton capacity parallel mounted type having a single speed with a weight operated overload cutoff. The lift distances of the hoist shall be as specified in Paragraph 1.05.

B. The hoist shall be furnished with a non-motor driven trolley suitable for operation on the monorail track. The trolley shall have a sufficient capacity to carry the hoist plus the full rated load of the hoist.

C. The hoist shall be equipped with a mechanical load brake and a separate electrically activated motor brake. Hoists shall have oil bath lubricated gearing and anti-friction bearings throughout.

D. The hoists shall be equipped with upper and lower geared limit switches and load limiting device to prevent overload. The load limiting device shall prevent damage to the hoist and ancillary equipment due to an overload condition. Load limiting device shall be such that not more than 150 percent of the hoist capacity may be lifted at any time.

E. Motor horsepower shall be minimum 1 HP and suitable for operation on a 480 V, 3-phase, 60 Hz power supply. Hoist motor shall be totally enclosed non-ventilated duty rated for the application and shall conform to all applicable portions of Division 16. The hoist motor shall be powered by a variable frequency drive to provide smooth and uniform acceleration.

F. The hoist shall be pendant push button operated. The pendant shall be suspended from the hoist. The pendant shall have a single speed "Raise" and "Lower" buttons for the hoists and a single speed "Forward" and "Reverse" buttons for the trolley. The pendant shall contain an on-off switch which will disconnect power to the equipment.

2.06 ELECTRIFICATION

A. Electrification shall be festoon cable, attached, or mounted parallel to the monorail track. The festoon cable system shall be supplied complete with all necessary support brackets, cable trolleys, cable supports, support insulators, power feeds, and cable sufficient for the length of travel.

2.07 TRACK SWITCHES

A. Track switch design shall provide for a movable inner frame operating rollers from one throw position to another which is locked into position fore and aft by positive locking pins.

B. Stops shall be provided as an integral part of the switch to protect the end of an incoming track when the switch track is set against the incoming track and shall resist the impact forces of a fully loaded carrier traveling at a normal walking speed or at 50 percent (50%) of the full load speed if the carrier is motor propelled. Stops shall be provided to prevent a carrier (or trolley) on the movable track from running off the movable track when it is not engaged with an incoming track.

C. Inner and outer switch frames shall be fixture assembled and made of structural weldments.

D. Outer switch frame shall be designed for four-point suspension. Switch shall be directly bolted to the supporting structure which shall be rigidly braced.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation shall be in strict accordance with the respective instructions of the manufacturer and in the location shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations.

3.02 INSPECTION AND TESTING

A. The Contractor shall require the manufacturer to furnish the services of a factory representative for 4 hours (minimum) who has complete knowledge of proper operation and maintenance to inspect the final installation and supervise a test of equipment. These services may be combined with those provided under Paragraph 1.04.G.

B. Working under the direction of the manufacturer, and in the presence of the Engineer, the Contractor shall perform field tests as follows:

1. Full load operating tests on all monorail systems including deflection measurements on the monorail track.

2. The Contractor shall furnish the labor and weights for testing capacity of hoists.

3. In the event that the equipment fails to meet the above test, the necessary changes shall be made and the equipment re-tested. If the equipment remains unable to meet the test requirements to the satisfaction of the Engineer, it shall be removed and replaced with satisfactory equipment at the expense of the Contractor.

C. All defects recorded during the above field tests and all defects and failures occurring within the first year of operation shall be corrected by the Contractor.

D. The monorail system shall be re-certified 12 months following the initial monorail system certification.

END OF SECTION

SECTION 15020

MISCELLANEOUS PIPING AND ACCESSORIES INSTALLATION

PART 1 GENERAL

1.01 SCOPE

A. This section covers the installation of piping and accessories as indicated on the Drawings for the following piping sections:

1. Stainless Steel Pipe and Alloy Pipe, Tubing, and Accessories
2. Miscellaneous Plastic Pipe, Tubing, and Accessories
3. Cast Iron Soil Pipe and Accessories
4. Copper Tubing and Accessories

B. Contractor shall furnish all necessary jointing materials, coatings, and accessories that are specified herein.

C. Pipe supports and anchors shall be furnished by Contractor, and are covered in the Pipe Hangers and Supports section. Pipe trenching and backfilling are covered in Division 2.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 GENERAL

A. Coordination

1. Materials installed under this section shall be installed in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the manufacturer, unless exceptions are noted by Engineer.

1.04 SUBMITTALS

A. Drawings and Data

1. Complete specifications, data, and catalog cuts or drawings shall be submitted in accordance with the Submittals section. Items requiring submittals shall include, but not be limited to, the following:

a. Materials as specified herein.

B. Welder Certification

1. Prior to the start of the work, Contractor shall submit a list of the welders he proposes using and the type of welding for which each has been qualified. Copy of certification and identification stamp shall be submitted for each welder. Qualification tests may be waived if evidence of prior qualification is deemed suitable by Engineer.

C. Spool Drawings

1. Spool drawings indicating the complete line, showing all welded and assembly items, except for insulation shoes or nonstress-relieved lines, shall be developed and submitted.

1.05 QUALITY ASSURANCE

A. Welding and Brazing Qualifications

1. All welding and brazing procedures and operators shall be qualified by an independent testing laboratory in accordance with the applicable provisions of Section IX of the ASME Code. All procedure and operator qualifications shall be submitted to the Engineer for review.

B. Tolerances

1. These tolerances apply to in-line items and connections for other lines.

2. The general dimension, such as face-to-face, face or end-to-end, face- or end-to center, and center-to-center shall be 1/8 inch.

3. The inclination of flange face from true in any direction shall not exceed 3/64 inch per foot.

4. Rotation of flange bolt holes shall not exceed 1/16 inch.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Shipping shall be in accordance with the Materials, Transportation and Handling section. Handling and storage shall be in accordance with the Materials, Transportation and Handling section. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

B. Plastic pipe, tubing, and fittings shall be stored between 40°F and 90°F.

C. Coated Pipe

1. Handling methods and equipment used shall prevent damage to the protective coating and shall include the use of end hooks, padded calipers, and nylon or similar fabric slings with spreader bars. Bare cables, chains, or metal bars shall not be used. Coated pipe shall be stored off the ground on wide, padded skids. Plastic-coated pipe shall be covered or otherwise protected from exposure to sunlight.

PART 2 PRODUCTS

2.01 SERVICE CONDITIONS

A. Pipe, tubing, and fittings covered herein shall be installed in the services indicated in the various pipe sections.

2.02 MATERIALS

A. Threaded Fittings

1. AntiSeize Thread Lubricant: JetLube "Nikal". John Crane "Thread Gard Nickel". NeverSeez "Pure Nickel Special". or Permatex "Nickel AntiSeize".

2. Teflon Thread Sealer: Paste type; Hercules "Realtuff", John Crane "JC30", or Permatex "Thread Sealant with Teflon".

3. Teflon Thread Tape: Hercules "Tape Dope" or John Crane "Thread Tape".

B. Solvent Welded Fittings

1. Solvent Cement for PVC Systems: ASTM D2564

2. Solvent Cement for CPVC Systems: ASTM F493

a. Sodium Hypochlorite, Sodium Hydroxide, and Sodium Bisulfate Service: IPS Corporation "Weld-On 724

3. Primer for PVC Systems: ASTM F656

C. Solder or Brazed Fittings

1. Solder: Solid wire, ASTM B32, ANSI/NSF 61 certified; Alloy Grade Sb5, (95-5)

2. Soldering Flux: Paste type, ASTM B813

3. Brazing Filler Metal: AWS A5.8, BCuP-5; Engelhard "Silvaloy 15". Goldsmith "GB-15". or Handy & Harman "Sil-Fos"

4. Brazing Flux: Paste type, Fed Spec O-F-499, Type B

D. Insulating Fittings

1. Threaded: Dielectric steel pipe nipple, ASTM A53, Schedule 40, polypropylene-lined, zinc plated, Perfection Corp. “Clearflow Fittings”. Fittings shall be suitable for the service.

2. Flanged: Epco “Dielectric Flange Unions” or Central Plastics “Insulating Flange Unions”. Fittings shall be suitable for the service.

E. Pipe Insulation: See Thermal Insulation for Piping and Mechanical Insulation for Building Mechanical sections.

F. Protective Coatings

1. Tape Wrap: ANSI/AWWA C209, except single ply tape thickness shall not be less than 30 mils ; Protecto Wrap “200” or Tapecoat “CT”.

2. Primer: As recommended by the tape manufacturer.

3. Coal Tar Epoxy: High build coal tar epoxy; PPG Amercoat “Amercoat 78HB Coal Tar Epoxy”. Carboline “Bitumastic 300 M”. Tnemec “46H-413 Hi-Build Tneme-Tar”. or Sherwin-Williams “Hi-Mil Sher-Tar Epoxy”.

4. Epoxy for aeration and process air piping: Shop or field applied high solids epoxy; suitable for protection at continuous pipe wall temperatures up to 300° F. Coating shall be abrasion resistant. The finished coating shall have a minimum total film thickness of 10 mils. The surface shall be prepared in accordance with SSPC-SP7 as a minimum unless otherwise recommended by the coating manufacturer. The coating shall be Carboline “Thermaline 450”. PPG Amercoat “Amerlock 400 with Amercoat 880 Additive”. or approved equal.

PART 3 EXECUTION

3.01 INSPECTION

A. All piping components shall be inspected for damage and cleanliness before being installed. Any material damaged or contaminated in handling on the job shall not be used unless it is repaired and recleaned to the original requirements by Contractor. Such material shall be segregated from the clean material and shall be inspected and approved by Owner or his representative before its use.

3.02 PREPARATION

A. Field Measurement

1. Pipe shall be cut to measurements taken at the site, not from the Drawings. All necessary provisions shall be made in laying out piping to allow for expansion and contraction. Piping shall not obstruct openings or passageways. Pipes shall be held free of contact with building construction to avoid transmission of noise resulting from expansion.

3.03 INSTALLATION

A. General

1. All instruments and specialty items shall be installed according to the manufacturer's instructions and with sufficient clearance and access for ease of operation and maintenance.

2. Flat faced wrenches and vises shall be used for copper tubing systems. Pipe wrenches and vises with toothed jaws will damage copper materials and shall not be used. Bends in soft temper tubing shall be shaped with bending tools.

B. Pipe Sleeves

1. Piping passing through concrete or masonry shall be installed through sleeves that have been installed before the concrete is placed or when masonry is laid. Pipe sleeves installed through floors with a special finish, such as ceramic or vinyl composition tile, shall be flush with the finished floor surface and shall be provided with nickel or chromium plated floor plates. Unless otherwise indicated on the Drawings, in all other locations where pipes pass through floors, pipe sleeves shall project not less than 1 inch nor more than 2 inches above the floor surface, with the projections uniform within each area. In the case of insulated pipes, the insulation shall extend through pipe sleeves. Where the Drawings indicate future installation of pipe, sleeves fitted with suitable plastic caps or plugs shall be provided.

2. Holes drilled with a suitable rotary drill will be considered instead of sleeves for piping which passes through interior walls and through floors with a special finish.

3. Unless otherwise indicated on the Drawings, all pipes passing through walls or slabs which have one side in contact with earth or exposed to the weather shall be sealed watertight with special rubber-gasketed sleeve and joint assemblies, or with sleeves and modular rubber sealing elements.

4. Piping shall be made dust tight and gas tight with special rubber-gasketed sleeve and joint assemblies; with sleeves sealed with modular rubber sealing elements; or by caulking with oakum and polysulfide or urethane sealant, when passing through the following locations indicated on the Drawings.

C. Pipe Joints

1. Pipe joints shall be carefully and neatly made in accordance with the indicated requirements.

2. Threaded

a. Pipe threads shall conform to ANSI/ASME B1.20.1, NPT, and shall be fully and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed after threading and before assembly to remove all burrs. Unless otherwise indicated, threaded joints shall be made up with teflon thread tape, thread sealer, or a suitable joint compound.

b. Threaded joints in plastic piping shall be made up with teflon thread tape applied to all male threads. Threaded joints in stainless steel piping shall be made up with teflon thread sealer and teflon thread tape applied to all male threads. Threaded joints in steel piping for chlorine service shall be made up with teflon thread tape or litharge and glycerin paste applied to all male threads.

3. Compression

a. Ends of tubing shall be cut square and all burrs shall be removed. The tubing end shall be fully inserted into the compression fitting and the nut shall be tightened not less than 11/4 turns and not more than 11/2 turns past finger tight, or as recommended by the fitting manufacturer, to produce a leak tight, torque free connection.

4. Flared

a. Ends of annealed copper tubing shall be cut square, and all burrs shall be removed prior to flaring. Ends shall be uniformly flared without scratches or grooves. Fittings shall be tightened as needed to produce leak tight connections.

5. Soldered and Brazed

a. Where solder fittings are specified for lines smaller than 2 inches , joints may be soldered or brazed at the option of Contractor. Brazing alloy shall contain no tin.

b. Surfaces to be joined shall be thoroughly cleaned with flint paper and coated with a thin film of flux. At each joint, tubing shall enter to the full depth of the fitting socket.

c. Care shall be taken to avoid overheating the metal or flux. Each joint shall be uniformly heated to the extent that filler metal will melt on contact. While the joint is still hot, surplus filler metal and flux shall be removed with a rag or brush.]

6. Solvent Welded

a. Solvent welded connections shall only be used for PVC or CPVC pipe. All joint preparation, cutting, and jointing procedures shall comply with the pipe manufacturer's recommendations and ASTM D2855. Pipe ends shall be beveled or chamfered to the dimensions recommended by the manufacturer. Newly assembled joints shall be suitably blocked or restrained to prevent movement during the setting time recommended by the manufacturer. Pressure testing of solvent welded piping systems shall not be performed until the applicable curing time, as set forth in Table X2.1 of ASTM D2855, has elapsed. Solvent welding shall be performed by bonding operators who have met the requirements of ASME B31.3 and A328.

7. Epoxy and Adhesive Bonded

a. Epoxy and adhesive bonded joints shall only be used for FRP pipe. All joint preparation, cutting, and jointing procedures shall comply with the pipe manufacturer's recommendations. Adhesive shall be mixed and applied in

accordance with the manufacturer's recommendations. After joining, either the pipe or the fitting shall be rotated approximately one-half turn to uniformly distribute adhesive. A slight fillet of adhesive at the bond line is desirable, but all excess adhesive shall be wiped off immediately. Newly assembled joints shall be suitably blocked or restrained to prevent movement during the curing period recommended by the manufacturer.

8. Flanged

   a. Flange bolts shall be tightened sufficiently to slightly compress the gasket and effect a seal, but shall not be torqued less than the minimum value required by the gasket manufacturer. Flange bolts shall not be so tight as to fracture or distort the flanges. A plain washer shall be installed under the head and nut of bolts connecting plastic pipe flanges. Antiseize thread lubricant shall be applied to the threaded portion of all stainless-steel bolts during assembly.

   b. Flange bolt holes shall be oriented as follows, unless otherwise indicated on the spool drawings:

   c. Vertical flange face: Bolt holes to straddle the vertical centerline.

   d. Horizontal flange face: Both holes shall be aligned with connecting pipe.

   e. Pipe sealants, thread compounds, or other coatings shall not be applied to flange gaskets unless recommended by the gasket manufacturer for the specified service and approved by Engineer.

   f. Welds at orifice flanges shall have internal surfaces ground smooth to the pipe wall.

   g. Slip-on flanges shall be welded inside and outside. There shall be a distance of approximately 1/16 to 1/8 inch between the edge of the fillet weld and the face of the flange. The seal weld shall be applied so that the flange face shall be free of weld spatter and does not require refacing.

   h. Flat-faced flanges shall be used when mating to Class 125 flanges. Full-face gaskets shall be used with flat-faced flanges and ring gaskets shall be used with raised faced flanges.

   i. Weld neck flanges shall be used with butt-weld fittings. The bore of weld neck flanges shall match the pipe wall thickness.

   j. Insulating joints connecting submerged (buried) piping to exposed piping shall be installed above the maximum water surface elevation and before the first pipe support not having coated anchor bolts or adhesive-bonded concrete anchors. All submerged (buried) metallic piping shall be isolated from the concrete reinforcement. Insulating flanges shall be tested for electrical isolation after installation and bolt-up but prior to introduction of conducting fluid.

9. Welded

    a. Welding shall conform to the specifications and recommendations contained in the "Code for Pressure Piping", ANSI B31.1.

    b. Weld cross-sections shall be equal to or greater than the pipe wall thickness. Welds shall be smooth and continuous and shall have interior projections no greater than 1/16 inch. Backing strips or rings shall not be used except with specific prior review by Engineer as to use, material, and design. Root gap inserts that are completely melted and consumed in the weld bead are acceptable only when reviewed in advance by Engineer.

    c. Stainless steel welding shall be inert gas tungsten arc (TIG) or the direct current, straight polarity, inert gas metal arc process (MIG). Refer to the Stainless Steel Pipe and Alloy Pipe, Tubing, and Accessories section for additional welding requirements.

    d. Carbon steel welding shall be made by the shielded metal arc process.

    e. For socket weld joints, fully engage the two pipe ends, then separate them by 1/16 inches prior to welding to all space for shrinkage.

10. Grooved Couplings

    a. Grooves for grooved couplings shall be cut with a specially designed grooving tool. Grooves cut in steel pipe shall conform to flexible grooving dimensions, as set forth in AWWA C606, and shall be clean and sharp without burrs or check marks.

11. Pushon

    a. Gasket installation and other jointing procedures shall be in accordance with the recommendations of the manufacturer. Each spigot end shall be suitably beveled to facilitate assembly. All joint surfaces shall be lubricated with a heavy vegetable soap solution immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean.

12. Rubber-Gasketed

    a. Rubber-gasketed joints for hub and spigot type cast iron soil pipe shall have plain spigot ends, without beads. Cut ends of all pipe shall be cut square, beveled, and all burrs shall be removed. Spigot ends shall be coated with a lubricant recommended by the gasket manufacturer and fully seated in the gasket. Clamps for hubless cast iron soil pipe shall be installed in accordance with the manufacturer's recommendations.

13. Other Pipe Joints

    a. Coupled joints in tempered glass pipe, plastic joints in vitrified clay pipe, and other proprietary type joints shall be made in accordance with the manufacturer's recommendations and to the satisfaction of Engineer.

D. Pipe

1. Pipe shall be installed as specified, as indicated on the Drawings, or, in the absence of detail piping arrangement, in a manner acceptable to Engineer.

2. Piping shall be installed without springing or forcing the pipe in a manner which would induce stresses in the pipe, valves, or connecting equipment.

3. Piping shall be supported in conformance with the Pipe Hangers and Supports section.

4. Piping shall be connected to equipment by flanges or unions as specified in the various piping sections. Piping connecting to equipment shall be supported by a pipe support and not by the equipment.

5. Water, gas, and air supply piping shall be provided with a shutoff valve and union at each fixture or unit of equipment, whether or not indicated on the Drawings, to permit isolation and disconnection of each item without disturbing the remainder of the system. Air supply piping shall be provided with sectionalizing valves and valved air inlet connections as needed for isolation of portions of the system for periodic testing. Gas supply lines to buildings shall be provided with a shutoff valve and union located above grade immediately outside the building. A capped drip leg shall be provided at the bottom of the vertical riser of gas supply piping adjacent to gas fired appliances.

6. A union shall be provided within 2 feet [600 mm] of each threaded-end valve unless there are other connections which will permit easy removal of the valve. Unions shall also be provided in piping adjacent to devices or equipment which may require removal in the future and where required by the Drawings or the Specifications.

7. All air piping shall be graded to points of drainage collection where drip legs and drain valves shall be provided. Air piping shall be sized for the service conditions, with the indicated minimum sizes:

Service	**Minimum Size**
Air signal	1/4 inch OD
Air supply	1/2 inch OD
Buried piping	3/4 inch

8. Water supply piping within structures shall be arranged, and facilities provided, for complete drainage. All piping serving metering equipment shall be uniformly graded so that air traps are eliminated and complete venting is provided.

9. Stuffing box leakage from water sealed pumps shall be piped to the nearest point of drainage collection.

10. Taps for pressure gauge connections on the suction and discharge of pumping units shall be provided with a nipple and a ball type shutoff valve.

11. Drilling and tapping of pipe walls for installation of pressure gauges or switches will not be permitted.

12. In all piping, insulating fittings shall be provided to prevent contact of dissimilar metals, including but not limited to, contact of copper, brass, or bronze pipe, tubing, fittings, valves, or appurtenances, or stainless-steel pipe, tubing, fittings, valves, or appurtenances with iron or steel pipe, fittings, valves, or appurtenances. Insulating fittings shall also be provided to prevent contact of copper, brass, or bronze pipe, tubing, fittings, valves or appurtenances with stainless steel pipe, tubing, fittings, valves, or appurtenances.

13. Branch connections in horizontal runs of steam, air, and gas piping shall be made from the top of the pipe.

14. Buried PVC piping shall be "snaked" in the trench and shall be kept as cool as possible during installation. PVC pipe shall be kept shaded and shall be covered with backfill immediately after installation.

15. All chemical piping shall be installed so that lines are readily accessible for cleaning. Tees shall be provided at regular intervals in all chemical piping except chlorine piping, with extra openings plugged, to facilitate cleaning. Teflon thread tape or teflon thread sealer shall be applied to the threads of the plugs so that they can be easily removed. At each point where hose or reinforced plastic tubing is connected to rigid piping, a quick disconnect coupling shall be provided.

16. Vent and gas piping for anhydrous ammonia, chlorine and sulfur dioxide gas shall be installed so that liquid traps are avoided. The open end of each vent line shall elbow down and shall be provided with a corrosion resistant insect screen.

17. Double-contained chemical feed piping shall be installed according to the manufacturer's recommendations. Joints shall be solvent cemented. Splitting and rewelding of fittings will not be acceptable. Suitable drains and vents shall be provided to permit complete drainage of both the primary and secondary containment piping. Interstitial supporting devices shall be designed to allow continuous drainage in the annular space to the drain ports. Drain fittings shall be designed to allow a valve attachment to be made so that the secondary containment compartment can be readily drained and manually inspected for leaks.

18. Piping adjacent to flow sensors shall be installed in accordance with the requirements of the manufacturer of the flow sensor and commonly accepted design practices of the appropriate straight pipe runs both upstream and downstream.

19. Drains required for operation are shown on the Drawings. However, vents at all high points and drains at all low points in the piping that are required for complete draining for pressure test may not be shown on these Drawings. Contractor shall add such items as found to be necessary during detail piping design and/or piping installation.

E. Reducers

1. Eccentric reducers shall be installed flat on the bottom for steam, condensate return and digester gas services.

F. Valves

1. Isolation valves provided with equipment and instruments shall be located in a manner which will allow ease of access and removal of the items to be isolated. Prior to soldering or brazing valves, teflon and elastomer seats and seals shall be removed to prevent damage.

3.04 PIPING ASSEMBLY

A. General

1. Contractor shall only use labor that has been qualified by training and experience to capably perform the specified activities required to accomplish the work in a satisfactory manner.

2. Any deviations from the Specifications or piping locations shown on the Drawings require prior review and approval by Engineer.

B. Buttwelded Piping

1. The specification and qualification of weld joints and welders for buttwelded piping shall be in accordance with ASME Boiler Pressure Vessel Code, Section IX, Welding and Brazing. Weld procedure specifications (WPS) and procedure qualification reports (PQR) shall be submitted to Engineer for review and validation of joint design, efficiencies and strength before installation begins.

2. Nondestructive examination (NDE) shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section V, Nondestructive Examination. The minimum level of NDE shall be as follows:

   a. 100 percent visual examination of welds by a qualified examiner (per ASME B31.1)

   b. Radiographic testing (RT) of 10 percent random sampling of welds

3. If the Contractor wants to use alternative techniques or intends to apply alternative methods considered equivalent to those indicated herein, a proposal on such techniques or methods shall be submitted in writing to Engineer for review and approval at least 14 days before intended date of use.

4. Welding shall not begin until weld joint and welder qualification submittals have been reviewed and approved. NDE shall be performed before the pressure and leakage testing of the piping. Weld acceptance standards shall be in accordance with ASME B31.1, Chapter VI. If a weld fails the NDE, it shall be repaired and the test repeated at no additional cost to the Owner.

3.05 PROTECTIVE COATING

A. Standard weight steel pipe in buried locations will have exterior surfaces protected with a shop applied plastic coating.

B. All surfaces to be tape-wrapped shall be thoroughly cleaned and primed in accordance with the tape manufacturer's recommendations immediately before wrapping. The tape shall be applied by two-ply (half lap) wrapping or as needed to provide a total installed tape thickness of at least 60 mils . Joints in plastic coated pipe shall be cleaned, primed, and tape-wrapped after installation.

C. Joints in galvanized steel piping in underground locations shall be field painted with two coats of coal tar epoxy coating.

D. Inspection

1. All shop applied plastic coatings and tape wrap on pipe or fittings shall be inspected for holidays and other defects after receipt of the pipe or fitting on the job and immediately before installation. All field applied tape wrap on pipe, joints, fittings, and valves shall be inspected for holidays and other defects following completion of wrapping. Inspection of plastic coatings after installation of the pipe or fitting in the trench shall be made where, in the opinion of Engineer, the coating may have been damaged during installation. Holidays and defects disclosed by inspection shall be repaired in accordance with the recommendations of the coating or tape wrap manufacturer, as applicable.

2. The inspection shall be made using an electrical holiday detector. The detector and inspection procedures shall conform to the requirements of Section 4.4 of ANSI/AWWA C209.

3.06 PRESSURE AND LEAKAGE TESTING

A. The Contractor shall coordinate this section with the Testing of Pipelines section. Each piping system shall be tested for at least 1 hour with no loss of pressure. Piping shall be tested at the indicated pressures:

Service	**Test Pressure**	**Test Medium**
Compressed Air Supply	1.2 times working pressure but not less than 50 psi	Compressed air with 100 percent of all oil 0.025 micron and larger removed
Other piping	1-1/2 times working pressure but not less than 50 psi unless otherwise noted in the specifications	Suitable fluid or gas; for distilled water piping, distilled water or filtered oil-free compressed air may be used

B. Compressed air or pressurized gas shall not be used for testing plastic piping unless specifically recommended by the pipe manufacturer.

C. Leakage may be determined by loss-of-pressure, soap solution, chemical indicator, or other positive and accurate method acceptable to Engineer. All fixtures, devices, or accessories which are to be connected to the lines and which would be damaged if subjected to the specified test pressure shall be disconnected and the ends of the branch lines plugged or capped as needed during the testing.

D. Unless otherwise required by the applicable codes, drainage and venting systems shall be air tested. For air testing, the system shall be charged with air to a minimum pressure of 5 psig. Openings shall be plugged as necessary for either type of test. To be considered free of leaks, the system shall hold the air for 30 minutes without any drop in the air pressure.

E. All necessary testing equipment and materials, including tools, appliances and devices, shall be furnished and all tests shall be made by and at the expense of Contractor. Contractor shall give Engineer 5 working days advanced notice of scheduled testing.

F. All joints in piping shall be tight and free of leaks. All joints which are found to leak, by observation or during any specified test, shall be repaired, and the tests repeated.

G. Air Pressure Tests

1. Pressure tests shall be performed on all air piping systems as specified herein to conform to ASME B31.1.

2. The test pressure shall be as specified herein and shall not exceed the maximum allowable test pressure of any non-isolated component, such as vessels, compressors, blowers, or valves, in the system. The pressure in the system shall gradually be increased to not more than one-half of the test pressure, after which the pressure shall be increased in steps of approximately one-tenth of the test pressure until the required test pressure has been reached. The pressure shall be continuously maintained for a minimum duration of 10 min. It shall then be reduced to the blower rated discharge pressure held for such time as may be necessary to conduct the examination for leakage.

3. Contractor shall be responsible for ensuring that all air piping is free of leaks. All joints which are found to be leaking shall be repaired and the test repeated.

3.07 CLEANING

A. The interior of all pipe, valves, and fittings shall be smooth, clean, and free of blisters, loose mill scale, sand, dirt, and other foreign matter when installed. Before being placed in service, the interior of all lines shall be thoroughly cleaned, to the satisfaction of Engineer.

B. Metal anhydrous ammonia, chlorine and sulfur dioxide piping shall be cleaned as recommended by the gas chemical feed system supplier. All surfaces which may come into contact with gas chemical shall be thoroughly dry and free of oil or grease before being placed in service. The recommended cleaning procedures shall be submitted for review in accordance with the Submittals section.

C. Tin lined copper tubing for distribution of distilled water shall be flushed and cleaned with distilled water in accordance with the tubing manufacturer's recommendations.

3.08 ACCEPTANCE

A. Owner reserves the right to have any section of the piping system which he suspects may be faulty cut out of the system by Contractor for inspection and testing. Should the joint prove to be sound, Owner will reimburse Contractor on a time and material basis as specified in the Contract. Should the joint prove to be faulty, the destructive test will continue joint by joint in all directions until sound joints are found. Costs for replacement of faulty work and/or materials shall be the responsibility of Contractor.

END OF SECTION

SECTION 15050

BASIC MECHANICAL BUILDING SYSTEMS MATERIALS AND METHODS

PART 1 GENERAL

1.01 SCOPE

A. This section covers general mechanical building system requirements as referenced from other sections and furnishing and installation of:

1. Mechanical identification
2. Special coatings

B. for the plumbing and heating, ventilating, and air conditioning systems. Protective coatings for ductwork and equipment without special coatings shall be as specified in the Protective Coatings and Architectural Painting sections.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 GENERAL

A. Coordination

1. Where two or more units of the same class of materials are required, they shall be the product of a single manufacturer; however, all the component parts of the system need not be the products of one manufacturer.

B. General Equipment Stipulations

1. The General Equipment Stipulations shall apply to all materials furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

C. Governing Standards

1. Except as modified or supplemented herein, all work covered by this section shall be performed in accordance with all applicable local codes and ordinances, laws, and regulations which pertain to such work. In case of a conflict between these specifications and any state law or local ordinance, the latter shall govern.

D. Metal Thickness

1. Metal thickness and gages specified herein are minimum requirements. Gages refer to US Standard gage.

1.04 SUBMITTALS

A. Drawings and Data

1. Complete information, detailed specifications, and data covering materials, parts, devices, and accessories forming a part of the materials furnished, shall be submitted in accordance with the Submittals Procedures section.

Number Plates
- Product data on number plates.
- A listing of equipment to receive number plates shall be submitted.

Special Coatings
- Name of manufacturer.
- Coating type.
- Color.
- Chemical resistance data.
- Temperature range data.
- Surface preparation.
- Application data.
- Film thickness per coat.
- Drying and curing time information.

Equipment Motors
- Name of Manufacturer.
- Type and Model.
- Horsepower (kW) rating and service factor.
- Temperature rise and insulation rating.
- Full load rotative speed.
- Type of bearings and method of lubrication.
- Net weight.
- Overall dimensions.
- Efficiency at full, 3/4, and 1/2 loads.
- Full load current and power factor.
- Locked rotor current.

Adjustable Frequency Drives
Type and model.
Name of manufacturer.
Operating speed range, rpm.
Rated bhp [kW] at maximum speed.
Efficiency at maximum speed, percent.
Maximum heat output, BTUH [kW].
Speed at maximum heat output, rpm.
Dimensions and net weight of complete panel.
Catalog and data sheets on all components.
Electrical schematics and wiring diagrams.

B. Samples

1. Samples shall be submitted in accordance with the Submittals Procedures section.

2. Samples of color, lettering style, and other graphic representation required for each type of identification material and device shall be submitted.

3. Samples of protective and special coatings for equipment shall be submitted to Engineer for approval. The samples shall be at least 3 inches by 3 inches [75 mm by 75 mm] in size.

1.05 QUALITY ASSURANCE

A. Welding Qualifications

1. All welding procedures and welding operators shall be qualified by an independent testing laboratory in accordance with the applicable provisions of AWS Standard Qualification Procedures. All procedure and operator qualifications shall be in written form and subject to Engineer's review. Accurate records of operator and procedure qualifications shall be maintained by Contractor and made available to Engineer upon request.

B. Manufacturer's Experience

1. Unless the equipment manufacturer is specifically named in this section, the manufacturer shall have furnished equipment of the type and size specified which has been in successful operation for not less than the past 5 years.

1.06 EXTRA MATERIALS

A. The following extra materials shall be furnished for the listed equipment:

1. Touchup special coating material

B. Extra materials shall be packaged in accordance with the Product Delivery Requirements section, with labels indicating the contents of each package. Each label shall indicate manufacturer's name, equipment name, equipment designation, part nomenclature, part number, address of nearest distributor, and current list price. Extra materials shall be delivered to Owner as directed.

PART 2 PRODUCTS

2.01 SERVICE CONDITIONS

A. All equipment shall be designed and selected to meet the specified conditions. Where equipment is provided with special coatings, unit capacities shall be corrected to account for any efficiency losses from the selected special coating.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

A. Dimensional Restrictions

1. Layout dimensions will vary between manufacturers and the layout area indicated on the Drawings is based on typical values of the first manufacturer listed. Contractor shall review the contract Drawings, the manufacturer's layout drawings, and installation requirements and shall make any modifications required for proper installation subject to acceptance by Engineer.

B. Elevation

1. Equipment shall be designed to operate at the elevation indicated in the Meteorological and Seismic Design Criteria section. All equipment furnished for sites above 2000 feet above sea level shall be properly derated to operate and meet the specified capacities at the site conditions.

2.03 Equipment Efficiencies

A. Unless otherwise indicated in the respective equipment paragraph, the equipment efficiency shall be in accordance with the requirements of ASHRAE Energy Standard 90.1.

1. Drive Units

a. Drive units shall be designed for 24-hour continuous service.

1) VBelt Drives

a) Each Vbelt drive shall include a sliding base or other suitable belt tension adjustment. Vbelt drives shall have a service factor of at least 1.5 at maximum speed based on the nameplate horsepower of the drive motor unless otherwise indicated in the specific equipment paragraph. Multiple belts shall be provided in matched sets and shall be oil resistant, non-static type. External belts and drive assemblies shall be protected by a belt safety guard constructed in accordance with OSHA requirements. The guard shall be provided with a tachometer opening.

b) Unless otherwise indicated in the specific equipment paragraph, equipment with smaller than 10 horsepower motors shall have adjustable pitch sheaves and equipment with 10 horsepower and

larger motors shall have fixed sheaves. Adjustable sheaves shall be selected so that the fan speed at the specified conditions is selected at the mid-position of the sheave range. Fixed sheaves shall be replaced as necessary with sheaves of the proper size during the air system balancing to provide the required speed for the specified airflow.

2. Electric Motors

a. Motor horsepower scheduled on the Drawings are minimum motor horsepower. Larger motors shall be provided if required to meet the specified capacities for the equipment furnished. Motors furnished with equipment shall meet the following requirements.

1) Premium efficient motors with a minimum efficiency of at least that specified in the Electric Motors section shall be provided where available as a standard option. All other motors shall meet the minimum efficiency standards required by the 2007 Energy Independence and Security Act.

2) Designed and applied in accordance with NEMA, ANSI, IEEE, AFBMA, and NEC for the duty service imposed by the driven equipment, such as frequent starting, intermittent overload, high inertia, mounting configuration, or service environment.

3) Rated for continuous duty at 40° C ambient.

4) Motors used in applications which exceed the usual service conditions as defined by NEMA, such as higher than 40° C ambient, altitude exceeding 3,300 feet , explosive or corrosive environments, departure from rated voltage and frequency, poor ventilation, frequent starting, or adjustable frequency drive applications, shall be properly selected with respect to their service conditions and shall not exceed specified temperature rise limits in accordance with ANSI/NEMA MG 1 for insulation class, service factor, and motor enclosure type.

5) To ensure long life, motors shall have nameplate horsepower [kW] equal or greater than the maximum load imposed by the driven equipment and shall carry a service factor rating as follows:

Motor Size	Enclosure	Service Factor
Fractional hp	Open	1.15
	Other Than Open	1.0
Integral hp	Open	1.15
	Other Than Open	1.0

Motors used with adjustable frequency drives shall have a 1.15 service factor on sine wave power and a 1.0 service factor on drive power.

6) Designed for full voltage starting.

7) Designed to operate from an electrical system that may have a maximum of 5 percent voltage distortion according to IEEE 519.

8) Totally enclosed motors shall have a continuous moisture drain that also excludes insects.

9) Bearings shall be either oil or grease lubricated.

10) Motor nameplates shall indicate as a minimum the manufacturer name and model number, motor horsepower, voltage, phase, frequency, speed, full load current, locked rotor current, frame size, service factor, power factor, and efficiency.

11) Dripproof motors, or totally enclosed motors at Contractor's option, shall be furnished on equipment in indoor, above-grade, clean, and dry locations.

12) Totally enclosed motors shall be furnished on:

    a) Outdoor equipment.
    b) Equipment for installation below grade.
    c) Equipment operating in chemical feed and chemical handling locations.
    d) Equipment operating in wet or dust-laden locations.

13) Explosionproof motors shall be furnished as specified by applicable codes or as specified in other sections.
14) A manufacturer's standard motor may be supplied on packaged equipment and fans in which case a redesign of the unit would be required to furnish motors of other than the manufacturer's standard design. However, in all cases, the motor types indicated are preferred and shall be furnished if offered by the manufacturer as a standard option.
15) Motors used with adjustable frequency drives shall have insulation system meeting the requirements of NEMA MG 1, Part 31.

B. Adjustable Frequency Drives

1. Adjustable frequency drives shall be provided as indicated on the Drawings and shall be coordinated with the requirements of the associated equipment. The equipment

manufacturer shall be responsible for furnishing the adjustable frequency drive, for matching the motor and the drive, and for coordinating the collection of data and the design to limit harmonics to the levels specified.

2. Adjustable frequency drives shall be as covered in the Motor Control Centers section.

2.04 MANUFACTURE AND FABRICATION

A. Welding

1. All welds shall be continuous (seal type) on submerged or partially submerged components.

B. Anchor Bolts and Expansion Anchors

1. Anchor bolts, expansion anchors, nuts, and washers shall be as indicated in the Special Provisions section unless otherwise indicated on the Drawings.

C. Edge Grinding

1. Sharp corners of cut or sheared edges which will be submerged in operation shall be dulled by at least one pass of a power grinder to improve paint adherence.

D. Surface Preparation

1. All iron and steel surfaces, except motors, shall be shop cleaned by sandblasting or equivalent, in strict conformance with the paint manufacturer's recommendations. All mill scale, rust, and contaminants shall be removed before shop primer is applied.

2.05 MATERIALS

A. Mechanical Identification

1. Mechanical identification consisting of equipment number plates, equipment information plates, valve tags, and ductwork identification shall conform to the requirements of the Special Provisions section and as indicated herein. All equipment tagged on the drawings shall be provided with number plates bearing the equipment tag number identified on the Drawings. Brass or stainless-steel nameplates giving the name and address of manufacturer, product name, catalog number, serial number, operating and power characteristics, label of tested compliances, and all other pertinent data shall be attached to each piece of equipment.

2. Number Plates

a. Hand-lettered or tape labels will not be acceptable.

3. Piping

    a. Piping identification shall be as specified in the Protective Coatings section. The lettering size, length of color field, colors, and viewing angles of identification devices shall be in accordance with ASME A13.1.

4. Valves

    a. Valve tags shall indicate if the valve is normally open or normally closed.

5. Ductwork

    a. Ductwork shall be identified with nameplates as specified herein, or stenciled painting. Ductwork shall be identified with the equipment number and area served, direction of airflow, and service (supply, return, mixed, exhaust, and outside air). The identification shall be located at equipment, at each side of structure or enclosure penetrations, and at each obstruction.

B. Special Coatings

1. Where indicated on the Drawings, sheet metal ductwork, dampers, registers, grilles, coils, and equipment shall be given a special coating suitable for the corrosive atmosphere indicated. Sheet metal ductwork, dampers, registers, grilles, coils, and equipment construction shall be suitable to allow proper application of the special coating system in accordance with the manufacturer's recommendation.

PART 3 EXECUTION

3.01 INSTALLATION

A. Materials furnished under this section shall be installed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the manufacturer, unless exceptions are noted by the Engineer.

B. The installation of identifying devices shall be coordinated with the application of covering materials and painting where devices are applied to surfaces. All surfaces to receive adhesive number plates shall be cleaned before installation of the identification device.

END OF SECTION

SECTION 15051

PIPING – GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies the basic administrative and testing requirements for piping. Specific piping materials, systems and related installation and testing requirements are specified in other Sections of Division 2 and 15.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 01666 – Testing of Pipelines

B. Section 01781 – Project Record Documents

C. Section 01782 – Operation and Maintenance Data

D. Division 2 – Site Work

E. Section 15100 – Valves and Appurtenances

F. Section 15120 – Piping Specialties

G. Section 15250 – Thermal Insulation for Piping

1.04 SUBMITTALS

A. Submit, in accordance with Section 01300, Submittals, general submittals for piping and piping systems are listed below. It is not intended that all submittals listed below be

provided for all piping materials and systems. Refer to individual System or Piping Sections for specific submittals.

B. Shop Drawings and Product Data

1. Piping layouts in full detail
2. Location of pipe hangers and supports
3. Location and type of backup block or device to prevent joint separation
4. Large scale details of wall penetrations and fabricated fittings
5. Schedules of all pipe, fittings, special castings, couplings, expansion joints and other appurtenances
6. Catalog cuts of joints, couplings, harnesses, expansion joints, gaskets, fasteners, and other accessories
7. Brochures and technical data on coatings and linings and proposed method for application and repair

C. Samples

D. Design Data

E. Test Reports

1. One (1) copy of certified shop tests showing compliance with appropriate standard
2. One (1) copy of all field test report, signed by Contractor and Engineer

F. Certificates

1. Copies of certification for all welders performing work in accordance with ANSI B31.1

G. Manufacturers Installation (or application) instructions

H. Statement of Qualifications

I. Manufacturers Field Report

J. Project Record Document

K. Operation and Maintenance Data in accordance with Section 01782

L. Warranties

1.05 REFERENCE STANDARDS

A. ASTM International (ASTM), latest edition.

1. ASTM A193 Standard Specification for Alloy-Steel and Stainless-Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

2. ASTM A194 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

B. American National Standards Institute (ANSI), latest edition.

1. ANSI B16.5 Pipe Flanges and Flanged Fittings

2. ANSI B31.1 Power Piping

C. American Welding Society (AWS), latest edition.

1. AWS B2.1 Specification for Welding Procedure and Performance Qualifications

D. American Water Works Association (AWWA), latest edition.

1. AWWA Manual M11 Steel Pipe: A Guide for Design and Installation

E. American Society of Mechanical Engineers (ASME)

F. Underwriters Laboratories (UL)

G. Factory Mutual (FM)

H. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE

A. All materials shall be new and unused.

B. Install piping to meet requirements of local codes.

C. Provide manufacturer's certification that materials meet or exceed minimum requirements as specified. Reference to standards such as ASTM and ANSI shall apply to those versions in effect at the time of bid opening.

D. Coordinate dimensions and drilling of flanges with flanges for valves, pumps and other equipment to be installed in piping systems. Bolt holes in flanges to straddle vertical centerline.

E. Reject materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, paint thinner, and acid solder.

F. Pipe-joint compound, for pipe carrying flammable or toxic gas, must bear approval of UL or FM.

G. Unless otherwise specified, pressures referred to in all Piping Sections are expressed in pounds-per-square-inch-gauge (psig) above atmospheric pressure, and all temperatures are expressed in degrees Fahrenheit (°F).

1.07 DELIVERY, STORAGE AND HANDLING

A. During loading, transportation and unloading take care to prevent damage to pipes and coating. Carefully load and unload each pipe under control at all times. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation to ensure no injury to pipe or lining.

PART 2 PRODUCTS

2.01 MATERIALS

A. Specific piping materials and appurtenances are specified in the respective Piping or System Sections.

B. General installation materials shall be as specified below.

1. Unions shall be brass or bronze unions for joining nonferrous pipe; malleable brass or bronze-seated iron or steel unions for joining ferrous pipe; PVC unions for joining PVC pipe; CPVC unions for joining CPVC pipe.

2. Temporary plugs shall be standard plugs or caps which are suitable for permanent service.

3. Flexible connections shall be flanged spool type, 180-degree F maximum service, single filled arch with synthetic rubber tube and cover, steel-ring reinforced synthetic fiber carcass, with flanges drilled to 150 lb ANSI B16.5. Steel retaining rings, control rods and compression sleeves shall be provided where shown and as required for the working pressure of the system in which the joint is installed. All flexible joints shall be rated for the working pressure of the system in which they are installed.

C. Bolts and Nuts for Ductile Iron Flanges

1. Bolts and nuts for connecting flanged piping, valves and other appurtenances shall conform to the following requirements.

a. Bolts and nuts for flanges shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M for bolts, and ASTM A194, Grade 8M for nuts.

b. Painted carbon steel, zinc plated, and hot-dipped galvanized bolts are not acceptable unless specifically indicated on the Drawings.

2. All stainless-steel bolts and nuts shall be coated with a chloride-free anti-galling lubricant that shall be similar to Ramco TRX-Synlube, Ramco Anti-Seize, Husky

Lube “O” Seal, or an approved equal. The anti-galling lubricant on piping for potable water systems shall be ANSI/NSF 61 certified.

PART 3 EXECUTION

3.01 GENERAL

A. All dirt, scale, weld splatter, water and other foreign matter shall be removed from the inside and outside of all pipe and sub-assemblies prior to installing.

B. All pipe joints and connections to equipment shall be made in such a manner as to produce a minimum of strain at the joint.

C. Install piping in a neat manner with lines straight and parallel or at right angles to walls or column lines and with risers plumb. Run piping so as to avoid passing through ductwork or directly under electric light outlets and/or interference with other lines or extending beyond furring lines as determined by Architectural Drawings. All work shall be accomplished using recognized methods and procedures of pipe fabrication and in accordance with the latest revision of applicable ANSI Standards, ASME Codes and Pipe Fabrication Institute Standards.

1. Use full length of pipe except where cut lengths are necessary. Do not spring or deform piping to make up joints.

2. Pipe shall be cut square, not upset, undersize, or out of round. Ends shall be carefully reamed and cleaned before being installed.

    a. Bending of pipe is not permitted. Use fittings for all changes in direction.

3. Do not use bushings except where specifically approved by the Engineer. Reducers shall be eccentric to provide for drainage from all liquid-bearing lines and facilitate air removal from water lines except where noted otherwise on the Drawings.

4. Verify the locations and elevations of any existing piping and manholes before proceeding with work on any system. Any discrepancies between the information shown on the Drawings and the actual conditions found in the field shall be reported at once to the Engineer. No claim for extra payment will be considered if the above provision has not been complied with.

5. Where lines of lower service rating tie into services or equipment of higher service rating the isolation valve between the two shall conform to the higher rating.

6. Mitering of pipe to form elbow is not permitted.

7. All piping interiors shall be thoroughly cleaned after installation and kept clean by approved temporary closures on all openings until the system is put in service. Closures should be suitable to withstand the hydrostatic test.

8. End caps on pre-cleaned pipe shall not be removed until immediately before assembly. All open ends shall be capped immediately after completion of installation.

D. Test Connections

1. Provide 1/2-inch female NPT test connection equipped with 1/2-inch brass plug on all pump suction and discharge lines. Where indicated on the Drawings, test connections should be equipped with bar stock valve and gauge. Provide test connections at all steam traps. The connection shall be located on the discharge side of the trap between the trap and the first valve. It shall consist of a 1/2-inch branch connection terminated with a gate valve.

E. Unions

1. Unions screwed or flanged shall be provided where indicated and in the following locations even if not indicated.

a. In long runs of piping to permit convenient disassembly for alterations or repairs

b. In by-passes around equipment

c. In connections to tanks, pumps, and other equipment between the shut-off valve and the equipment

d. In connections on both sides of traps, controls, and automatic control valves

F. Vents and Drains

1. Provide vents and drains in the following places:

a. Water Lines - Vents at high points and drains at low points

b. Air Lines - Drains at low points

3.02 UNIONS

A. Use unions to allow dismantling of pipe, valves, and equipment.

3.03 WELDING

A. Welding in accordance with ANSI B31 and AWS B3.0.

B. Install welding fittings on all welded lines. Make changes in direction and intersection of lines with welding fittings. Do not miter pipes to form elbows or notching of straight runs to form tees, or any similar construction. Do not employ welder who has not been fully qualified in above specified procedure and so certified by approved welding bureau or similar locally recognized testing authority.

3.04 FLANGED JOINTS

A. Make flanged joints with bolts; bolt studs with nut on each end; or studs with nuts where one flange is tapped. Use number and size of bolts conforming to same ANSI Standard as flanges. Before flanges pieces are assembled, remove rust resistant coating from machined surfaces, clean gaskets and smooth all burrs and other defects. Make up

flanged joints tight, care being taken to prevent undue strain upon valves or other pieces of equipment.

3.05 SLEEVE COUPLINGS

A. Install tie rods, pipe clamps or bridles when sleeve type couplings or fittings are used in piping system where indicated, and at changes in direction or other places as necessary, to prevent joints from pulling apart under pressure. Use bridles and tie rods at least 3/4-inch in diameter, except where tie rods replace flange bolts of smaller size, in which case fit with nut on each side of pair of flanges. Joint harnessing shall conform, as a minimum, to the requirements for the bolts and tie bolt lugs as set forth in AWWA Manual M11.

3.06 WALL SLEEVE SEALS

A. Use expandable rubber segmented sealing device with corrosion-resistant fasteners to make watertight the annular space between pipe and sleeve. Determined the required inside diameter of each individual wall opening or sleeve to fit the pipe and seal it to assure a watertight joint as recommended by the manufacturer, before ordering, fabricating or installing. Install pipe concentrically through wall sleeve. Install and tighten seal per manufacturer's instructions.

3.07 TESTING

A. Test all pipelines for liquid/gas tightness as specified in the Piping sections and Section 01666, Testing of Pipelines. Furnish all labor, testing plugs or caps, pressure pumps, pipe connections, gauges and all other equipment required. Testing shall be performed in accordance with one or more of the testing procedures appended to this Section as specified in each Piping Section. All testing shall be performed in the presence of the Engineer.

B. Repair faulty joints or remove defective pipe and fittings and replace as approved by the Engineer. Retest.

3.08 DISINFECTION

A. After satisfactory testing, all potable water distributed systems shall be thoroughly disinfected with a solution of not less than 50 parts per million of available chlorine. The disinfecting solution shall be allowed to remain in the system for a period of three (3) hours after which time all valves and faucets shall be opened, and the system shall be flushed with clean water.

B. Water being flushed from structures or pipelines after disinfection with a chlorine residue of 2 mg/l or greater, shall be treated with a dichlorination solution, in a method approved by the Engineer, prior to discharge.

HYDROSTATIC TEST

SCOPE: This test shall be used to hydrostatically test piping systems for structural integrity and leaks in accordance with the requirements of Section 01666, Testing of Pipelines. The test shall be performed at ambient temperature unless otherwise specified.

1.0 TEST FLUID

1.1 Water should be used as the test fluid whenever possible. In those systems where water cannot be used the test fluid may be either the one to be used in the system or the one agreed upon by the Engineer and the Contractor.

2.0 TEST EQUIPMENT

2.1 Water – Of sufficient capacity to deliver the required test pressure.

2.2 Strainer – On inlet side of the pump to prevent foreign matter from entering the system.

2.3 Valves – Shall be provided on the suction and discharge side of the pump.

2.4 Heater – To allow heating of the test fluid when elevated temperatures are required for test.

2.5 Relief Valve – Set at a pressure to relieve at 20% to 25% percent above the required test pressure.

2.6 Pressure Gauge(s) – Capable of reaching 50% over the test pressure. These should be located at the pump discharge and any other place deemed convenient by the Contractor.

2.7 Pressure gauges and relief valves shall be checked for accuracy before use in test procedures.

3.0 PREPARATION FOR TEST

3.1 Determine the fluid to be used for the test, and, if other than ambient temperature is required, what the test temperature will be.

3.2 When a fluid other than water is used for a test, the equipment used for the test shall be of a material compatible with the test fluid. Normally this would be equal to the piping material.

3.3 Vents shall be provided at the high points of the system and drains provided where means of venting or draining do not exist.

3.4 Remove or block off, all relief valves, rupture discs, alarms, control instruments, etc, that shall not be subjected to the test pressure.

3.5 All discs, balls, or pistons from check valves shall be removed if they interfere with filling of the system. Open all valves between inlet and outlet of the section to be tested.

3.6 Connect pump and provide temporary closures for all of the external openings in the system. Use caution to ensure that the closures are properly designed and strong enough to withstand the test pressure.

3.7 All joints, including welds, are to be left uninsulated and exposed for examination during test.

3.8 A joint previously tested in accordance with this Section may be covered or insulated.

3.9 Piping designed for vapor or gas shall be provided with additional temporary supports, if necessary, to support the weight of the test liquid.

3.10 Expansion joints shall be provided with temporary restraint for additional pressure under test or shall be isolated from the test.

3.11 Flanged joints, where blanks are inserted to isolate equipment during the test, need not be tested.

4.0 TEST PRESSURE

4.1 The hydrostatic test pressure shall as specified in Section 01666, Testing of Pipelines unless otherwise specified in the System Section.

5.0 TEST PROCEDURE

5.1 Allow the test fluid to enter the system. Open vents to allow displacement of all entrapped air. For all pipelines exceeding 500-ft in length, the maximum rate of filling shall be limited to that which produces a maximum nominal flow velocity of one foot per second in the pipe to be tested.

5.2 Close vents and restrict personnel in the test area to those involved in the test.

5.3 Raise the pressure slowly with the pump until the predetermined test pressure is reached. Maintain pressure for duration of time specified in System Section, keeping personnel at a safe distance.

5.4 Reduce the pressure about 20% and hold it at that point while the entire system is carefully inspected for leaks, cracks, or other signs of defects.

5.5 If defects are found, the pressure shall be released, the system drained, the defects corrected and the test repeated.

5.6 After a satisfactory test has been completed, the line shall be drained.

6.0 FLUSHING

6.1 Lines tested with water shall be completely drained.

6.2 Lines shall be flushed, after test.

7.0 TEST RECORDS

7.1 Records shall be maintained of all tests performed.

7.2 Test records shall include:

A. Date of Testing

B. Identification of Piping Tested

C. Test Fluid

D. Test Pressure

E. Signatures of Contractor and Engineer

7.3 If leaks are found, they shall be noted on the record. After correction, retesting as specified for original test.

7.4 Records of test shall be maintained by the Contractor. Provide two (2) copies to the Engineer and one (1) copy to the Owner as part of the Project Record Documentation (see Section 01781).

SERVICE PRESSURE TEST

SCOPE: This test shall be used to test piping systems using service pressure and the fluid for which the system is used.

It shall not be used to test piping systems conveying combustible or flammable liquids or systems that comply with ANSI B31 codes.

1.0 TEST FLUID

1.1 The fluid for which the system is designed shall be the test fluid.

2.0 TEST EQUIPMENT

2.1 A pressure gauge capable of registering 25 psi over the design pressure shall be installed down-stream from the supply shut-off valve if one is not included in the system.

3.0 PREPARATION FOR TEST

3.1 Insulated lines shall have all joints left exposed until completion of the test.

4.0 TEST PRESSURE

4.1 The test pressure shall be equal to the maximum pressure that the line will be subjected to under normal operating conditions as determined by the Engineer.

5.0 TEST PROCEDURE

5.1 Liquids

5.1.1 See that all personnel not involved in the test vacate the area.

5.1.2 Allow the system fluid to enter the system slowly while venting the air at the extreme far and uppermost points. For all pipelines exceeding 500-ft. in length, the maximum rate of filling shall be limited to that which produces a maximum nominal flow velocity of one foot per second in the pipe to be tested.

5.1.3 When the system is full and all air is vented, close the vents.

5.1.4 Allow the pressure in the system to build up to the full line pressure.

5.1.5 Inspect entire system for leaks.

5.2 Gas or Vapor (Including Compressed Air and Steam)

5.2.1 See that all personnel not involved in the test vacate the area.

5.2.2 In systems that do not have a pressure gauge near the main shut-off valve, a gauge shall be installed.

5.2.3 Allow the system fluid to enter the system slowly until the full operating pressure is reached.

5.2.4 Shut off main supply valve. Observe the gauge for 15 minutes. The pressure gauge shall not drop during this time.

5.2.5 If the gauge pressure drops, indicating the presence of a leak, visually inspect the systems and use soap suds or commercially available leak detectors to locate the leak(s).

5.3 If leaks are found, the lines shall be relieved of pressure, purged if necessary, and repaired. Tests shall be repeated for repaired sections.

6.0 TEST RECORDS

6.1 Records shall be maintained of all tests performed.

6.2 Test records shall include:

A. Date of Testing

B. Identification of Piping Tested

C. Test Fluid

D. Test Pressure

E. Signatures of Contractor and Engineer

6.3 If leaks are found, they shall be noted on the record. After correction, retesting is required.

6.4 Test records shall be maintained by the Contractor. Provide two (2) copies to the Engineer and one (1) copy to the Owner as part of the Project Record Documentation (see Section 01781).

END OF SECTION

SECTION 15064

STAINLESS STEEL PIPE AND ALLOY PIPE, TUBING, AND ACCESSORIES

PART 1 GENERAL

1.01 SCOPE

A. This section covers the furnishing of stainless steel pipe and alloy pipe, tubing and accessories through 24” diameter for the services as indicated herein. Pipe and tubing shall be furnished complete with all fittings, flanges, unions, and other accessories specified herein.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 SUBMITTALS

A. Drawings and Data

1. Complete specifications, data, and catalog cuts or drawings shall be submitted in accordance with the Submittals section. Submittals are required for all piping, fittings, gaskets, sleeves, and accessories, and shall include the following data:

    a. Name of Manufacturer
    b. Type and model
    c. Construction materials, thickness, and finishes
    d. Pressure and temperature ratings

B. Gasket Material Certifications

1. Contractor shall obtain and submit a written statement from the gasket material manufacturer certifying that the gasket materials are compatible with the joints specified herein and are recommended for the specified field test pressures and service conditions.

C. Welding Procedures and Qualifications.

1. All welding and brazing procedures and operators shall be qualified by an independent testing laboratory in accordance with the applicable provisions of Section IX of the ASME Code. All procedure and operator qualifications shall be in written form and submitted to the Engineer for review.

D. Compliance Data.

1. Pipe for liquid chemical service shall comply with ASME B31.3. Pipe for all other services shall comply with ASME B31.1.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Shipping shall be in accordance with the Materials, Transportation and Handling Requirements section. Handling and storage shall be in accordance with the Materials, Transportation and Handling Requirements section. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

PART 2 PRODUCTS

2.01 MATERIALS

A. Stainless steel pipe and alloy pipe materials shall be as specified herein.

B. Material Classification SS-2

SS-2 – Schedule 10S with Beveled Ends. Aeration air piping. 2-1/2 inch and larger.	Pipe Fittings	ASTM A312 or ASTM A778 with longitudinal seams only TP304L. Buttwelded, ASTM A403 WP-W or A774, wrought stainless steel, grade equivalent to pipe. Fittings shall conform to ANSI/ASME B16.9, Schedule 10S with beveled ends.

C. Material Classification SS-4

SS-4 – Schedule 40S with Beveled Ends. Compressed air piping. Aeration air piping (as an alternative to SS-2). 2-1/2 inch and larger.	Pipe Fittings	ASTM A312, Grade TP304L. Buttwelded, ASTM A312, Grade TP304L. Fittings shall conform to ANSI/ASME B16.9, Schedule 40S with beveled ends.

D. Material Classification SS-5

SS-5 – Schedule 40S with Beveled Ends. Sanitary lift station wetwell and valve vault piping. 2-1/2 inch and larger.	Pipe Fittings	ASTM A312, Grade TP316L. Buttwelded, ASTM A403, WP316L. Fittings shall conform to ANSI/ASME B16.9, Schedule 40S with beveled ends.

E. Material Classification SS-7

SS-7 – Schedule 40S with Plain Ends or Threaded. Compressed air piping. 2 inch and smaller with socket welded ends.	Pipe Fittings	ASTM A312, Grade TP304L, Socket welded, ASTM A182, F304L or threaded 304. Fittings shall conform to ANSI/ASME B16.11, Class 3000.

F. Accessory Materials

1. Accessory materials for the stainless steel pipe systems shall be as indicated. Flanges shall be flat faced for water service and shall be raised face for air or gas service except when connecting to flat face equipment or valve flanges.

Flanges

SS-2 Pipe Backing Flanges	Stainless steel plate, AISI Type 304 or 316 to match fittings. Provide stub ends or angle face rings with material and thickness to match fittings. The angle or radius between the angle face ring or stub end and the pipe shall match the angle or radius of the backing flange for proper seating. Flanges shall conform with ANSI/ASME B16.5, Class 150 diameter and drilling; with the following thicknesses:

Nominal Pipe Size inches	Flange Thickness inches
1/2-8	1/2
10-16	5/8
18-20	3/4
24-30	1
36	1-1/4

SS-4 and SS-5 Pipe Flanges: ANSI/ASME B16.5, Class 150, AISI Type 304, 304L, 316, or 316L, to match piping.

Nominal Pipe Size inches	Flange Thickness inches
1/2-8	1/2
10-16	5/8
18-20	3/4
24-30	1
36	1-1/4

Flange Bolts: ASTM A193 Class 2, AISI Type 304, ANSI B18.2.1, heavy hex head, length such that, after installation, the bolts will project 1/8 to 3/8 inch beyond outer face of the nut.

Flange Nuts: ASTM A194, AISI Type 304, ANSI/ASME B18.2.2, heavy hex pattern. Washers shall be installed under the nuts.

Flange Gaskets

Process air

Raised Face Flanges: Non-asbestos inorganic fiber with EPDM binder; dimensions to suit flange contact face, 1/16 inch minimum thickness for plain finished surfaces, 3/32 inch minimum thickness for serrated surfaces, rated for 275°F service; Garlock “IFG 5507.”

Flat Faced Flanges: Premium Grade, EPDM, full face type, 1/8 inch thick, rated for 275°F service; Garlock “8314.”

Elbows: Except for elbows in chemical service lines 4 inches and smaller, elbows shall be long radius type for which the laying length is 1.5 times the pipe diameter.

Protective Coatings – High Temperature Buried Service	
Epoxy for buried aeration and process air piping	Shop or field applied high solids epoxy; suitable for protection at continuous pipe wall temperatures up to 300° F. Coating shall be abrasion resistant. The finished coating shall have a minimum total film thickness of 10 mils. The surface shall be prepared in accordance with SSPC-SP7 as a minimum unless otherwise recommended by the coating manufacturer. The coating shall be Carboline “Thermaline 450,” PPG Amercoat “Amerlock 400,” or equal.
Expansion Joints	
Aeration air	Expansion joints shall be the elastomeric, arched type and shall be Mercer “Type 450” with “Type 500” retaining rings and Kevlar reinforcement, or equal. The number of arches shall be as indicated on the Drawings. The connection shall be suitable for a maximum pressure of 15 psig and maximum temperature of 275°F . Expansion joints shall have the following minimum ratings:
Insulating Fittings	
Threaded	Dielectric steel pipe nipple, ASTM A53, Schedule 40, polypropylene lined, zinc plated; Perfection Corp. “Clearflow Fittings.” Fittings shall be suitable for the service.
Flanged	Epco “Dielectric Flange Unions” or Central Plastics “Insulating Flange Unions.” Fittings shall be suitable for the service.

2. Branch Connections

   a. Branch connections 2-1/2 inches and smaller shall be made with welding fittings. Threaded outlets shall be used. Where the exact outlet size desired is in doubt, but is known to be less than 1 inch, a 1 inch outlet shall be provided and reducing bushings used as needed.
   b. Branch connections sized 3 and larger shall be made with pipe nipples or with welding fittings with welded outlets. Pipe nipples and welding fittings shall be welded to the pipe shell and reinforced as needed to meet design and testing requirements. The pressure rating of branch and branch connections shall equal or exceed the pressure rating of the main pipe it is connected to.
   c. Small branch connections shall be so located that they will not interfere with joints, supports, or other details, and shall be provided with caps or plugs to protect the threads during shipping and handling.

2.02 WELDING OF STAINLESS STEEL AND ALLOYS

A. Filler metal for welding austenitic stainless steel and alloys, P-number 8 base materials shall be in accordance with the following:

1. Material Type/Grade 304 shall use Type 308 filler metal.

2. Material Type/Grade 304L shall use Type 308L filler metal.

3. Material Type/Grade 316, shall use Type 316 filler metal.

4. Material Type/Grade 316L shall use Type 316L filler metal.

5. Material Type/Carpenter 20 shall use Carpenter 20 filler metal.

6. Material Type/Hastelloy C276 shall use Hastelloy C276 filler metal.

B. The following requirements shall apply when fabricating austenitic stainless steel and alloy components.

C. Grinding shall be by aluminum oxide, zirconium oxide, or silicon carbide grinding wheels that shall not have been used on carbon or low alloy steels. Hand or power wire brushing shall be by stainless steel brushes that shall not have been used on carbon or low alloy steels for stainless steel pipe. Hand or power wire brushing shall be by Carpenter 20 brushes that shall not have been used on carbon or low alloy steels for Carpenter 20 pipe. Hand or power wire brushing shall be by Hastelloy C276 brushes that shall not have been used on carbon or low alloy steels for Hastelloy C276 pipe. All tools used in fabrication shall be protected to minimize contact with steel alloys or free iron. Grinding wheels and brushes shall be identified and controlled for their use on these materials only to ensure that contamination of these materials does not occur.

D. Antispatter compounds, marking fluids, marking pens, tape, temperature indicating crayons, and other tools shall have a total halogen content of less than 200 parts per million.

E. Heat input control for welding shall be specified in the applicable WPS and shall not exceed 55,000 joules per inch as determined by the following formula:

$$\text{Heat Input } \left({}^{\text{J}}/_{\text{in.}}\right) = \frac{\text{Voltage x Amperage x 60}}{\text{Travel Speed } ({}^{\text{in.}}/_{\text{min.}})}$$

F. Complete penetration pressure retaining welds shall be made using the Gas Tungsten Arc Welding (GTAW) process for the root and second layer as a minimum.

G. Austenitic stainless steel instrument tubing shall be welded using only the GTAW process.

H. Socket welds or butt welds in all austenitic stainless steel instrument tubing lines shall require an inert gas backing (purge) using argon during welding to avoid oxidation.

I. The application of heat to correct weld distortion and dimensional deviation without prior written approval from the Engineer is prohibited.

J. Unless otherwise approved in writing, the GTAW process shall require the addition of filler metal.

K. The maximum preheat and interpass temperature for austenitic stainless steel shall be 350° F . The minimum preheat temperature shall be 50° F .

L. Complete joint penetration welds welded from one side without backing, weld repairs welded from one side without backing, or weld repairs in which the base metal remaining after excavation is less than 0.1875 inch from being through wall, which are fabricated from austenitic stainless steel ASME P-number 8 base metal or unassigned metals with similar chemical compositions, shall have the root side of the weld purged with an argon backing gas prior to welding. Backing gas (purge) shall only be argon. The argon backing gas shall be classified as welding grade argon or shall meet Specification SFA-5.32, AWS Classification SG-A. The backing gas (purge) shall be maintained until a minimum of two layers of weld metal have been deposited.

2.03 SHOP CLEANING AND PICKLING OF STAINLESS STEEL PIPING AND WELDS

A. All stainless steel piping shall be thoroughly cleaned and pickled at the mill in accordance with ASTM A380.

B. Pickling shall produce a modest etch and shall remove all embedded iron and heat tint. After fabrication, pickled surfaces shall be subjected to a 24 hour water test or a ferroxyl test to detect the presence of residual embedded iron. All pickled surfaces damaged during fabrication including welded areas shall either be mechanically cleaned or repickled or passivated in accordance with ASTM A380. Materials that have been contaminated with steel alloys or free iron shall not be used until all contamination is removed. When cleaning to remove steel or iron contamination is required, it shall be performed in accordance with ASTM A380, Code D requirements. Mechanical cleaning is not an acceptable cleaning method for oxygen or ozone piping. Oxygen and ozone piping shall be repickled or passivated as specified herein. All stainless steel surfaces shall be adequately protected during fabrication, shipping, handling, and installation to prevent contamination from iron or carbon steel objects or surfaces. Particulate matter shall be removed from piping and welds. Labels shall be affixed to the piping sections to indicate shop cleaning has been performed. Welds shall be either mechanically cleaned or pickled or passivated on the exterior of the pipe.

C. For buried piping, at least the exterior of all welds shall be passivated.

D. For oxygen or ozone piping, welds shall be pickled or passivated on the interior and exterior of the pipe. For small diameter piping, a solution shall be circulated. For piping large enough to enter, a passivation gel may be used. For oxygen or ozone systems, additional cleaning requirements may be required.

2.04 HIGH TEMPERATURE EPOXY COATING

A. Buried aeration air piping or filter backwash air piping shall be protected against corrosion by a shop or field applied high-solids epoxy coating as specified herein.

2.05 INSULATING FITTINGS

A. In all piping, insulating fittings shall be provided to prevent contact of dissimilar metals, including but not limited to, contact of copper, brass, or bronze pipe, tubing, fittings, valves, or appurtenances, or stainless steel pipe, tubing, fittings, valves, or appurtenances with iron or steel pipe, fittings, valves, or appurtenances. Insulating fittings shall also be provided to prevent contact of copper, brass, or bronze pipe, tubing, fittings, valves or appurtenances with stainless steel pipe, tubing, fittings, valves, or appurtenances.

PART 3 EXECUTION

3.01 INSTALLATION

A. Materials furnished under this section will be installed in accordance with the Miscellaneous Piping and Accessories Installation section.

End of Section

SECTION 15066

FIBERGLASS REINFORCED PLASTIC PIPE (AIR SERVICE)

PART 1 GENERAL

1.01 SCOPE

A. This section covers furnishing low pressure fiberglass reinforced plastic pipe for application in exhaust and odor control air systems as indicated on the Drawings. Piping shall be furnished complete with all fittings, transitions, jointing materials, expansion joints, and other necessary appurtenances.

B. Pipe supports, anchors, and odor control dampers are covered in other sections.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 GENERAL

A. Materials furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the manufacturer unless exceptions are noted by Engineer.

B. Coordination:

1. Contractor shall verify that each component of the system furnished is compatible with all other parts of the system, that all piping and materials are appropriate for the expected services, and that all devices necessary for a properly functioning system have been provided.

C. Pipe Identification:

1. Piping identification shall be as specified in the protective coating section.

1.04 SUBMITTALS

A. Drawings and Data

B. Complete specifications, data and catalog cuts, test reports, and shop assembled layout drawings shall be submitted in accordance with the Submittals Procedures section. The data and specifications shall include, but shall not be limited to, the following:

1. Pipe:

a. Manufacturer's name
b. Brand designation
c. Resin manufacturer and type of resin
d. Pressure, vacuum, and temperature rating of pipe
e. Certification of compliance with referenced standards
f. Layouts and dimensions of subassemblies to be shipped.
g. Detailed instructions for field butt joints including lay-up sequence, width of each reinforcement layer, and total number of layers
h. Test reports in accordance with the referenced standards for stiffness factor (ASTM D2412), longitudinal tensile properties (ASTM D2105 or ASTM D638), longitudinal compressive properties (ASTM D695), and short-term hydrostatic failure strength (ASTM D1599)
i. Where the pipe sizes needed for the project are larger than the named manufacturer's standard pipe sizes, the following information shall be submitted for the pipe and fittings that are being provided:

1) Manufacturer's name
2) Certificate of compliance that states compliance with referenced construction standards and test methods
3) Material sources
4) Material types
5) Average reinforced wall thickness for each pipe size
6) Minimum reinforced wall thickness for each pipe size
7) Average outside diameter for each pipe size
8) Liner material
9) Nominal liner thickness for each pipe size

2. Expansion Joints

a. Name of manufacturer
b. Type and model
c. Materials of construction
d. Force required for expansion and contraction

3. Certification letter stating that any shop fabrications have been constructed by the pipe manufacturer or pipe manufacturer's certified pipe fabrication source

1.05 QUALITY ASSURANCE

A. The manufacturer shall have available a laboratory and quality control facility capable of performing tests and inspections as required by the referenced standards. Material

testing, inspection procedures, and manufacturing methods are subject to inspection by the Engineer. The manufacturer shall provide the Engineer at least 3 weeks advance notice of pipe production should the Engineer elect to witness pipe fabrication.

B. Manufacturer's Field Services

1. The pipe manufacturer or designated representative shall provide hands-on training for the installation contractor's employees in the proper assembly of butt joints. The pipe manufacturer's representative shall be on-site for at least one 8-hour day, during which they shall observe the assembly of at least three butt joints. The pipe manufacturer shall submit written certification that the installation contractor's employees have satisfactorily completed all training and instruction and can perform the jointing required for this project in accordance with the pipe manufacturer's recommendations and as specified herein. All field butt joints shall be made by representatives of the pipe manufacturer or by employees of the installation contractor who have been trained and certified by the pipe manufacturer. Qualified fitters shall carry and have visible at all times a certificate of qualification issued by the pipe manufacturer. Contractor shall arrange the qualifying training.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section. Pipe and fittings shall be properly supported to avoid damage caused by flexural strains. Pipe and fittings shall not be thrown or dropped.

PART 2 PRODUCTS

2.01 SERVICE CONDITIONS

A. Fiberglass reinforced pipe will be used in odor control service conditions.

B. Pipe and appurtenances used in odor control systems will be continuously exposed to a humid environment containing hydrogen sulfide gas.

2.02 DESIGN REQUIREMENTS

A. Minimum Pipe Wall Stiffness

1. The minimum pipe wall stiffness, at 5percent deflection, determined in accordance with ASTMD2412 and AWWAC950, shall be not less than the following:

Nominal Pipe Diameter	**Pipe Stiffness**
inches	psi
1-8	36
10	18
12-16	9
18 and larger, other locations	5

B. Temperature

1. All pipe, fittings, and appurtenances shall be suitable for the following temperature conditions:

Design maximum temperature	100°F
Design minimum temperature	0°F

2.03 ACCEPTABLE MANUFACTURERS

A. The fiberglass reinforced plastic pipe, fittings and specials provided under this section shall be the products of National Oilwell Varco (NOV) or Conley as specified herein.

2.04 MATERIALS

A. The materials for the specified service conditions shall be as follows:

Service Condition:	Pipe Resin:
Odor Control	Vinyl Ester

B. Piping materials shall be as follows:

Vinyl Ester Pipe	
Centrifugally Cast	
14inches and smaller	ASTM D2997, centrifugally cast, reinforced vinyl ester resin pipe with 50mil liner; National Oilwell Varco (NOV)"Centricast CL-1520".
Filament-Wound	
16inches and smaller	ASTM D2996, with vinyl ester resin and at least a 20mil reinforced liner; National Oilwell Varco (NOV) "F-Chem" or Conley "Schedule30V".
18 inches and larger	ASTM D2996, with vinyl ester resin and at least a 20mil reinforced liner; National Oilwell Varco (NOV)"F-Chem or Conley "Schedule30V".
Fittings	Manufacturer's standard, glass fiber reinforced, thickness to match pipe, compatible with the pipe and with chemical resistance equal to or greater than the pipe. Elbows 24 inch and smaller shall be smooth radius. Elbow 30 inch and larger shall be smooth radius or mitered. Mitered elbows shall be constructed of a least 4 sections and 3 mitered joints. Elbows shall be constructed to have a radius-to-diameter ratio of 1.5 unless otherwise indicated on the Drawings.
Flanges	ASTM D3982 made on the specified pipe.
Flange Bolts or Studs	ASTM F593, Type304 stainless steel having a length such that, after installation, bolts will project 1/8 to 3/8inch [3 to 9mm] beyond the outer face of the nut.
Nuts	ASTM F594, Type304 stainless steel.
Flat Washers	ANSI B18.22.1, Type304 stainless steel.
Flange Gaskets	Full face, 1/8 inch thick, 40-50 durometer, EPDM.

Bell-and-Spigot Joints	Matched tapered bell-and-spigot ends bonded with adhesive.
Butt Joints	Butt and wrap, resin bonded using same resin as pipe, ASTM D6041, with thickness equal to the wall thickness of the pipe being joined.
Expansion Joints	As specified herein.
Adhesive	Pipe manufacturer's standard.

C. All above grade pipe, fittings and appurtenances shall contain ultraviolet (UV) inhibitors. Materials that do not otherwise contain added UV inhibitors, shall then have an epoxy or gelcoat containing UV inhibitors applied.

2.05 FABRICATION

A. Jointing Method

1. Unless otherwise specified, pipe shall have adhesive bonded bell and spigot joints or laminated butt joints. Shop fabricated assemblies should be provided to the maximum extent possible, to minimize the number of field joints. Shop fabrications including fittings and specials must be constructed by the pipe manufacturer or pipe manufacturer's certified pipe fabrication source.

2. Flanged joints shall be provided at each damper and item of equipment to facilitate disassembly, at each change in material, and where indicated on the Drawings. Bolts, nuts, washers, and gaskets shall be provided for all flanged connections in the piping system, including connections to equipment.

3. Field butt joints shall be located at least 12inches from any increasing or decreasing cross-section of pipe where the pipe to be jointed has the same diameter.

B. Transitions

1. Fiberglass reinforced plastic transition sections shall be furnished for connecting round pipe to rectangular openings on equipment. Transitions shall have a minimum wall thickness equal to the connecting pipe and shall not have a deflection greater than ½ percent of the longest side. Internal lining shall be of the same type of material and thickness as specified for the pipe. Transitions shall have flanged end connections compatible with the connecting equipment.

C. Expansion Joints

1. Expansion joints shall be furnished at the locations indicated on the Drawings and at other locations required for proper pipe installation. Expansion joints shall be resistant to ultraviolet light and shall be suitable for the service conditions.

2. Expansion joints shall be fully molded type rated for a minimum 3 psi working pressure and shall consist of an inner tube, body, and outer cover to be compatible with the specified service conditions. The tube shall be a minimum of 1/4 inch thick EPDM with two ply of high tensile nylon, polyester, or kevlar fabric reinforcement. The cover shall be a minimum 1/16-inch elastomer and shall be resistant to ultraviolet light.

3. Slip on type expansion joints shall fit tightly on the outside diameter of the piping and shall be secured in place by stainless steel adjustable bands with worm screw type adjustments to provide a gastight connection.

4. Flanged type expansion joints shall have split stainless steel retaining rings and shall have ASTM D3982 diameter and drilling. Expansion joints shall be Red Valve "Duct Expansion Joints", Mercer Rubber Company, or Holz Rubber Company.

PART 3 EXECUTION

3.01 INSPECTION

A. Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation. Any pipe that is damaged or shows evidence of contamination shall not be installed in the piping system.

3.02 PREPARATION

A. Field Measurement

1. Pipe shall be cut to measurements taken at the site, not from the Drawings. All necessary provisions shall be made in laying out piping to allow for expansion and contraction. Piping shall not obstruct openings or passageways. Pipe shall be held free of contact with building construction to avoid transmission of noise resulting from expansion.

3.03 INSTALLATION

A. Pipe shall be installed as specified and as indicated on the Drawings. All necessary provisions shall be taken in the fabrication and installation of piping to provide for expansion and contraction. Expansion joints shall be installed as specified in the pipe supports section.

B. The piping shall be supported as indicated on the Drawings and in accordance with the requirements of the pipe supports section.

C. The inside of pipe, fittings, and transitions shall be smooth, clean and free from blisters, when installed.

D. Pipe Sleeves

1. Piping passing through concrete or masonry shall be installed through sleeves installed before the concrete is placed or when masonry is laid.

E. Pipe Joints

1. Pipe joints shall be carefully and neatly made in accordance with the following specified requirements. All field joints made by trained and certified employees that are not representatives of the pipe manufacturer shall be made using individually packaged joint kits.

F. Adhesive Bonded Bell and Spigot Joints

1. All joint preparation, cutting, and jointing for adhesive bonded joints shall comply with the pipe manufacturer's recommendations. Adhesive shall be mixed and applied in accordance with the manufacturer's recommendations. Newly assembled joints shall be suitably blocked or restrained to prevent movement during the recommended curing period.

G. Flanged Joints

1. Flange bolts shall be tightened sufficiently to slightly compress the gasket and make a good seal, but not so tight as to distort the flanges. A flat washer shall be installed under each nut and bolt head.

H. Laminated Butt Joints

1. Laminated butt joints shall be made in accordance with the manufacturer's recommendations and as specified herein. Twenty inch and larger pipe shall be overlaid both inside (when accessible) and outside. Eighteen inch and smaller pipe shall be overlaid on the outside only. The minimum width of the overlay shall be as specified in the following table. Inside overlaps shall be made to seal the joint but shall not be considered in meeting the strength requirements.

Pipe Size	**Minimum Total Width of Overlay**
inches	**inches**
2-4	6
6-20	8
24-30	10
36-42	12
48-54	14
60	16
72	18

2. Finished joints shall be built up in successive layers, shall be as thick as the pieces being joined, and shall be as crevice-free as is commercially practicable, in accordance with ASTMD2563. The width of the first layer shall be at least 4inches. Successive layers shall be increased uniformly to provide the specified minimum total width of overlay which shall be centered on the joint. Crevices between jointed pieces shall be filled with resin, leaving a smooth inner surface. The interior of joints shall also be sealed by covering with not less than 0.05inch of liner of the same material as the pipe.

3. The inner surface shall be free of cracks and crazing, with a smooth finish, and with an average of not more than two pits per square foot, provided the pits are less than 1/8inch in diameter, not more than 1/32inch deep, and covered with sufficient resin to avoid exposure of inner surface fabric. Some waviness is permissible as long as the surface is smooth and free of pits. Such surfaces may be reinforced with glass surfacing mat, synthetic fibers, or other suitable material.

3.04 FIELD QUALITY CONTROL

A. Field Testing

1. All joints in piping shall be tight and free of leaks. Each joint which is found to leak, by observation or during any specified test, shall be repaired, and the tests repeated. All necessary testing equipment and materials, including tools, appliances, and devices, shall be furnished by Contractor. All tests shall be made by and at the expense of Contractor. Tests shall be conducted in a manner acceptable to Engineer and shall be repeated as many times as necessary to demonstrate compliance with specified requirements.

2. The Engineer or Engineer's representative shall be present during testing and shall be notified of the time and place of testing at least 3 days prior to commencement of the work.

3. Leakage may be determined by loss-of-pressure, soap solution, or positive and accurate method acceptable to Engineer. All equipment or other accessories which would be damaged if subjected to the specified test pressure shall be disconnected, and ends of branch lines plugged or capped, as required, during the testing procedures.

END OF SECTION

SECTION 15067

MISCELLANEOUS PLASTIC PIPE, TUBING, AND ACCESSORIES

PART 1 GENERAL

1.01 SCOPE

A. This section covers the furnishing of miscellaneous plastic pipe, tubing, and accessories. Pipe and tubing shall be furnished complete with all fittings, flanges, unions, jointing materials and other necessary appurtenances.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 SUBMITTALS

A. Drawings and Data

1. Complete specifications, data and catalog cuts or drawings shall be submitted in accordance with the Submittals Procedures section. Submittals are required for all piping, fittings, gaskets, sleeves, and accessories, and shall include the following data:

    a. Name of Manufacture
    b. Type and model
    c. Construction materials, thickness, and finishes
    d. Pressure and temperature ratings

B. Gasket Material Certifications

1. Contractor shall obtain and submit a written statement from the gasket material manufacturer certifying that the gasket materials are compatible with the joints specified herein and are recommended for the specified field test pressures and service conditions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

B. Pipe, tubing, and fittings shall be stored between 40°F and 90°F.

PART 2 PRODUCTS

2.01 PVC PIPE MATERIALS

A. PVC pipe materials and services shall be as specified herein.

B. Material Classification PVC-1

PVC-1 – Schedule 40 PVC Pipe with Solvent Welded Joints Hatch drains for vaults. Vents	Pipe Fittings	ASTM D1785, Cell Classification 12454, bearing NSF seal, Schedule 40 ASTM D2466, Cell Classification 12454, bearing NSF seal

C. Material Classification PVC-2

PVC-2 – Schedule 80 PVC Pipe with Solvent Welded Joints. Process water inside buildings. Sample lines. Sump pump discharge in buried locations (water).	Pipe Fittings	ASTM D1785, Cell Classification 12454, bearing NSF seal, Schedule 80. ASTM D2467, Cell Classification 12454, bearing NSF seal. Flanges or unions shall be provided where needed to facilitate disassembly of equipment or valves. Flanges or unions shall be joined to the pipe by a solvent weld. When acceptable to Engineer, threaded joints may be used instead of solvent welded joints in exposed interior locations for the purpose of facilitating assembly. The use of threaded joints in this system shall be held to a minimum.

D. Material Classification PVC-4

PVC-4 – PVC DWV Pipe (Single Wall) with Solvent Welded Joints. Sanitary drain piping for plumbing systems. Vents for sanitary drain piping for plumbing systems.	Pipe	ASTM D1785, cell classification 12454, bearing NSF seal
	Fittings	ASTM D2665 and ASTM D3311, cell classification 12454, bearing NSF seal

E. Accessory Materials

1. Accessory materials for the PVC Pipe systems shall be as indicated.

Flanges	Diameter and drilling shall conform to ANSI/ASME B16.5, Class 150. Schedule 80 for DWV systems
Flange Bolts and Nuts	ASTM A307, Grade B, length such that, after installation, the bolts will project 1/8 to 3/8 inch beyond outer face of the nut. Stainless steel for DWV and chemical feed systems, galvanized steel for all other systems
Flat Washers	ANSI B18.22.1, plain. Same material as bolts and nuts
Flange Gaskets	Full face, 1/8 inch thick, chemical-resistant elastomeric material suitable for the specified service
Expansion Joints	Edlon "Thermo-molded TFE" or Resistoflex "Style R6905" molded expansion joint.

2.02 CPVC PIPE

A. CPVC pipe materials and services shall be as specified herein.

B. Material Classification CPVC-1

CPVC-1 – Schedule 80 CPVC Pipe with Solvent Welded Joints Aluminum Sulfate (Alu) solution piping HVAC Condensate drain piping Odor control scrubber recirculation, overflow, and drain piping Hot water, tempered water Hot Water Circulating	Pipe	ASTM F441, Cell Classification 23447, bearing NSF seal, Schedule 80
	Fittings	ASTM F439, Cell Classification 23447, bearing NSF seal Flanges or unions shall be provided where needed to facilitate disassembly of equipment or valves. Flanges or unions shall be joined to the pipe by a solvent weld When acceptable to Engineer, threaded joints may be used instead of solvent welded joints in exposed interior locations for the purpose of facilitating assembly. The use of threaded joints in this system shall be held to a minimum

Potable Water(Cold Water) Plant Effluent WaterService Water Non-Potable Water	

C. Accessory Materials

1. Accessory materials for the CPVC Pipe systems shall be as indicated.

Flanges	Diameter and drilling shall conform to ANSI/ASME B16.5, Class 150.
Flange Bolts and Nuts	ASTM A307, Grade B, length such that, after installation, the bolts will project 1/8 to 3/8 inch beyond outer face of the nut. Stainless steel for chemical feed systems, galvanized steel for all other systems.
Flat Washers	ANSI B18.22.1, plain. Same material as bolts and nuts.
Flange Gaskets	Full face, 1/8 inch thick, chemical-resistant elastomeric material suitable for the specified service.
Expansion Joints	Edlon "Thermo-molded TFE" or Resistoflex "Style R6905" molded expansion joint.

2.03 POLYPROPYLENE PIPE

A. Material Classification PP-1

PP-1 – Schedule 80 Polypropylene Pipe with Socket Fusion Joints. Deionized water.	Pipe	ASTM D4101, Class 1, virgin, unpigmented homopolymer without additives or UV stabilizer; Enfield or Orion, Schedule 80. Dimensions in accordance with ASTM D2447.
	Fittings	Same material as pipe. Socket fusion type compatible with the pipe; Enfield or Orion.

B. Material Classification PP-2

PP-2 – Schedule 40 Polypropylene DWV Pipe with Heat Fused Joints Chemical resistance waste and vent piping for plumbing systems	Pipe Fittings	Schedule 40, ASTM D4101. Orion "Brownline" standard type where buried and "Blueline" flame retardant type where above grade, Enfield, or R&G Sloan Schedule 40, drainage pattern with manufacturers' standard heat fused socket joint. Solvent weld joints not permitted. Fittings and pipe shall be provided by the same manufacturer

2.04 HOSE PIPING

A. Hose piping materials shall be as specified herein.

B. Material Classification HS-2

HS-2 – Hose with Quick Disconnect Couplings Flexible connections in chemical piping, specifically to totes and other such temporary appurtenances. Lime slurry. Lime slurry at slakers and slurry pumps. Lime slurry in pump discharge.	Hose	ID not smaller than nominal size.
	Couplings	Boston "Crosslinked Polyethylene Hose" or Gates "Renegade", "Mustang 45 HW" or "Stallion" acid-chemical hose. To be selected for resistance to the service chemical. To be fully factory assembled including connection fittings. Cam-lock type quick connect/disconnect couplers and adapters as manufactured by OPW or PT. Coupling shall be fastened via band type stainless steel clamps. Hose barbs or threaded connections not permitted.

PART 3 EXECUTION

3.01 INSTALLATION

A. Materials furnished under this section will be installed in accordance with the Miscellaneous Piping and Accessories Installation section.

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SECTION 15069

CAST IRON SOIL PIPE AND ACCESSORIES

PART 1 GENERAL

1.01 SCOPE

A. This section covers the furnishing of cast iron soil pipe and accessories for the service conditions as specified herein. Cast iron soil pipe shall be furnished complete with all fittings and other accessories.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 SUBMITTALS

A. Drawings and Data

1. Complete specifications, data and catalog cuts or drawings shall be submitted in accordance with the Submittals Procedures section. Items requiring submittals shall include, but shall not be limited to, the following:

Pipe, Gaskets, and Couplings

Name of Manufacturer

Type and Model

Construction materials, thickness, and finishes

Coating product data sheets

Certification by manufacturer that the pipe and fittings furnished are in accordance with referenced standards. Certification shall include legal name and address of the manufacturer

1.04 DELIVERY, STORAGE, AND HANDLING

A. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and Storage shall be in accordance with the Product Storage and Handling Requirements section. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

PART 2 PRODUCTS

2.01 MATERIALS

A. Product Marking

1. Pipe and fittings shall bear manufacturer's product marking as required by the referenced standards. Markings shall be plainly marked including but not limited to country of origin, manufacturer's name, and date of manufacturer.

B. Material Classification CI-1

CI-1 – Bell and Spigot	Pipe and Fittings	ASTM A74
Building sanitary drain, waste and vent piping, all locations Building storm drain piping, all locations Clear water waste piping, all locations	Jointing Material	Rubber gaskets, ASTM C564.

C. Material Classification CI-2

CI-2 – Hubless	Pipe and Fittings	CISPI 301
Building sanitary drain, waste and vent piping, all locations except where buried	Jointing Material	Heavy duty coupling, with neoprene rubber sleeve, 304 stainless steel shield, and stainless steel clamping bands, or bolted cast iron coupling with stainless steel bolts and neoprene gasket. Couplings shall be Clamp-All Products "HI-TORQ 125," Husky "SD 4000," Mission Rubber Company LLC "HeavyWeight Coupling," or MG Piping Products "MG Coupling," without exception
Building storm drain piping, all locations except where buried Clear water waste piping, all locations except where buried		

PART 3 EXECUTION

1. INSTALLATION

A. Materials furnished under this section will be installed in accordance with the Miscellaneous Piping and Accessories Installation section.

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SECTION 15070

COPPER TUBING AND ACCESSORIES

PART 1 GENERAL

1.01 SCOPE

A. This section covers the furnishing of copper tubing and accessories. Copper tubing shall be furnished complete with all fittings, flanges, unions, and other accessories specified herein.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 SUBMITTALS

A. Drawings and Data

1. Complete specifications, data, and catalog cuts or drawings shall be submitted in accordance with the Submittals Procedures section. Submittals are required for all piping, fittings, gaskets, sleeves, and accessories, and shall include the following data:

    a. Name of Manufacturer
    b. Type and model
    c. Construction materials, thickness, and finishes
    d. Pressure and temperature ratings

B. Gasket Material Certification

1. Contractor shall obtain and submit a written statement from the gasket material manufacturer certifying that the gasket materials are compatible with the joints specified herein and are recommended for the specified field test pressures and service conditions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

PART 2 PRODUCTS

2.01 MATERIALS

A. Copper tubing materials and service shall be as specified herein.

B. Material Classification CU-1

CU-1 – Water Tubing with Flared Fittings Buried water supply, 2-inch 50 mm and smaller Differential pressure lines from flow elements to transmitters All instrument tubing not otherwise specified	Tubing Fittings	Soft annealed copper tubing, ASTM B88, Type K Flared, material to match tubing. Fittings shall conform to ANSI/ASME B16.26

C. Material Classification CU-2

CU-2 – Water Tubing with Brazed Joints Buried water supply, 2-1/2 and 3 inch	Tubing Fittings	Hard drawn copper tubing, ASTM B88, Type K Brazed joint, material to match tubing. Fittings shall conform to ANSI B16.18 or ANSI/ASME B16.22

D. Material Classification CU-3

CU-3 – Water Tubing with Solder and Brazed Joints Potable, water supply, 3 inch and smaller. Hot water supply. Tempered water supply	Tubing Fittings	Hard drawn copper tubing, ASTM B88, Type L. Solder joint (smaller than 2 inch except compressed air piping), Brazed joint (2 inch and larger for piping other than compressed air and all sizes for compressed air piping), material to

		match tubing. Fittings shall conform to ANSI B16.18, or ANSI/ASME B16.22.
	Flanges	Where required for connection to equipment, valves, and accessories, ANSI B16.24, class 150, cast bronze, brazed joint.

E. Material Classification CU-7

CU-7 – ARC Tubing with Brazed Fittings	Tubing	Hard drawn ACR copper tubing, ASTM B280. Dimensions shall be in accordance with ASTM B280
Refrigerant piping	Fittings	Brazed

F. Accessory Materials

1. Accessory materials for the copper tubing systems shall be as indicated.

Flange Bolts and Nuts	ASTM A307, Grade B, length such that, after installation, the bolts will project 1/8 to 3/8 inch beyond outer face of the nut
Flange Gaskets	ASTM D1330, Grade I, red rubber, ring type, 1/8 inch thick
Expansion Joints	Tempflex "Model HB Expansion Compensators" with copper tube ends
Insulating Fittings	
Threaded	Dielectric steel pipe nipple, ASTM A53, Schedule 40, polypropylene lined, zinc plated; Perfection Corp. "Clearflow Fittings"
Flanged	Epco "Dielectric Flange Unions" or Central Plastics "Insulating Flange Unions"

PART 3 EXECUTION

3.01 INSTALLATION

A. Materials furnished under this section will be installed in accordance with the Miscellaneous Piping and Accessories Installation section.

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SECTION 15072

DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required and install all non-buried ductile iron piping, gray-iron or ductile iron fittings and appurtenances as shown on the Drawings and as specified herein.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 01600 – Materials, Transportation and Handling

B. Section 01666 – Testing of Pipelines

C. Section 01732 – Pipe Penetrations

D. Division 2 – Site Work

E. Section 02516 – Ductile Iron Pipe and Fittings (buried)

F. Division 3 – Concrete

G. Section 09902 – Finish Painting

H. Section 15100 – Valves and Appurtenances

I. Section 15140 – Pipe Hangers and Support

J. Section 15250 – Thermal Insulation for Piping

1.04 SUBMITTALS

A. Submit, in accordance with Section 01300, Submittals, a list of materials to be furnished, the names of the suppliers and the date of delivery of materials to the site. Submittals shall include the following:

1. Shop drawings including piping layouts, schedules, including dimensioning, fittings, locations of valves and appurtenances, joint details, methods, and locations of supports and all other pertinent technical specifications for all piping to be furnished.

2. Shop drawing submittals for piping under this Section shall include all data and information required for the complete piping systems. All dimensions shall be based on the actual equipment to be furnished. Types and locations of pipe hangers and/or supports shall be shown on the piping layouts for each piping submittal.

3. Certification that all pipe supplied under this Section complies with all reference standards specified.

1.05 REFERENCE STANDARDS

A. ASTM International (ASTM), latest edition:

1. ASTM A193 Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

2. ASTM A194 Standard Specification for Carbon Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

3. ASTM B1000 Standard Practices For Casting Preparation And Test Procedure Of Porcelain Enamel-Lined Pipe, Fittings, And Valves For Use In The Municipal Wastewater, Sewage, And Water Treatment Industry

B. American Water Works Association (AWWA), latest edition:

1. AWWA C104 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings

2. AWWA C110 Ductile-Iron and Gray-Iron Fittings

3. AWWA C111 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

4. AWWA C115 Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges

5. AWWA C151 Ductile-Iron Pipe, Centrifugally Cast

6. AWWA C606 Grooved and Shouldered Joints

7. AWWA C153 Ductile-Iron Compact Fittings

C. Where reference is made to one of the above standards, the reference in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE

A. Each length of ductile iron pipe supplied for the project shall be hydrostatically tested at the point of manufacture to 500 psi for a duration of 10-seconds per AWWA C151. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any rupture of the pipe wall. Certified test results shall be furnished in duplicate to the Engineer prior to time of shipment.

B. All ductile iron pipe and fittings to be installed under this project shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish in duplicate to the Engineer sworn certificates of such tests and their results prior to the shipment of the pipe.

C. All pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory selected by the Owner, at the Owner's expense.

D. Inspection of the pipe and fittings will also be made by the Engineer or representative of the Owner after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the specified requirements, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job.

E. All pipe and fittings shall be permanently marked with the following information:

1. Manufacturer, date
2. Size, type, class, or wall thickness
3. Production Standard (AWWA, ASTM, etc.)

1.07 DELIVERY, STORAGE AND HANDLING

A. See Section 01600, Materials, Transportation and Handling, for general requirements.

B. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or coatings. Under no circumstances shall the pipe be dropped or skidded against each other. Slings, hooks, or pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior surface or internal lining of the pipe.

C. Materials, if stored, shall be kept safe from damage. The interior of all piping, fittings and other appurtenances shall be kept free from dirt or foreign matter at all times.

D. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations.

1.08 PLANT INSPECTION

A. All ductile iron pipe and gray iron or ductile iron fittings to be installed under this Contract shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish in duplicate to the Engineer sworn certificates of such tests and their results. In addition, all ductile iron pipe and fittings to be installed under this Contract may be inspected at the foundry for compliance with this Section by an independent testing laboratory selected by the Owner. The manufacturer's cooperation shall be required in these inspections. The cost of foundry inspection of all pipe approved for this Contract, plus the cost of inspection of a reasonable amount of disapproved pipe (125% of the total length of each diameter required), will be borne by the Owner.

PART 2 PRODUCTS

2.01 MATERIALS

A. Ductile iron pipe shall conform to AWWA C115, Thickness Class 53, and maximum working pressure of 350 psi. Flanges shall be faced and drilled after being screwed on the pipe, with flanges true to 90 degrees with the pipe axis and shall be flush with end of pipe. Gaskets shall be ethylene propylene (EPDM) 1/8-inch thick and shall conform to the dimensions shown in Table A.1 of AWWA C115.

1. Flanged joints shall be supplied with bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts shall conform to the same ANSI standard as the flange. Except as otherwise specified or noted on the Drawings, bolts and nuts shall conform to ASTM A194 as follows:

    a. Bolts and nuts for Class 150 flanges shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M for bolts, and ASTM A194, Grade 8M for nuts.

    b. Painted carbon steel, zinc plated, and hot-dipped galvanized bolts are not acceptable unless specifically indicated on the Drawings.

    c. All stainless-steel bolts and nuts shall be coated with a chloride-free anti-galling lubricant similar to Ramco TRX-Synlube, Ramco Anti-Seize, Husky Lube “O” Seal, or an approved equal. The anti-galling lubricant on piping for potable water systems shall be ANSI/NSF 61 certified.

2. Mechanical joint ductile iron pipe shall conform to AWWA C151 and C111 as applicable.

3. Pipe for use with split-type flexible coupling joints shall have radius grooved ends conforming to AWWA C606.

4. Fittings shall be ductile iron or gray iron as specified above. Except as specified below, flanges and flanged fittings shall conform to AWWA C110 or AWWA C153 for 250 psi minimum pressure rating.

5. All pipe and fittings shall have a cement mortar lining and bituminous seal coat on the inside in accordance with AWWA C104, double thickness.

6. Pipe and fittings exposed to view in the finished work shall not receive the standard asphalt coating but shall be shop primed on the outside in accordance with Section 09902, Finish Painting. All other pipe and fittings shall be shop coated on the outside with bituminous coating in accordance with the above referenced standards and will not require any other coating. If it is necessary to use bituminous coated pipe in exposed areas, the coating shall be completely removed by blast cleaning and the cleaned surfaces shall be immediately primed as specified in Section 09902, Finish Painting.

7. Split-Type Couplings

    a. Split-type couplings shall conform to AWWA C606.

    b. Pipe ends for use with split-type couplings shall have grooved ends to provide either a rigid joint or flexible joint as required by the Drawings or as specified herein.

    c. Flexible joint grooving shall permit expansion and contraction and angular deflection. Rigid joint grooving shall allow no angular or linear movement.

    d. Split-type couplings with rigid grooving may be used in lieu of flanged connections. However, the location and the number and type of joints shall be subject to the approval of the Engineer.

    e. Flanged adapter connections at fittings, valves and equipment shall be Vic-Flange Style 341 as manufactured by the Victaulic Company of America or approved equal.

8. Sleeve Type Couplings

    a. Sleeve-type couplings shall be as made by Dresser Mfg. Div., Bradford, PA; Smith-Blair, Inc., San Francisco, CA; R.H. Baker & Co., Inc., Huntington Park, CA; or approved equal.

    b. Couplings for exposed pipe shall be of steel and shall be Dresser Style 38; Smith-Blair Style 413; Baker Allsteel; or equal. The couplings shall be provided with stainless steel bolts and nuts unless indicated otherwise.

    c. All couplings shall be furnished with the pipe stop removed.

    d. Couplings shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.

9. Flange Coupling Adapters

    a. Flange coupling adapters shall be made by Smith-Blair, Inc., Texarkana, Arkansas, or approved equal.

    b. Flange coupling adapters shall be restrained with a Class 150 or Class 300 drilled flanges and shall be Smith-Blair Style 911 or approved equal.

c. Flange coupling adapters shall be provided with gaskets of a composition suitable for exposure to the liquid and pressure within the pipe.

d. Restraints shall be wedge style and shall not penetrate the wall of the pipe.

e. All flange coupling adapters shall be finished with a factory applied fusion bonded epoxy.

10. Wall castings shall be of the sizes and types shown on the Drawings. Flanges and/or mechanical joint bells shall be drilled and tapped for studs where flush with the wall.

11. Wall castings shall be provided with an intermediate wall collar. The collar shall be located at the center of the overall length of casting for castings set flush with the wall. For castings which extend through the wall, the collar shall be located such that it is within the middle third of the wall. Collars shall either be cast integrally with the casting or shall be of the assembled type consisting of two (2) mechanical joint retainer glands with gasket.

12. Base bends and base tees shall have machined and drilled bases.

13. Filler flanges and beveled filler flanges shall be furnished and installed as required. Filler flanges and beveled filler flanges shall be furnished faced and drilled complete with extra length bolts. Filler flanges shall be equal to Clow Fig. F-1984 and beveled filler flanges shall be equal to Clow Fig. F-1986.

2.02 SURFACE PREPARATION AND SHOP PRIME PAINTING

A. All piping and fittings exposed to view shall have its surface prepared and painted as specified in Section 09902, Finish Painting. Surface preparation and priming is a part of the work of this Section. Pipe finish painting and marking is included in Section 09902, Finish Painting, but it shall be part of the work of this Section to assist as required by the Engineer in identifying pipe contents, direction of flow and all else required for proper finish painting and marking of pipe.

2.03 INTERIOR LINING

A. Ductile iron pipe and fittings shall have the same type of lining as specified herein unless approved by the Engineer.

B. Potable water lines and pressurized process lines: Cement mortar lining and seal coat conforming to AWWA C104 A21.

C. As an option, the pipe supplier may line fittings in accordance with AWWA C550 and NSF 61.

D. Gravity sewer or gravity process (drains) lines: Ceramic epoxy lining, amine-cured, with a minimum thickness of 40-mils, similar and equal to Protecto 401 or Tnemec Series 431. Provide certification that the lining was applied in accordance with the manufacturer's instructions.

E. Where designated on the plans, pipe and fittings shall be glass lined in accordance with ASTM B1000. The glass lining applied to pipe and fittings shall be hard, smooth, continuous vitreous material. The lining shall be a bright, light color and have a minimum dry film thickness of 10 mils.

F. Fusion bonded epoxy coating conforming to AWWA C116 or AWWA C550 and NSF 61.

PART 3 EXECUTION

3.01 HANDLING PIPE AND FITTINGS

A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before installing, and no piece shall be installed which is found to be defective. Any damage to the pipe linings or coatings shall be repaired as directed by the Engineer.

B. All pipe and fittings shall be subjected to a careful inspection and hammer test just prior to being installed.

C. If any defective pipe is discovered after it has been installed it shall be removed and replaced with a sound pipe in a satisfactory manner. All pipe and fittings shall be thoroughly cleaned before installing, shall be kept clean until they are used in the work and when installed shall conform to the lines, grades and dimensions required.

3.02 INSTALLATION

A. All piping and fittings shall be installed true to alignment and rigidly supported thrust anchors shall be provided where required. Any damage to linings or coatings shall be repaired to the satisfaction of the Engineer before the pipe is installed. Each length of pipe shall be cleaned out before erection.

B. Sleeves shall be installed of proper size for all pipes passing through floors or walls as shown on the Drawings. Where indicated on the Drawings or required for liquid or gas-tightness the pipe shall be sealed.

C. Concrete inserts for hangers and supports shall be furnished and installed in the concrete as it is placed. The inserts shall be set in accordance with the requirements of the piping layout and jointing method and their locations shall be verified from approved piping layout drawings and the structural drawings. Pipe hangers and supports are specified in Section 15140.

D. Except as otherwise shown on the Drawings either split-type couplings or flange joints may be used. Split-type couplings used in place of flanged joints shall use rigid grooving. Split-type couplings located as shown on the Drawings with flexible grooving shall be used regardless of whether adjacent joints use flanges or split-type couplings. Prior to approval of joint method, layouts for hanger and supports shall be submitted to the Engineer for approval. Pipe for use with non-restrained sleeve type couplings shall have plain ends. Pipe for use with split-type couplings shall have radius grooved ends.

E. Flanged joints shall be made with opposite bolts tightened alternately and evenly.

F. Prior to assembly of split couplings, the grooves as well as other parts shall be thoroughly cleaned. The ends of the pipes and outside of the gaskets shall be moderately coated with petroleum jelly, cup grease, soft soap, or graphite paste and the gasket shall be slipped over one pipe end. After the other pipe has been brought to the correct position, the gasket shall be centered over the pipe ends with the lips against the pipes. The housing sections then shall be placed. After the bolts have been inserted, the nuts shall be tightened until the housing sections are firmly in contact, metal-to-metal, without excessive bolt tension.

G. All valves, fittings, equipment and appurtenances needed on the pipelines shall be set and jointed as indicated on the Drawings or as required. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. 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.

3.03 TESTING

A. All pipelines shall be tested for compliance with the specified requirements. If leaks are discovered, they shall be repaired under this Section and approved by the Engineer. Pressure and leakage tests will be required. All pipe and fittings shall be pressure tested as specified in Section 01666, Testing of Pipelines.

END OF SECTION

SECTION 15094

BACKFLOW PREVENTERS

PART 1 GENERAL

1.01 SCOPE

A. This section covers the furnishing of backflow preventers and associated appurtenances, as indicated herein.

B. Piping, pipe supports, insulation, and accessories which are not an integral part of the backflow preventers or are not specified herein are covered in other sections.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 GENERAL

A. General Equipment Stipulations

1. The Special Provisions shall apply to all equipment and materials provided under this section. If requirements in this specification differ from those in the Special Provisions section, the requirements specified herein shall take precedence.

B. Identification

1. Equipment specified herein shall be identified with a brass or stainless-steel nameplates giving the name and address of manufacturer, product name, catalog number, serial number, the rated capacity, head, speed, operating and power characteristics, label of tested compliances, and all other pertinent data shall be attached to piece of equipment. Valves shall be identified in accordance with the Special Provisions section.

1.04 SUBMITTALS

A. Drawings and Data

1. Complete fabrication and assembly drawings, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the Submittals section. The data and specifications for each unit shall include, but shall not be limited to the following:

a. Name of manufacturer
b. Type and model
c. Construction materials and finishes
d. Net weight
e. Unit dimensions
f. Performance curves indicating flow capacity versus pressure drop

B. Operations and Maintenance Data and Manuals

1. Adequate operation and maintenance information shall be supplied as required in the Submittals section. Operation and maintenance manuals shall be submitted in accordance with the Submittals section. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Shipping shall be in accordance with Materials, Transportation and Handling section. Handling and Storage shall be in accordance with the Materials, Transportation and Handling section.

PART 2 PRODUCTS

2.01 PERFORMANCE AND DESIGN REQUIREMENTS

A. Backflow preventers shall be designed to meet the requirements as indicated herein and in the Backflow Preventer Schedule on the Drawings.

2.02 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers and specific products are listed in the Design and Construction paragraph.

2.03 DESIGN AND CONSTRUCTION

A. Backflow prevention device type shall be as indicated herein.

B. Reduced Pressure Zone Backflow Preventers

1. Reduced pressure zone (RPZ) backflow preventers shall consist of isolation valves, two independent check valves, and differential relief valve. The assembly shall automatically reduce the pressure in the zone between the check valves. In the event that the reduced pressure is not maintained, the differential relief valve shall open, maintaining the proper zone differential. RPZ backflow preventers shall comply with AWWAC511 and ASSE Standard1013 requirements and shall be suitable for horizontal installation. Backflow preventers shall comply with the requirements of ANSI/NSF61, AnnexG for low lead. Each RPZ backflow preventer shall be provided with a relief valve air-gap drain fitting.

2. RPZ backflow preventers in 2 inch and smaller sizes shall be provided with bronze bodies and with a threaded bronze bodied ball valve on each end of the device. Two inch and smaller RPZ backflow preventers shall be Febco “ModelLF860”. Wilkins “Model 975XL2” or Watts Regulator “Series LF919”. RPZ backflow preventers larger than 2 inch shall be provided with ductile iron bodies and with a ductile iron resilient wedge gate valve on each end of the device. RPZ backflow preventers larger than 2 inch shall be, Zurn “Model 375”, Febco “Model LF860 Large” or approved equal.

C. Hose Connection Vacuum Breakers

1. Hose connection vacuum breakers shall be provided with3/4inch hose thread ends, brass or bronze bodies, stainless steel stem, rubber seat, and rubber disc. Hose connection vacuum breakers shall be of tamper-resistant design to prevent removal, manual drain feature, and shall comply with ASSE Standard1011 requirements. Hose connection vacuum breakers shall be Febco “Series731”. Watts Regulator Company “Series8” or Wilkins “Model BFP8”.

PART 3 EXECUTION

3.01 INSTALLATION

A. Materials furnished under this section will be installed in accordance with the Valves and Appurtenances section.

END OF SECTION

SECTION 15099

PRESSURE REDUCING VALVES

PART 1 GENERAL

1.01 SCOPE

A. This section covers the furnishing of pressure reducing valves as specified herein.

B. Piping, pipe supports, insulation, and accessories which are not an integral part of the valves or are not specified herein are covered in other sections.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 GENERAL

A. General Equipment Stipulations

1. The Special Provisions shall apply to all equipment and materials provided under this section. If requirements in this specification differ from those in the Special Provisions section, the requirements specified herein shall take precedence.

B. Identification

1. Valves specified herein shall be identified in accordance with the Special Provisions section.

1.04 SUBMITTALS

A. Drawings and Data

1. Complete fabrication and assembly drawings, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the Submittals section.

The data and specifications for each unit shall include, but shall not be limited to, the following:

a. Net weight of each valve and accessory
b. Name of manufacturer
c. Type and model
d. Construction materials and finishes
e. Unit dimensions
f. Performance curves indicating flow capacity versus pressure drop

B. Operation and Maintenance Data and Manuals

1. Adequate operation and maintenance information shall be supplied as required in the Submittals section. Operation and maintenance manuals shall be submitted in accordance with the Submittals section. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

PART 2 PRODUCTS

2.01 PERFORMANCE AND DESIGN REQUIREMENTS

A. Pressure reducing valves shall be designed to meet the service requirements as indicated herein and in the Pressure Reducing Valves Schedule on the Drawings.

B. Each pressure reducing valve shall be designed to provide tight shutoff under conditions of no flow and shall not "hunt" under ordinary flow conditions. Pressure reducing valves shall be selected and sized as recommended by the valve manufacturer. Valve pressure setpoint shall be adjustable to at least 20 percent above and below the reduced pressure setpoint.

2.02 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers and specific products are listed in the Construction paragraph.

2.03 MATERIALS

A. Valve materials shall be as indicated below and in the Construction paragraph.

Shop Coatings

Epoxy Enamel, NSF certified (Liquid Service)	Ameron "Amerlock 400 High-Solids Epoxy Coating", Carboline "Carboguard 891", or Tnemec "Series N140 PotaPox Plus"; immersion service.

2.04 CONSTRUCTION

A. Water Service

1. Pressure reducing valves for water service shall be direct-acting or pilot-operated type as indicated in the Pressure Reducing Valve Schedule.

2. Direct-acting valves shall be globe type with threaded connections and union assembly. The valves shall be provided with bronze body and cover, stainless steel trim, reinforced neoprene diaphragm, BunaN disc, and stainless-steel strainer. Direct-acting pressure reducing valves shall be Watts “Model CRD-L”, ClaVal “Model 990”, or Cash-Acme..

2.05 SAFETY VALVES FOR AIR SERVICE

A. Safety valves for air service shall be ASME labeled and shall have carbon steel bodies with stainless steel seats and discs, packed lifting levers, and integral spring enclosures. Gauges shall be provided for all valves. The safety valves shall be located as indicated on the drawings. The safety valves shall be as manufactured by Consolidated or Crosby.

2.06 SHOP PAINTING

A. All ferrous metal surfaces of valves and accessories, both interior and exterior, shall be shop painted for corrosion protection in accordance with the following list. The valve manufacturer’s standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the field painting specified in the Finish Painting section.

Interior Surfaces	
Liquid Service	Epoxy (NSF certified).
Exterior Surfaces	Universal primer with epoxy finish coat.

PART 3 EXECUTION

3.01 INSTALLATION

A. Materials furnished under this section will be installed in accordance with the Valves and Appurtenances section.

END OF SECTION

SECTION 15100

VALVES AND APPURTENANCES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to install, test, and make ready for service all non-buried valves as shown on the Drawings and as specified herein.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 SECTION INCLUDES

A. Outlet/Tapping Saddles

B. Ball Valves

C. Check Valves

D. Gate Valves

E. Plug Valves

F. Knife Gate Valves

G. Air/Vacuum Valves

H. Mud Valves

I. Flap Gates

J. Operators

K. Pressure Sensor Rings

L. Dielectric Connectors

M. Butterfly Valves

N. Pressure Relief and Pressure Sustaining Valves

O. Strainers

P. Solenoid Valves

Q. Plastic Valves

1.04 RELATED SECTIONS

A. Section 01170 – Special Provisions

B. Section 01600 – Materials, Transportation and Handling

C. Section 01666 – Testing of Pipelines

D. Section 01782 – Operation and Maintenance Data

E. Section 01783 – Product Warranties

F. Section 02640 – Valves, Hydrants, and Appurtenances

G. Section 09902 – Finish Painting

H. Section 13330 – Instrumentation Products

I. Section 15072 – Ductile Iron Piping and Fittings

1.05 REFERENCES

A. American National Standards Institute / American Society of Mechanical Engineers (ANSI/ASME), latest edition:

1. ANSI/ASME B1.20.1 Pipe Threads, General Purpose, Inch

2. ANSI/ASME B16.1 Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

3. ANSI/ASME B16.3 Malleable Iron Threaded Fittings: Classes 150 and 300

4. ANSI/ASME B16.4 Gray Iron Iron Threaded Fittings: Classes 125 and 250

5. ANSI/ASME B16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 Metric Inch Standard

6. ANSI/ASME B16.10 Face-to-Face and End-to-End Dimensions of Valves
7. ANSI/ASME B16.11 Forged Fittings, Socket Welding and Threaded
8. ANSI/ASME B16.15 Cast Copper Threaded Fittings: Classes 125 and 250
9. ANSI/ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings
10. ANSI/ASME B16.24 Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valve Classes 150, 300, 900, 1500 and 2500

B. American National Standards Institute / NSF International (ANSI/NSF), latest edition:

1. ANSI/NSF 61 Drinking Water System Components - Health Effects

C. ASTM International (ASTM), latest edition:

1. ASTM A48 Standard Specification for Gray Iron Castings
2. ASTM A126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
3. ASTM A193 Standard Specification for Alloy-Steel and Stainless-Steel Bolting for High Temperature or High-Pressure Service and Other Special Purpose Applications
4. ASTM A194 Standard Specification for Carbon Alloy Steel, and Stainless-Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
5. ASTM A276 Standard Specification for Stainless Steel Bars and Shapes
6. ASTM A351 Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
7. ASTM A436 Standard Specification for Austenitic Gray Iron Castings
8. ASTM A536 Standard Specification for Ductile Iron Castings
9. ASTM A743 Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
10. ASTM B30 Standard Specification for Copper Alloys in Ingot and Other Remelt Forms
11. ASTM B62 Standard Specification for Composition Bronze or Ounce Metal Castings
12. ASTM B371 Standard Specification for Copper-Zinc-Silicon Alloy Rod

13. ASTM B584 Standard Specification for Copper Alloy Sand Castings for General Applications

14. ASTM D1784 Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

15. ASTM D2000 Standard Classification System for Rubber Products in Automotive Applications

D. American Water Works Association (AWWA), latest edition:

1. AWWA C110 Ductile-Iron and Gray-Iron Fittings

2. AWWA C111 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

3. AWWA C115 Flanged Ductile-Iron Pipe with Ductile Iron or Gray-Iron Threaded Flanges

4. AWWA C116 Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings

5. AWWA C150 Thickness Design of Ductile-Iron Pipe

6. AWWA C151 Ductile-Iron Pipe, Centrifugally Cast

7. AWWA C153 Ductile-Iron Compact Fittings

8. AWWA C504 Rubber-Seated Butterfly Valves

9. AWWA C507 Ball Valves, 6 in. Through 60 In. [150 mm through 1,500 mm]

10. AWWA C508 Swing-Check Valves for Waterworks Service, 2 In. Through 48 In. [50 mm Through 1,200 mm] NPS

11. AWWA C511 Reduced-Pressure Principle Backflow Prevention Assembly

12. AWWA C512 Air Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service

13. AWWA C515 Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service

14. AWWA C540 Power-Actuating Devices for Valves and Slide Gates

15. AWWA C550 Protective Interior Coatings for Valves and Hydrants

16. AWWA C606 Grooved and Shouldered Joints

E. Manufacturers Standardization Society of the Valve and Fitting Industry (MSS), latest edition:

1. MSS SP-61 Pressure Testing of Steel Valves
2. MSS SP-67 Butterfly Valves
3. MSS SP-70 Cast Iron Gate Valves, Flanged and Threaded Ends
4. MSS SP-71 Gray Iron Swing Check Valves, Flanged and Threaded Ends
5. MSS SP-72 Ball Valves with Flanged or Butt-Welding Ends for General Service
6. MSS SP-78 Cast Iron Plug Valves, Flanged and Threaded Ends
7. MSS SP-80 Bronze Gate, Globe, Angle and Check Valves
8. MSS SP-85 Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
9. MSS SP-98 Protective Coatings for the Interior of Valves, Hydrants and Fittings
10. MSS SP-110 Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

F. Factory Mutual (FM)

G. Underwriters Laboratories (UL)

H. Where reference is made to one of the following standards, the revision in effect at the time of bid opening shall apply.

1.06 SYSTEM DESCRIPTION

A. All of the equipment and materials specified herein are intended to be standard for use in controlling the flow of wastewater, sludges, air, chemicals, and raw, filtered and finished water as noted on the Drawings.

B. Install valves with all appurtenances and miscellaneous items required to form complete and workable systems.

C. Certain valves similar to those specified in this Section may be specified in other sections to be furnished and installed with individual equipment or systems. In case of a conflict, those individual equipment or system requirements shall govern.

1.07 SUBMITTALS

A. See Section 01300, Submittals, for submittal procedures.

B. Product Data: Provide descriptive literature, bulletins, and/or catalogs of the equipment, and a complete bill of materials.

C. Shop Drawings: Indicate important details of construction and dimensions.

D. Design Data: Indicate pressure class and flow capacity.

E. Test Reports: Provide certified hydrostatic test data, per manufacturer's standard procedure or referenced standard.

F. Certificates: Certify that products of this section meet or exceed specified requirements.

G. Manufacturer's Instructions: Indicate installation and calibration procedures.

H. Manufacturer's Field Reports: Indicate proper installation and calibration.

I. Project Record Documents: Record actual locations of all valves and appurtenances.

J. See Section 01782, Operation and Maintenance Data, for O&M manual requirements.

1.08 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section, with not less than ten (10) years of documented experience.

B. Design, construct and install equipment in accordance with best methods and practices, and in compliance with this Section as applicable.

C. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

D. Provide the services of a qualified and factory-trained service representative of the manufacturer to provide operational and maintenance instruction for a minimum of one (1) day (8-hour period) for:

1. Pressure regulating, relief or sustaining valves

2. Air release, air, and vacuum valves

1.09 DELIVERY, STORAGE AND HANDLING

A. See Section 01600, Materials, Transportation and Handling, for delivery, storage, and protection procedures.

B. Additional packing and shipping requirements:

1. Prior to shipping, cover all valve ends to prevent entry of foreign material. Maintain covers in place until equipment is installed and piping connections are completed.

a. Valves, 3-inch and larger: Ship and store on site with wood or plywood covers on each valve end

b. Valves, smaller than 3-inch: Ship and store on site with heavy cardboard covers on each valve end

c. Rising stems and exposed stems: Coat with protective oil film and maintain until valve is installed and accepted

2. Inspect equipment for damage or defects.

3. Repair coatings damage to acceptance of the Engineer.

C. Storage and Protection:

1. Avoid exposure of plastic and similar brittle items to the sun or extremes in temperatures to prevent deformation. Consult the manufacturer's information for further requirements.

1.10 PROJECT CONDITIONS

A. Coordinate valve installation with size, location and installation of piping and any required service utilities.

B. Sequence installation to ensure valve, piping, and utility connections are achieved in an orderly and expeditious manner.

1.11 WARRANTY

C. See Section 01783, Product Warranties, for additional warranty requirements.

1.12 MAINTENANCE

A. See Section 01600, Materials, Transportation and Handling, for additional provisions.

B. Supply special tools and the manufacturer's standards spare parts where noted and specified.

C. Supply special tools packaged in a steel box, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended.

D. Provide a list of all spare parts and replacement parts with individual prices and location where they are available. Prices will remain in effect for a period of not less than one (1) year after final acceptance.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The use of a manufacturer's name and/or model or catalog number establishes the standard of quality and general configuration desired for valves and their appurtenances.

2.02 MATERIALS AND COMPONENTS

A. Bronze valves, 2-inch and smaller: Provide threaded ends unless otherwise specified.

B. Bronze valves, 2.5-inch and larger: Provide flanged ends unless otherwise specified.

C. Ferrous valves, 2.5-inch and larger: Provide flanged ends unless otherwise specified.

D. Valve pressure rating: Minimum working pressure of 150 psig or matching the connected pipe working pressure, unless otherwise indicated. Reference pressure rating in raised letters or indelibly mark on an identification plate on a visible place on the valve body.

E. Valve ends:

1. Threaded: Threads according to ASME B1.20.1.

2. Flanged: ASME B16.1 for cast iron valves, ASME B16.5 for steel valves, ASME B16.24 for bronze valves

3. Solder joint: Sockets according to ASME B16.18

a. Caution: Use solder with a melting point below 840 deg. F for angle, check, gate, and globe valves; below 421 deg. F for ball valves

b. Use lead-free solder on valves serving domestic water piping

4. Grooved: Ends according to AWWA C606.

F. Valve sizes: Same as upstream pipe, unless otherwise specified.

G. Design valves and actuators for submerged service when located outdoors but not within a building; in vaults; within a maximum of 2 feet above any liquid; or where valve and actuator might otherwise be submerged. All other units shall be as a minimum weather tight.

H. Bolts and Nuts for Ductile Iron Flanges

1. Bolts and nuts for connecting flanged piping, valves and other appurtenances shall conform to the following requirements.

a. Bolts and nuts for flanges shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M for bolts, and ASTM A194, Grade 8M for nuts.

b. Painted carbon steel, zinc plated, and hot-dipped galvanized bolts are not acceptable unless specifically indicated on the Drawings.

2. All stainless-steel bolts and nuts shall be coated with a chloride-free anti-galling lubricant that shall be similar to Ramco TRX-Synlube, Ramco Anti-Seize, Husky Lube “O” Seal, or an approved equal. The anti-galling lubricant on piping for potable water systems shall be ANSI/NSF 61 certified.

2.03 COATINGS

A. ANSI/NSF 61 compliant where in contact with Potable Water.

B. Cast and ductile iron valves exposed (non-buried): Provide AWWA C550 fusion bonded epoxy coating, 10-mils minimum, interior and exterior.

2.04 OUTLET / TAPPING SADDLES

A. Saddles shall be of ductile iron, designated for working pressure not less than 250 psi. Saddles shall be furnished with AWWA C110 flanged outlets. Saddles shall be as manufactured by the American Cast Iron Pipe Company or equal. Nuts and bolts shall be Type 304 stainless steel.

2.05 BALL VALVES

A. General Service Ball Valves

1. Ball valves, 2-inch and smaller, general service: ASTM B584 cast bronze, two-piece bodies; chrome-plated bronze ball; reinforced TFE seats; full ports; separate packnut with adjustable stem packing; anti-blowout stem; ASME B16.11 threaded end connections; rated for 600 psig service; and conforming to MSS SP-110. Equip valves with lever handle operators. Nibco or approved equal.

B. Stainless Steel Ball Valves

1. Ball valves, 2 1/2-inch and smaller, for stainless steel piping: ASTM A351 Type CF8M stainless steel, two (2) piece body; and rated for 1,000 psi service. Meet all other requirements of general service ball valves. Nibco, Crane/Aloyco, or approved equal.

C. Plastic Ball Valves

1. Ball valves, 4-inch and smaller, for PVC or CPVC piping to match chemical service: type in-line, true union, full port schedule 80; rated for 0 to 140 degrees Fahrenheit; and rated for 150 psi nonshock cold WOG service. Body/Bonnet trim shall be PVC or CPVC to match chemical system. Ball shall be PVC or CPVC to match chemical system. Stem shall be PVC or CPVC to match chemical system. Seat shall be Teflon. Thrust washer shall be Teflon. Steam seal shall be Viton O-ring. Body seals shall be Viton O-rings. End connections to be socket welded. Valve operator shall be lever. Meet all other requirements of general service ball valves. Hayward Plastic Products "True Union Ball Valve TBH Series"; Nibco "Chemtrol TU Series Tru-Bloc Ball Valve"; Spears Manufacturing Co "True Union 2000 Standard Series 3600 Ball Valve".

D. Three-Way Ball Valves

1. Three-way ball valves in anti-siphon loop service, 2-inch and smaller, for PVC or CPVC piping to match chemical service: true union, full port schedule 80; rated for 0 to 140 degrees Fahrenheit; and rated for 150 psi nonshock cold WOG service. Body/Bonnet trim shall be PVC or CPVC to match chemical system. Ball shall be

PVC or CPVC to match chemical system. Stem shall be PVC or CPVC to match chemical system. Thrust washer and trim shall be Teflon. Stem and body seals shall be Viton O-rings. End connections to be socket welded. Valve operator shall be lever. Meet all other requirements of general service ball valves. Asahi-America "Type 23 Multiport," Hayward "Three-Way Ball Valves," Nibco "3-Way Ball Valve," Spears "True Union 2000 Industrial 3-Way Valve."

2.06 CHECK VALVES

A. Swing Check Valves

1. 3-inch through 42-inch Swing Check Valves shall be suitable for cold working pressures of 250 psig, 150 psig for 30-in. (800mm) and larger in water, wastewater, abrasive, and slurry service. The valves shall be designed, manufactured, and tested in accordance with American Water Works Association Standards ANSI/AWWA C508. Valves shall be provided with flanges. Swing Check Valves shall be Swing Check Valves as manufactured by Val-Matic® Valve & Manufacturing Corporation, ARCO Swing Check Valve by DeZurik, Series 41 Check Valve by American AVK Company, or approved equal.

2. Swing Check Valve Design:

   a. The valve body shall be full flow equal to nominal pipe diameter at all points through the valve. The body shall be constructed of ASTM A536 ductile iron with flat faced flanged connections.

   b. The top access port shall be full size, allowing removal of the disc without removing the valve from the line.

   c. The body seat shall be 316 stainless steel. All external fasteners shall be stainless steel.

   d. The disc and disc arm shall be ASTM A536 ductile iron. The disc shall be attached to the disc arm with a stainless-steel fastener.

   e. The disc seat shall be acrylonitrile butadiene (NBK) and security held in place by stainless steel screws.

   f. The pivot shaft shall be one-piece stainless steel.

   g. The valve disc shall be cycle tested 1,000,000 times in accordance with ANSI/AWWA C508 and show no signs of wear, cracking, or distortion to the valve disc or seat and shall remain drop tight at both high and low pressures. The test results shall be independently certified.

3. Required Swing Check Valve Options

   a. Equip valves with a pre-wired limit switch; indicate closed position to a remote location.

B. Small Diameter Check Valves (less than 3-inch)

1. Check valves, 2 1/2-inch and smaller, general service: Y-pattern, swing-type; Class 125 ASTM B62 bronze bodies; TFE seat disc; ASME B16.11 threaded end connections; rated for 200 psig service; and conforming to MSS SP-80. Nibco, or approved equal.

2. Check valves, 2 1/2-inch and smaller, for stainless steel piping: ASTM A351 Type CF8M stainless steel; and rated for 300 psig service. Meet all other requirements of general service swing check valves. Crane/Aloyco or approved equal.

C. Duck Bill Check Valve

1. Duck bill check valves, 1-inch to 4-inch, all-rubber sleeve: Buna-N sleeve unless otherwise indicated; inside-pipe style secured with expanding stainless steel clamps. Red Valve Tideflex Series 37G or approved equal

2. Duck bill check valves, 3-inch to 24-inch, all-rubber sleeve: Buna-N sleeve unless otherwise indicated; integral elastomer sleeve flange; stainless steel backup ring with stainless steel hardware; ASME B16.5, Class 150 flanged end connections. Red Valve Series 35 Check Valve or approved equal.

D. Ball Check Valve

1. Ball check valve, 3-inch and smaller: true-union ball check with PVC or CPVC body; socket inlet and outlet connections; and rated for 150 psig nonshock service. Viton or EPDM seat and seals; limited to 0 to 140 degrees Fareinheit service; Hayward Plastics Products “Ball Check Valve”, Nibco “Chemtrol True Union Ball Check Valve”, Spears Manufacturing Co. “True Union 2000 Industrial Series 4500 Ball Check Valves.” To be used with PVC or CPVC piping associated with the aluminum sulfate chemical feed system.

2.07 GATE VALVES

A. General Service Gate Valves

1. Gate valves, 2-inch and smaller, general service: Class 125 bronze bodies; silicon-bronze stems; bronze screwed bonnets; single solid wedge bronze disc; non-rising stems; rated for 200 psig service; ASME B16.11 threaded end connections; and conforming to MSS SP-80. Equip valves with malleable iron hand wheel operators. Nibco, Hammond, Powell, Jenkins, Stockham or approved equal.

B. Resilient Seated Gate Valves

1. Valves 3-inch and larger shall be manufactured in accordance with AWWA C515 and as specified herein. Valves shall be Series A-2360 or A-2361 by Mueller Company, Series 2500 by American Flow Control, or approved equal.

2. Valves for potable water service shall be constructed with a bronze stem. Valves in contact with wastewater shall be constructed with a 304 or 316 stainless steel stem

(it is understood that this may not be the standard material for the gate valves named in the Specification, but it is nonetheless required).

3. Valves shall be provided with a minimum of two O-ring stem seals.

4. Bonnet and gland bolts and nuts shall be Type 304 or 316 stainless steel. The hot-dip process in accordance with ASTM A153 is not acceptable. Allen-wrench type bonnet and gland fastening shall not be acceptable and will be rejected.
5. Wedges shall be totally encapsulated.

6. Units shall be, in addition, UL and FM approved.

7. Cast the word “OPEN” and an arrow indicating direction to open on each valve body or operator.

8. Equip valves with malleable iron hand wheel operators. Equip vertical valves, 16-inch and larger with spur gear actuator; equip horizontal valves 16-inch and larger with bevel gear actuator; include grease case.

9. AWWA requirements for thrust collar and stem to be integrally cast (not pinned on), and copper alloy valve stems shall be strictly enforced.

10. Valves shall have flanged ends compliant with AWWA C115 unless otherwise noted.

11. A ten (10) year warranty shall be provided for all resilient seated gate valves furnished on the Project.

2.08 PLUG VALVES

A. Lined Eccentric Plug Valves

1. Plug valves, 4-inch to 54-inch: ASTM A126, Class B cast iron bodies, ASME B16.1, Class 125 flanged end connections; ASTM A126, Class B cast iron one-piece plug, quarter-turn, non-lubricating; AWWA C504, Buna-N, ASTM D2000 resilient plug facing; port area 100% of pipe area (4-inch and smaller), 80% (6 to 24-inch), or 75% (30-inch and larger); welded-in nickel overlay seats; self-lubricating ASTM A743 Type 316 stainless steel radial shaft bearings; PTFE thrust bearings; AWWA C504 V-type stem seals; stainless steel bonnet bolts; rated for 175 psig service (4 to 12-inch), or 150 psig service (14-inch and larger); drip-tight shutoff with pressure from either direction. Valves shall be by Pratt, Dezurik, Val-Matic, or approved equal.

   a. Equip 4-inch and smaller valves with steel wrench lever manual operator unless otherwise indicated on the drawings.

   b. Equip 6-inch and larger valves with totally enclosed, geared, manual operator with hand wheel

   c. Equip with electric actuators where shown on the plans

   d. All plug valves shall be equipped with grease zerks to allow for the valve seat to be flushed with grease.

2.09 KNIFE GATE VALVES

A. All knife gate valves shall be bonneted flanged knife gate valves suited for 50 psig working pressure or greater as required by the specific piping application. The knife gates shall include a square gate and be rated for throttling service. Valves shall be marked for direction of flow and round bar wedges and gate guides shall be installed in the liner body to force the gate against the seat. The gate shall be a beveled knife edge. Valves shall have metal to metal seating, with a raised seat face with a relief groove to allow the gate to push solid particles aside to prevent material packing in the seat area. The knife gate body, gate, yoke, and stem shall be Type 304/316 stainless steel. Packing gland bolts shall be Type 18-8 stainless steel with Type 18-8 selflocking nuts. Seats shall be solid stainless steel.

B. The valves shall have full port straight through opening. Flanges shall be drilled to match connecting piping. Knife gate valves shall be manufactured by similar and equal to Model H-300-B-T304 by Hilton Valve, Inc. or approved equal.

2.10 AIR/VACUUM, VACUUM BREAKER, AND AIR RELEASE VALVES

A. Combination Air/Vacuum Valves (Wastewater)

1. Air/Vacuum valves, 1 to 6-inch, standard combination: Stainless steel Type 316 valve bodies as shown on the plans; ANSI Standard flanged or NPT threaded inlet and outlet connections; stainless steel float; and rated for 150 psig service. A.R.I., Dezurik, or approved equal. Equip air/vacuum valve with manufacturer approved isolation valve and optional air-out only device as specified.

B. Air Release Valves (Water)

1. Air release valves, 1 to 3-inch: NSF 61 certified fusion bonded epoxy coated steel, cast, or ductile iron valve bodies; ANSI Standard flanged or NPT threaded inlet and outlet connections; stainless steel float; and rated for 150 psig service APCO No. 200-A, Val-Matic Model 15-50, or approved equal. Equip air release valve with manufacturer approved isolation valve.

C. Vacuum Breaker Valves (Chemical)

1. Vacuum breaker valves, 1 to 3-inch: chemically resistant diaphragm two piece type PVC body; NPT threaded inlet and outlet connections; and rated for 100 psig nonshock service; limited to 0 to 140 degrees Fahrenheit service; Plast-O-Matic “Series CKM Check Valves” or “Series VB Vacuum Breakers”. To be used with PVC or CPVC piping.

2.11 MUD VALVES

A. Mud Valves shall be flanged end, non-rising stem type. Valve bodies and stem guides shall be of stainless steel. Stainless steel body valves shall be all 316 stainless steel, with resilient rubber seats, Trumbull Model Series 1367-135X or equal. Mounting hardware shall match the valve material. Each valve shall be provided with coupling nut, 316 stainless steel extension stem, stem guides, and cast iron handwheel with a 316 stainless

steel position indicator wall bracket, Trumbull model 367-2460 or equal. Mud valves shall be installed with the valve seat level.

2.12 FLAP GATES

A. Flap gates shall be furnished with all necessary parts and accessories indicated on the Drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of flap gates. Each gate shall be designed to automatically open whenever the unseating head exceeds the seating head by 0.30 foot or less, and to automatically close whenever the seating head exceeds the unseating head. When gates are installed for pump discharge service, they shall be provided with an anti-lock bar to prevent the cover from tipping forward and becoming lodged in the opening, and with a leaf spring or other suitable device to limit cover travel during pump operation. Acceptable manufacturers are Hydro Gate, Rodney Hunt, or equal.

B. The body, cover, and hinge arms shall be constructed of ASTM A-240 and A-276 Stainless Steel type 304L or 316L. Seals shall be Neoprene Durometer between 50 and 65. Hinge Bushings shall be non-metallic and permanent self-lubricating. Fasteners shall be ASTM F593 and F594, GR1 for type 304 and GR2 for type 316.

2.13 OPERATORS

A. Valve Actuators General

1. See paragraph 2.02.G for submergence requirements.

2. Supply and rigidly mount all actuators, manual or powered, on valves at the factory. Ship valves and their individual actuators as integral units.

3. Valve Actuators: Supply non-buried valves with manual hand wheels, handles or levers mounted on the operator, unless otherwise noted on the Drawings. Hand wheels shall not exceed 18-inch diameter.

4. Except as indicated on the Drawings, supply chain wheel operators with zinc plated chain guides and steel chain for all valves 3-inch and larger when the valve center line is located 7 feet or more above the operating floor. Loop steel chain within 4 feet or the floor.

5. Supply actuators capable of moving the valve from full open to full close position and in reverse and holding the valve at any position part way between full open or closed.

6. Supply operating devices with the word “OPEN” and a direction arrow cast or engraved into their surfaces.

7. Floor Boxes: Designed for use with operating nuts, standard cast iron type, and cast-in-place with fastening tip by Clow or equal.

8. Stem Guides: Adjustable wall bracket type, bronze brushed, with maximum spacing of 10 feet, by Clow, Rodney Hunt, or equal. Supply universal joints and pin

couplings, rated at five time the maximum operating torque, for stems longer than 10 feet. Supply stem adapters as necessary.

9. Where required by the installation, or as specified on the Drawings, supply an extended stem and floor stand; hand wheel with position indicator and etched or cast arrow to show rotation direction to open valve; and a resilient and moisture-resistant seal around stem penetration of slab.

10. Gear Actuators:

    a. Unless otherwise indicated, supply gear actuators for all valves 8-inch diameter and larger, and all valves where manual operator effort is greater than 80 lbs. rim pull.

    b. Supply worm or helical gear type actuators with output shaft perpendicular to valve shaft, having a removable hand wheel mounted on the output shaft, and conforming to AWWA C504.

    c. Supply gear actuators capable of removal from the valve without dismantling the valve or removing the valve from the pipeline.

    d. Supply the following components: machine-cut steel gearing designed for smooth operation; permanently lubricated bearings with bronze bearing bushings; and sealed housings of the same material as the valve body to exclude moisture and dirt, and to allow reduction mechanism to operate in lubricant.

2.14 PRESSURE SENSOR RINGS (NOT USED)

2.15 DIELECTRIC CONNECTIONS

A. Dielectric Connectors

1. Dielectric pipe fittings/insulators and unions shall be used to prevent galvanic action wherever valves or piping of dissimilar metals connect. This shall be particularly the case for copper, brass, stainless steel, and bronze piping connecting to cast iron or steel piping systems.

2. Dielectric unions shall be used for 2-inch and smaller connections. Steel union nuts shall meet ASTM A575 requirements. The steel or ductile iron connection end shall have a steel body and shall have accurately machined taper tapped pipe threads in accordance with ASME B2.1. The copper connection end shall be a copper solder joint that meets requirements of ASTM B88. Dielectric unions shall be rated for at least 250 psi at 210 degrees F.

3. Dielectric flange unions shall be used for connections 2 1/2-inch and larger. Cast iron flanges shall meet ASTM A126; the copper solder end shall meet ASTM B62 and the pipe thread shall meet ASME B2.1. Dielectric flange unions shall be rated for at least 175 psi at 210 degrees F.

4. Dielectric unions and flange unions shall be as manufactured by Epco Inc., Cleveland, OH or equal.

5. Flange insulating kits shall be as acceptable to the Engineer, as manufactured by Pipeline Seal and Insulator, Inc. (PSI, Inc.) or equal.

6. Insulated sleeve couplings and flange adaptors shall be similar to those units as specified elsewhere.

2.16 BUTTERFLY VALVES

A. All Butterfly valves and operators shall conform to AWWA C504, Class B, except as specifically modified herein. Valves shall have a minimum 150-psi pressure rating or as noted on the Drawings and be manufactured by Dezurik, Val-Matic, Pratt, or equal.

B. All Butterfly valves for air service shall be rated for an operating temperature of up to 290°F.

C. Bolts and nuts shall be fabricated from low alloy-steel for corrosion resistance. Galvanized hardware is not acceptable.

D. Butterfly valves 6-inches and smaller shall be equipped with a lever actuator. Valves larger than 6-inches shall be equipped with a gearbox and handwheel unless otherwise noted.

E. Valve seats shall be full resilient seats retained in the body in accordance with AWWA C504.

F. Valve discs shall be constructed of ductile iron, ASTM A536. Discs shall be furnished with a 316 stainless steel seating edge to mate with the rubber seat. Seats shall be fully adjustable and replaceable with the valves in place for all valves 24-inch diameter and larger.

G. Valve body – Ductile iron, ASTM A536, Grade 65-45-12. Flanged end valves shall be of the short body design and shall have Class 125 flanged ends faced and drilled per ASME B16.1. Permanently self-lubricating body bushings shall be provided and shall be sized to withstand bearing loads. Stuffing box of liberal dimensions shall be provided at the operator end of the operator end of the vane shaft.

H. The valve shaft shall be of Type 304 stainless steel and designed for both torsional and shearing stresses when the valve is operated under its greatest dynamic or seating torque. No reductions of shaft diameter will be allowed except at the operator connection. Any reduction shall have a full radius fillet.

I. The valve manufacturer shall furnish an affidavit that the butterfly valves have been manufactured and tested in accordance with AWWA C504.

2.17 PRESSURE RELIEF AND PRESSURE SUSTAINING VALVE

A. Pressure Relief and Pressure Sustaining Valve, globe pattern; ASTM A536 Ductile Iron bodies; ASME B16.42 flanged end connections; Stainless steel anti-cavitation trim; Buna-N disc; nylon reinforced Buna-N diaphragm, stainless steel stem, nut, spring, trim, fittings, and tubing; rated for 150 psig service. Valve shall be Cla-Val Model 50-01KO with

isolation valves, CRL60 relief pilot, opening speed control, Y-Pattern pilot strainer, inlet and outlet pressure gauges, limit switch position indicator, inlet pressure transmitter, or approved equal.

2.18 STRAINERS

A. In-line strainers shall be Cla-Val Model X43H or approved equal. Strainers shall have ASTM A536 Ductile Iron bodies, ASME B16.42 flanged end connections, 10 mesh Type 316 Stainless Steel screens, and stainless-steel hardware. Strainers shall be rated for 250 psi and equipped with a 1 ¼" stainless steel drain ball valve. The drain shall be piped to the wet well to facilitate maintenance.

2.19 SOLENOID VALVES

A. Solenoid Valves shall be packless piston type direct acting for sizes less than 1-inch and internal pilot operated for size 1-inch and larger, 2-way or 3-way, and shall be ASCO Valve; Red Hat by Automatic Switch Co., similar by Atkomatic Valve Co., or approved equal for air and water service.

B. Valves shall be energize to open unless otherwise noted.

C. Valves shall have forged brass bodies, NPT end connections of the connected pipe, Type 316 stainless steel internal parts, and Buna-N or Ethylene Propylene valve seats. Valves shall have a minimum 150 psi safe working pressure and zero minimum operating pressure differential. Connections shall be threaded.

D. Note that solenoid valves may be shown on Electrical and/or Mechanical Drawings, or may only be specified.

2.20 PLASTIC VALVES

A. General

1. All valves except as otherwise specified shall be certified as completely compatible with the intended and specified service; compatibility shall apply to the material of the valve and internal components, including all seals, gaskets, O-rings and washers; solvents and primers used in valve joint make-up shall be specifically in conformance with the written instructions of the valve supplier. Service chemicals and service conditions are shown in the piping sections in Division 15.

2. Except as otherwise specified valve ends shall be socket-type designed for solvent welding. The valve manufacturer shall provide specific recommendations for solvent and primer.

3. Valve material shall be the same as the piping service except as specified.

   a. PVC shall be Type 1, Grade 1, per ASTM D1784 classification, made from unplasticized polymer, and generally suitable for service to 120 degrees F

   b. CPVC shall be Type 4, Grade 1, per ASTM D1784, classification generally suitable for service to 180 degrees F

c. Polypropylene (PP) shall conform to the material requirements of ASTM D4101 for copolymer polypropylene. Generally suitable for service to 195 degrees F

d. PVDF (polyvinylidene fluoride) shall be manufactured from high molecular weight polymers of vinylidene fluoride. Generally suitable for service to 250 degrees F

e. The manufacturer of the valves shall retain material source quality documentation and shall furnish it to the Engineer upon request

4. Unless otherwise specified:

a. O-rings, valve seats and stem seals shall be Teflon, or Teflon encapsulated elastomer. Alternative materials may not be substituted without complete documentation provided to the Engineer of service suitability

b. Gaskets shall be made from PTFE-bonded sheet material, GORE-TEX manufactured by W.L. Gore & Associates; AV Low-Torque gaskets by Asahi/America or equal

c. Valve external hardware shall be Type 316 stainless steel. No internal metallic components shall be exposed to the service fluid

d. No factory or field coatings shall be applied to the valves

5. All valves, except butterfly valves shall have a non-shock service pressure rating of not less than 120 psig at 70 degrees F.

6. All valves shall be given hydrostatic and pressure and leakage tests at the factory. Provide certified copy of test results.

7. Valves shall be the standard, catalogued products of the following manufacturers: Chemtrol, Asahi/America, Plast-O-Matic, Hayward, or Spears.

8. Valves specified as furnished with equipment or equipment systems shall comply with these requirements.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Install all valves and appurtenances per the manufacturer's instructions at the locations shown, true to alignment and rigidly supported. Repair any damage to valves or appurtenances, incurred during shipping or storage, to the satisfaction of the Engineer before installation.

B. Install all brackets, extension rods, guides, operators, and appurtenances as shown on the Drawings, or otherwise required. Before setting these items, check all Drawings and figures that have a direct bearing on their location. The Contractor shall be responsible for the proper location of valves and appurtenances during the construction of the work.

C. Carefully inspect all materials for defects in construction and materials. Clean all debris and foreign material from openings, etc. Maintain all valve flange covers in place until connected piping is in place. Check all operating mechanisms for proper functioning, and all nuts and bolts for tightness. Repair or replace valves and other equipment which do not operate easily or are otherwise defective, at no additional cost to the Owner.

D. Install valves in accordance with referenced standards, except as herein modified. Supply certification of materials or installation as required by these specifications. Notify the Engineer of additional requirements not covered in this Section.

E. Unless otherwise noted, make up joints for valves and appurtenances utilizing the same procedures as specified under the applicable type of connection pipe joint. Install all valve and other items in the proper position as recommended by the manufacturer. Contractor shall be responsible for verifying manufacturer's torquing requirements for all valves.

3.02 INSTALLATION OF MANUAL OPERATIONAL DEVICES

A. Unless otherwise noted, install all operational devices with the valve at the factory. Install the operator as shown on the Drawings or as acceptable to the Engineer to allow easy accessibility for operation and maintenance and to prevent interference with other piping, valves, and appurtenances.

B. Install floor boxes, valve boxes, extension stems, and low floor stands vertically centered over the operating nut, with couplings as required, and with the elevation of the box top adjusted to conform to the elevation of the finished floor surface or grade at the completion of the Contract. Adequately support boxes and stem guides during concrete placement to maintain vertical alignment.

3.03 INSPECTION, TESTING AND CORRECTION OF DEFICIENCIES

A. Take care not to over-pressure valves or appurtenance during pipe testing. If any unit proves to be defective, replace or repair it to the satisfaction of the Engineer.

B. Perform no testing until the manufacturer's service engineer has provided written certification that the installed equipment has been examined and found to be in complete accordance with the manufacturer's requirements.

C. Functional Test: Prior to startup, inspect all items for proper alignment, quiet operation, proper connection, and satisfactory performance. Operate all units continuously while connected to the attached piping without vibration, jamming, leakage, or overheating, and confirm that valve performs the specified function.

D. Field test all valves along with the associated pipelines. Adjust, remove, or replace any valve or appurtenance found to be defective as a result of testing, to the satisfaction of the Engineer.

3.04 CLEANING

A. Clean all valves, including valve interiors, prior to installation, testing, disinfection, and final acceptance.

3.05 VALVE TAGS

A. Furnish and Install valve tags on all valves in accordance with Section 01170, Special Provisions, and as indicated on the Drawings.

END OF SECTION

SECTION 15101

VALVE/PLANT VALVE AND APPURTENANCE SCHEDULE

PART 1 GENERAL

A. General

1. This Section is provided for the convenience of the Contractor and does not relieve the Contractor of the responsibility of providing all valves and appurtenances required by the complete set of Contract Documents including the Drawings and other sections of the Specifications. No valves smaller than 4” in diameter are listed in this schedule.

B. The following abbreviations are referenced in the following schedule:

1. AIR – PROCESS AERATION AIR
2. DRAIN – SERVICE VARIES
3. FW – FILTER WASTE
4. GRIT – GRIT
5. PWS – PLANT WATER SYSTEM
6. RAS – RETURN ACTIVATED SLUDGE
7. RS – RAW SEWAGE
8. SLUDGE – SLUDGE
9. SWAS – SURFACE WASTE ACTIVATED SLUDGE
10. WAS – WASTE ACTIVATED SLUDGE
11. WS – WATER SYSTEM
12. WW – WASTEWATER

No.	Valve Number	Location	Valve Type	Service	Connection	Operator	Remarks	Sheet No.
1	24" PV-A01	Pumped Influent Meter Vault	Plug	RS	Mechanical	Gear	Buried	P-2, MA-22, C-20
2	12" PV-A02	Pumped Influent Meter Vault	Plug	RS	Mechanical	Gear	Buried	P-2, MA-22, C-20
3	4" PV-A03	Pumped Influent Meter Vault	Plug	RS	Mechanical	Gear	Buried	P-2, MA-22, C-20
4	24" PV-A04	Pumped Influent Meter Vault	Plug	RS	Mechanical	Gear	Buried	P-2, MA-22, C-20
5	12" PV-A05	Pumped Influent Meter Vault	Plug	RS	Mechanical	Gear	Buried	P-2, MA-22, C-20
6	4" PV-A06	Pumped Influent Meter Vault	Plug	RS	Mechanical	Gear	Buried	P-2, MA-22, C-20
7	4" PV-A07	Headworks: To GC-02	Plug	Grit	Flanged	Handwheel	Normally Open	P-2, MA-6
8	4" PV-A08	Headworks: To GC-02	Plug	Grit	Flanged	Handwheel	Normally Open	P-2, MA-6
9	4" PV-A09	Headworks: To GC-02	Plug	Grit	Flanged	Handwheel	Normally Open	P-2, MA-6
10	4" PV-A10	Headworks: To GC-02	Plug	Grit	Flanged	Handwheel	Normally Open	P-2, MA-6
11	4" PV-A11	Headworks: To GC-01	Plug	Grit	Flanged	Handwheel	Normally Open	P-2, MA-6
12	4" PV-A12	Headworks: To GC-01	Plug	Grit	Flanged	Handwheel	Normally Open	P-2, MA-6
13	4" PV-A13	Headworks: To GC-01	Plug	Grit	Flanged	Handwheel	Normally Open	P-2, MA-6
14	4" PV-A14	Headworks: To GC-01	Plug	Grit	Flanged	Handwheel	Normally Open	P-2, MA-6
15	4" PV-A15	Headworks: GC-01/GC-02	Plug	Grit	Flanged	Chainwheel	Normally Closed	P-2, MA-13
16	24" GV-A16	Influent structure	Gate	RS	Flanged	Spur Gear	Normally Open	P-2, MA-6, MA-8
17	24" GV-A17	Influent structure	Gate	RS	Flanged	Spur Gear	Normally Open	P-2, MA-6, MA-8
18	24" GV-A18	Influent structure	Gate	RS	Flanged	Spur Gear	Normally Open	P-2, MA-6, MA-8
19	24" GV-A19	Influent structure	Gate	RS	Flanged	Spur Gear	Normally Open	P-2, MA-6, MA-8
20	30" PV-A20	Wet Weather Bypass to Filters	Plug	RS	Mechanical	Gear	Buried	P-2, MA-26, C-22
21	30" PV-A21	Wet Weather Bypass to Filters	Plug	RS	Mechanical	Gear	Buried	P-2, MA-26, C-22
22	12" PV-C02	Aeration Basin 02	Plug	SWAS	Mechanical	Operating Nut	Buried	P-3, MC-2, C-21
23	12" PV-C01	Aeration Basin 01	Plug	SWAS	Mechanical	Operating Nut	Buried	P-3, MC-2, C-21
24	6" CV-C03	Surface Wasting Valve Vault	Check	SWAS	Flanged	Manual	Non-Buried	P-3, MC-3, MC-4
25	6" PV-C04	Surface Wasting Valve Vault	Plug	SWAS	Flanged	Gear + Handwheel	Normally Open	P-3, MC-3, MC-4
26	6" PV-C05	To Sludge Thickener Splitter Box	Plug	SWAS	Mechanical	Operating Nut	Normally Open	P-3, MC-3, MC-4, C-22
27	12" PV-D01	RAS Pump Station No.1 Meter Vault No. 1	Plug	RAS	Mechanical	Operating Nut	Buried	P-4, MD-4, C-21
28	12" PV-D02	RAS Pump Station No.1 Meter Vault No. 1	Plug	RAS	Mechanical	Operating Nut	Buried	P-4, MD-4, C-21
29	12" PV-D03	RAS Pump Station No.1 Meter Vault No. 2	Plug	RAS	Mechanical	Operating Nut	Buried	P-4, MD-5, C-22
30	12" PV-D04	RAS Pump Station No.1 Meter Vault No. 2	Plug	RAS	Mechanical	Operating Nut	Buried	P-4, MD-5, C-22
31	6" GV-P01	From Secondary Clarifier No.2	Gate	WW	Mechanical	Operating Nut	Buried	P-4, C-22
32	6" GV-P02	From Secondary Clarifier No.3	Gate	WW	Mechanical	Operating Nut	Normally Closed	P-4, C-22
33	4" GV-F01	RAS Pump Station No.2	Gate	RAS	Flanged	Handwheel	Normally Open	P-4, MF-1
34	4" ARV-F02	RAS Pump Station No.2	Air	RAS	Flanged	N/A	NA	P-4, MF-1
35	12" CV-F03	RAS Pump Station No.2	Check	RAS	Flanged	N/A	Normally Open	P-4, MF-1
36	12" PV-F04	RAS Pump Station No.2	Plug	RAS	Flanged	Handwheel	Normally Open	P-4, MF-1
37	4" GV-F05	RAS Pump Station No.2	Gate	RAS	Flanged	Handwheel	Normally Open	P-4, MF-1
38	4" ARV-F06	RAS Pump Station No.2	Air	RAS	Flanged	N/A	NA	P-4, MF-1
39	12" CV-F07	RAS Pump Station No.2	Check	RAS	Flanged	N/A	Normally Open	P-4, MF-1
40	12" PV-F08	RAS Pump Station No.2	Plug	RAS	Flanged	Handwheel	Normally Open	P-4, MF-1
41	12" PV-F09	RAS Pump Station No.2 Meter Vault	Plug	RAS	Mechanical	Operating Nut	Buried	P-4, MF-2, C-22
42	12" PV-F10	RAS Pump Station No.2 Meter Vault	Plug	RAS	Mechanical	Operating Nut	Buried	P-4, MF-2, C-22
43	4" PV-H01	Filter No.1	Plug	WW	Flanged	Electric	Normally Open	P-5, MH-1 thru MH-5

No.	Valve Number	Location	Valve Type	Service	Connection	Operator	Remarks	Sheet No.
44	4" PV-H02	Filter No.1	Plug	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
45	6" BV-H03	Filter No.1	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
46	6" BV-H04	Filter No.1	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
47	6" BV-H05	Filter No.1	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
48	6" BV-H06	Filter No.1	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
49	6" BV-H07	Filter No.1	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
50	4" PV-H08	Filter No.1	Plug	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
51	4" PV-H09	Filter No.2	Plug	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
52	6" BV-H10	Filter No.2	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
53	6" BV-H11	Filter No.2	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
54	6" BV-H12	Filter No.2	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
55	6" BV-H13	Filter No.2	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
56	6" BV-H14	Filter No.2	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
57	4" PV-H15	Filter No.2	Plug	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
58	4" PV-H16	Filter No.2	Plug	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
59	4" PV-H17	Filter No.3	Plug	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
60	4" PV-H18	Filter No.3	Plug	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
61	6" BV-H19	Filter No.3	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
62	6" BV-H20	Filter No.3	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
63	6" BV-H21	Filter No.3	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
64	6" BV-H22	Filter No.3	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
65	6" BV-H23	Filter No.3	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
66	4" PV-H24	Filter No.3	Plug	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
67	4" PV-H25	Filter No.4	Plug	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
68	6" BV-H26	Filter No.4	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
69	6" BV-H27	Filter No.4	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
70	6" BV-H28	Filter No.4	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
71	6" BV-H29	Filter No.4	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
72	6" BV-H30	Filter No.4	Butterfly	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
73	4" PV-H31	Filter No.4	Plug	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
74	4" PV-H32	Filter No.4	Plug	WW	Flanged	Electric	NA	P-5, MH-1 thru MH-5
75	4" BV-H33	Filter Backwash Pump 01	Ball	FW	Flanged	Handwheel	NA	P-5, MH-5, MH-1
76	4" BV-H34	Filter Backwash Pump 01	Ball	FW	Flanged	Handwheel	NA	P-5, MH-5, MH-1
77	4" CV-H35	Filter Backwash Pump 01	Check	FW	Flanged	Handwheel	NA	P-5, MH-5, MH-1
78	4" BV-H36	Filter Backwash Pump 02	Ball	FW	Flanged	Handwheel	NA	P-5, MH-5, MH-1
79	4" BV-H37	Filter Backwash Pump 02	Ball	FW	Flanged	Handwheel	NA	P-5, MH-5, MH-1
80	4" CV-H38	Filter Backwash Pump 02	Check	FW	Flanged	N/A	NA	P-5, MH-5, MH-1
81	4" BV-H39	Filter Backwash Pump 03	Ball	FW	Flanged	Handwheel	NA	P-5, MH-5, MH-1
82	4" BV-H40	Filter Backwash Pump 03	Ball	FW	Flanged	Handwheel	NA	P-5, MH-5, MH-1
83	4" CV-H41	Filter Backwash Pump 03	Check	FW	Flanged	N/A	NA	P-5, MH-5, MH-1
84	4" BV-H42	Filter Backwash Pump 04	Ball	FW	Flanged	Handwheel	NA	P-5, MH-5, MH-1
85	4" BV-H43	Filter Backwash Pump 04	Ball	FW	Flanged	Handwheel	NA	P-5, MH-5, MH-1

No.	Valve Number	Location	Valve Type	Service	Connection	Operator	Remarks	Sheet No.
86	4" CV-H44	Filter Backwash Pump 04	Check	FW	Flanged	N/A	NA	P-5, MH-5, MH-1
87	6" BV-H45	Post Aeration Blower-01	Butterfly	Air	Flanged	Handle	NA	P-5, MH-6
88	6" CV-H46	Post Aeration Blower-01	Check	Air	Flanged	N/A	NA	P-5, MH-6
89	6" BV-H47	Post Aeration Blower-02	Butterfly	Air	Flanged	Handle	NA	P-5, MH-6
90	6" CV-H48	Post Aeration Blower-02	Check	Air	Flanged	N/A	NA	P-5, MH-6
91	6" BV-H49	Post Aeration Blower-03	Butterfly	Air	Flanged	Handle	NA	P-5, MH-6
92	6" CV-H50	Post Aeration Blower-03	Check	Air	Flanged	N/A	NA	P-5, MH-6
93	6" BV-H51	Post Aeration No.1	Butterfly	Air	Waffer	Handle	NA	P-5, MH-6
94	6" BV-H52	Post Aeration No.2	Butterfly	Air	Waffer	Handle	NA	P-5, MH-6
95	4" GV-I01	Effluent Pump Station WW1	Gate	WW	Flanged	Handwheel	Normally Open	P-6, MI-1, MI-2, MI-3
96	4" ARV-I02	Effluent Pump Station WW1	Air	Air	Flanged	N/A	NA	P-6, MI-1, MI-2, MI-3
97	20" CV-I03	Effluent Pump Station WW1	Check	WW	Flanged	N/A	NA	P-6, MI-1, MI-2, MI-3
98	20" GV-I04	Effluent Pump Station WW1	Gate	WW	Flanged	Handwheel	Normally Open	P-6, MI-1, MI-2, MI-3
99	4" GV-I05	Effluent Pump Station WW2	Gate	WW	Flanged	Handwheel	Normally Open	P-6, MI-1, MI-2, MI-3
100	4" ARV-I06	Effluent Pump Station WW2	Air	Air	Flanged	N/A	NA	P-6, MI-1, MI-2, MI-3
101	20" CV-I07	Effluent Pump Station WW2	Check	WW	Flanged	N/A	NA	P-6, MI-1, MI-2, MI-3
102	20" GV-I08	Effluent Pump Station WW2	Gate	WW	Flanged	Handwheel	Normally Open	P-6, MI-1, MI-2, MI-3
103	4" GV-I09	Effluent Pump Station WW3	Gate	WW	Flanged	Handwheel	Normally Open	P-6, MI-1, MI-2, MI-3
104	4" ARV-I10	Effluent Pump Station WW3	Air	Air	Flanged	N/A	NA	P-6, MI-1, MI-2, MI-3
105	20" CV-I11	Effluent Pump Station WW3	Check	WW	Flanged	N/A	NA	P-6, MI-1, MI-2, MI-3
106	20" GV-I12	Effluent Pump Station WW3	Gate	WW	Flanged	Handwheel	Normally Open	P-6, MI-1, MI-2, MI-3
107	4" GV-I13	Effluent Pump Station DW1	Gate	WW	Flanged	Handwheel	Normally Open	P-6, MI-1, MI-2, MI-3
108	4" ARV-I14	Effluent Pump Station DW1	Air	Air	Flanged	N/A	NA	P-6, MI-1, MI-2, MI-3
109	12" CV-I15	Effluent Pump Station DW1	Check	WW	Flanged	N/A	NA	P-6, MI-1, MI-2, MI-3
110	12" GV-I16	Effluent Pump Station DW1	Gate	WW	Flanged	Handwheel	Normally Open	P-6, MI-1, MI-2, MI-3
111	4" GV-I17	Effluent Pump Station DW2	Gate	WW	Flanged	Handwheel	Normally Open	P-6, MI-1, MI-2, MI-3
112	4" ARV-I18	Effluent Pump Station DW2	Air	Air	Flanged	N/A	NA	P-6, MI-1, MI-2, MI-3
113	12" CV-I19	Effluent Pump Station DW2	Check	WW	Flanged	N/A	NA	P-6, MI-1, MI-2, MI-3
114	12" GV-I20	Effluent Pump Station DW2	Gate	WW	Flanged	Handwheel	Normally Open	P-6, MI-1, MI-2, MI-3
115	4" GV-I21	Effluent Pump Station DW3	Gate	WW	Flanged	Handwheel	Normally Open	P-6, MI-1, MI-2, MI-3
116	4" ARV-I22	Effluent Pump Station DW3	Air	Air	Flanged	N/A	NA	P-6, MI-1, MI-2, MI-3
117	12" CV-I23	Effluent Pump Station DW3	Check	WW	Flanged	N/A	NA	P-6, MI-1, MI-2, MI-3
118	12" GV-I24	Effluent Pump Station DW3	Gate	WW	Flanged	Handwheel	Normally Open	P-6, MI-1, MI-2, MI-3
119	4" CV-I25	Effluent Pump Station PWP-01	Check	PWS	Flanged	N/A	NA	P-6, MI-1, MI-2, MI-3
120	4" GV-I26	Effluent Pump Station PWP-01	Gate	PWS	Flanged	Handwheel	Normally Open	P-6, MI-1, MI-2, MI-3
121	4" GV-I27	Effluent Pump Station PWP-01	Gate	PWS	Flanged	Handwheel	Normally Open	P-6, MI-1, MI-2, MI-3
122	4" GV-I28	Effluent Pump Station 4-Way Tie In	Gate	PWS	Flanged	Handwheel	Normally Open	P-6, MI-1, MI-2, MI-3
123	4" PRV-I29	Effluent Pump Station 4-Way Tie In	4-Way	PWS	Flanged	N/A	NA	P-6, MI-1, MI-2, MI-3
124	4" GV-I30	Effluent Pump Station 4-Way Tie In	Gate	PWS	Flanged	Handwheel	Normally Open	P-6, MI-1, MI-2, MI-3
125	4" CV-I31	Effluent Pump Station PWP-02	Check	PWS	Flanged	N/A	NA	P-6, MI-1, MI-2, MI-3
126	4" GV-I32	Effluent Pump Station PWP-02	Gate	PWS	Flanged	Handwheel	Normally Open	P-6, MI-1, MI-2, MI-3
127	4" GV-I33	Effluent Pump Station PWP-02	Gate	PWS	Flanged	Handwheel	Normally Open	P-6, MI-1, MI-2, MI-3

No.	Valve Number	Location	Valve Type	Service	Connection	Operator	Remarks	Sheet No.
128	36" GV-I34	To Town Branch Creek	Gate	WW	Mechanical	Manual	Normally Closed	P-6, MI-1, MI-2, MI-4
129	8" PV-G01	Wasting Meter Vault-FW	Plug	FW	Mechanical	Gear	Buried	P-7, MG-2, C-22
130	8" PV-G02	Wasting Meter Vault-FW	Plug	FW	Mechanical	Gear	Buried	P-7, MG-2, C-22
131	8" PV-G03	Wasting Meter Vault-WAS	Plug	WAS	Mechanical	Gear	Buried	P-7, MG-2, C-22
132	8" PV-G04	Wasting Meter Vault-WAS	Plug	WAS	Mechanical	Gear	Buried	P-7, MG-2, C-22
133	8" PV-P03	To Sludge Thickener Distribution Box	Plug	FW	Mechanical	Operating Nut	Normally Closed	P-7
134	8" PV-P04	To 48-Inch Gravity Influent	Plug	FW	Mechanical	Operating Nut	Buried	P-7
135	4" CV-G05	Lift Station No. 4 Valve Vault-LSPS-01	Check	Drain	Flanged	N/A	NA	P-7, MA-25
136	4" GV-G06	Lift Station No. 4 Valve Vault-LSPS-01	Gate	Drain	Flanged	Gear + Handwheel	Normally Open	P-7, MA-25
137	4" GV-G07	Lift Station No. 4 Valve Vault-LSPS-01	Gate	Drain	Mechanical	Operating Nut	Buried	P-7, MA-25, C-20
138	4" CV-G08	Lift Station No. 4 Valve Vault-LSPS-02	Check	Drain	Flanged	N/A	NA	P-7, MA-24
139	4" GV-G09	Lift Station No. 4 Valve Vault-LSPS-02	Gate	Drain	Flanged	Gear + Handwheel	Normally Open	P-7, MA-24
140	4" GV-G10	Lift Station No. 4 Valve Vault-LSPS-02	Gate	Drain	Mechanical	Operating Nut	Buried	P-7, MA-25, C-20
141	8" GV-P05	Electromagnetic Flow Meter Bypass No. 1	Gate	WS	Mechanical	Operating Nut	Normally Closed	P-11, C-23
142	8" GV-P06	Electromagnetic Flow Meter Bypass No. 2	Gate	WS	Mechanical	Operating Nut	Normally Closed	P-11, C-23
143	8" GV-P07	Electromagnetic Flow Meter Isolation No. 1	Gate	WS	Mechanical	Operating Nut	Buried	P-11, C-23
144	8" GV-P08	Electromagnetic Flow Meter Isolation No. 2	Gate	WS	Mechanical	Operating Nut	Buried	P-11, C-23
145	6" GV-P09	Water system: To FH	Gate	WS	Mechanical	Operating Nut	Buried	P-11, C-22
146	6" GV-P10	Water System: To Admin/Lab Building	Gate	WS	Mechanical	Operating Nut	Buried	P-11, C-23
147	6" GV-P11	Water System: To WAS Station	Gate	WS	Mechanical	Operating Nut	Buried	P-11, C-22
148	4" GV-P12	Water System: Isolation	Gate	WS	Mechanical	Operating Nut	Buried	P-11, C-22
149	4" GV-P13	Water System: To YH	Gate	WS	Mechanical	Operating Nut	Buried	P-11, C-21
150	4" GV-P14	Water System: Isolation	Gate	WS	Mechanical	Operating Nut	Buried	P-11, C-21
151	4" GV-P15	Water System: To North Pump Station	Gate	WS	Mechanical	Operating Nut	Buried	P-11, C-21
152	4" GV-P16	Water System: Isolation	Gate	WS	Mechanical	Operating Nut	Buried	P-11, C-21
153	4" GV-P17	Water System: To YH	Gate	WS	Mechanical	Operating Nut	Buried	P-11, C-20
154	4" GV-P18	Plant Water: To YH	Gate	PWS	Mechanical	Operating Nut	Buried	P-11, C-23
155	4" GV-P19	Plant Water: To Influent Structure	Gate	PWS	Mechanical	Operating Nut	Buried	P-11, C-22
156	4" GV-P20	Plant Water: To Influent Structure	Gate	PWS	Mechanical	Operating Nut	Buried	P-11, C-22
157	4" GV-P21	Plant Water: To Influent Structure	Gate	PWS	Mechanical	Operating Nut	Buried	P-11, C-20
158	4" GV-P22	Plant Water: To Odor Control System	Gate	PWS	Mechanical	Operating Nut	Buried	P-11, C-20
159	4" GV-P23	Plant Water: To Grit Separators	Gate	PWS	Mechanical	Operating Nut	Buried	P-11, C-20
160	4" GV-P24	Plant Water: To Grit Classifiers & Bar Screens	Gate	PWS	Mechanical	Operating Nut	Buried	P-11, C-20
161	6" PV-K01	Blower Building Valve Vault	Plug	Sludge	Flanged	Operating Nut	Non-Buried	MK-1, MK-2
162	6" PV-K02	Blower Building Valve Vault	Plug	Sludge	Flanged	Operating Nut	Non-Buried	MK-1, MK-2
163	6" PV-K03	Blower Building Valve Vault	Plug	Sludge	Flanged	Operating Nut	Non-Buried	MK-1, MK-2
164	6" PV-K04	Blower Building Valve Vault	Plug	Sludge	Flanged	Operating Nut	Non-Buried	MK-1, MK-2
165	6" PV-K05	Digester No. 4 and No.5 Valve Vault	Plug	Sludge	Flanged	Operating Nut	Non-Buried	MK-3
166	6" PV-K06	Digester No. 4 and No.5 Valve Vault	Plug	Sludge	Flanged	Operating Nut	Non-Buried	MK-3
167	6" PV-K07	Digester No. 4 and No.5 Valve Vault	Plug	Sludge	Flanged	Operating Nut	Non-Buried	MK-3
168	6" PV-K08	Digester No. 4 and No.5 Valve Vault	Plug	Sludge	Flanged	Operating Nut	Non-Buried	MK-3
169	6" PV-K09	Digester No. 4 and No.5 Valve Vault	Plug	Sludge	Flanged	Operating Nut	Non-Buried	MK-3

No.	Valve Number	Location	Valve Type	Service	Connection	Operator	Remarks	Sheet No.
170	6" PV-K10	Digester No. 4 and No.5 Valve Vault	Plug	Sludge	Flanged	Operating Nut	Non-Buried	MK-3
171	6" PV-K11	Digester No. 4	Plug	Sludge	Flanged	Operating Nut	Non-Buried	MK-4
172	6" PV-K12	Digester No. 4	Plug	Sludge	Flanged	Operating Nut	Non-Buried	MK-4
173	6" PV-K13	Digester No. 5	Plug	Sludge	Flanged	Operating Nut	Non-Buried	MK-5
174	6" PV-K14	Digester No. 5	Plug	Sludge	Flanged	Operating Nut	Non-Buried	MK-5

Note: All “P” Numbered Valves indicate that they are only shown in the process diagrams. They are not found in the mechanical sheets. All of these valves are also buried

MK Valves are only shown on mechanical sheets

END OF SECTION

SECTION 15120

PIPING SPECIALTIES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies piping materials, systems, and related installation and testing requirements for piping.

B. The items shall include the following:

1. Unions
2. Flanged Joints
3. Dielectric Connectors
4. Plugs and Caps
5. Miscellaneous Adaptors
6. Vents and Drains
7. Shock Absorbers (Water Hammer Arrestor)
8. Line Strainers
9. Service Clamps
10. Cleanouts
11. Floor Drains
12. Quick Connect Couplings
13. Mechanical Sleeve Seals
14. Flexible Connectors
    a. Sleeve Couplings
    b. Split or Grooved Couplings
    c. Flange Adapters
    d. Pump and Equipment Flexible Connectors
    e. Flexible Connectors
15. Expansion Joints
    a. Single- and Multiple-Arch Type
    b. Bellows Style
    c. Flexible Metal Hose
16. Harnessing and Restraints
17. Pressure Gauges
18. Diaphragm Seals for Gauges
19. Thermometers
20. Rotameters
21. Static Mixers
22. Spray Nozzle
23. Chemical Diffusers
24. Diffuser Sockets
25. Appurtenances and Miscellaneous Items

26. Testing

    a. Hydrostatic Test
    b. Service Pressure Test
    c. Pneumatic Test
    d. Leak Test (Freon)

C. Color coding and labeling of pipe is included in Section 09902, Finish Paining.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 01300 – Submittals

B. Section 09902 – Finish Painting

C. Section 15100 – Valves and Appurtenances

D. Section 15140 – Pipe Hangers and Supports

E. Section 15250 – Thermal Insulation for Piping

1.04 REFERENCE STANDARDS

A. ASTM International (ASTM), latest edition:

1. ASTM A36 Standard Specification for Carbon Structural Steel

2. ASTM A126 Standard Specification for Gray Iron Casting for Valves, Flanges and Pipe Fittings

3. ASTM A193 Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

4. ASTM A194 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
5. ASTM A278 Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 Degrees F
6. ASTM A325 Standard Specification for Strength Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
7. ASTM A536 Standard Specification for Ductile Iron Castings
8. ASTM A575 Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
9. ASTM B62 Standard Specification for Composition Bronze or Ounce Metal Castings
10. ASTM B88 Standard Specification for Seamless Copper Water Tube

B. American National Standards Institute (ANSI), latest edition:

1. ANSI A13.1 Scheme for the Identification of Piping Systems
2. ANSI B1.1 Unified Inch Screw Threads (UN and UNR Thread Form)
3. ANSI B18.2 Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws
4. ANSI B31 Code for Pressure Piping
5. ANSI B31.1 Power Piping

C. American Society of Mechanical Engineers (ASME), latest edition:

1. ASME B2.1 Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals)
2. ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings
3. ASME B16.5 Pipe Flanges and Flange Fittings

D. American Welding Society (AWS), latest edition:

1. AWS B3.0 Welding Procedure and Performance Qualifications

E. American Water Works Association (AWWA), latest edition:

1. AWWA C110 Ductile-Iron and Gray-Iron Fittings, 3-in Through 48-in (75mm Through 1200mm), for Water and Other Liquids

2. AWWA C111 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

3. AWWA C219 Bolted Sleeve-Type Couplings for Plain-End Pipe

4. AWWA C606 Grooved and Shouldered Joints

5. AWWA M11 Steel Pipe - A Guide for Design and Installation

F. Plumbing and Drainage Institute (PDI), latest edition:

1. WH 201 Water Hammer Arrestors

G. Underwriters Laboratories (UL), latest edition:

H. Factory Mutual (FM), latest edition

I. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 SUBMITTALS

A. Submit, in accordance with Section 01300, Submittals, general submittals for piping, piping systems and pipeline appurtenances are listed below. It is not intended that all submittals listed below be provided for all piping materials and systems. Refer to individual System or Piping Sections for specific submittals.

B. Shop Drawings and Product Data:

1. Piping layouts in full detail

2. Location of pipe hangers and supports

3. Location and type of backup block or device to prevent joint separation

4. Large scale details of wall penetrations and fabricated fittings

5. Schedules of all pipe, fittings, special castings, couplings, expansion joints and other appurtenances

6. Catalog cuts of joints, couplings, harnesses, expansion joints, gaskets, fasteners, and other accessories

7. Catalog cuts of all pipeline appurtenances specified herein

8. Brochures and technical data on coatings and linings and proposed method for application and repair

C. Samples

D. Design Data

E. Test Reports:

1. Five (5) copies of certified shop tests showing compliance with appropriate standard

2. Five (5) copies of all field test report, signed by Contractor

F. Certificates:

1. Copies of certification for all welders performing work in accordance with ANSI B31.1

G. Manufacturers Installation (or application) instructions.

H. Statement of Qualifications

I. Manufacturers Field Report

J. Project Record Document

K. Operation and Maintenance Data in accordance with Section 01782, Operation and Maintenance Data.

L. Warranties in accordance with Section 01783, Product Warranties.

1.06 QUALITY ASSURANCE

A. All materials shall be new and unused.

B. Install piping to meet requirements of local codes.

C. Provide manufacturer's certification that materials meet or exceed minimum requirements as specified.

D. Coordinate dimensions and drilling of flanges with flanges for valves, pumps, and other equipment to be installed in piping systems. Bolt holes in flanges to straddle vertical centerline.

E. Reject materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, paint thinner and acid solder.

F. Pipe-joint compound, for pipe carrying flammable or toxic gas, must bear approval of UL or FM.

G. Unless otherwise specified, pressures referred to in all Piping Sections are expressed in pounds per square inch, gauge above atmospheric pressure, psig and all temperature are expressed in degrees Fahrenheit (F).

1.07 DELIVERY, STORAGE AND HANDLING

A. During loading, transportation and unloading, take care to prevent damage to pipes and coating. Carefully load and unload each pipe under control at all times. Place skids or

blocks under each pipe in the shop and securely wedge pipe during transportation to ensure no injury to pipe and lining. Cover or cap all pipe ends while pipe is in storage, until it is made a part of the work.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Specific piping materials and appurtenances are specified in the respective Piping or System Sections. The use of a manufacturer's name and/or model number is for the purpose of establishing the standard of quality and general configuration desired.

B. Equipment shall be of the size shown on the Drawings or as noted and as far as possible equipment of the same type shall be identical and from one (1) manufacturer.

C. Equipment shall have the name of the maker, nominal size, flow directional arrows (if applicable), working pressure for which they are designed, and standard referenced specifications cast in raised letters or indelibly marked upon some appropriate part of the body.

D. Unless otherwise noted, items shall have a minimum working pressure of 150 psi or be of the same working pressure as the pipe they connect to, whichever is higher and suitable for the pressures noted where they are installed.

2.02 UNIONS

A. Unions shall be brass or bronze unions for joining nonferrous pipe; malleable brass or bronze-seated iron or steel unions for joining ferrous pipe; PVC unions for joining PVC pipe; CPVC unions for joining CPVC pipe.

2.03 FLANGED JOINTS

A. Flanged Joints. Bolt and nuts, Grade B, ASTM A193 stainless steel, bolt number and size same as flange standard; studs - same quality as machine bolts; 1/16-inch thick rubber gaskets with cloth insertions; rust-resistant coatings.

1. Bolts and nuts for connecting flanged piping, valves and other appurtenances shall conform to the following requirements.

    a. Bolts and nuts for Class 150 or Class 250 flanges shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M for bolts, and ASTM A194, Grade 8M for nuts.

    b. Painted carbon steel, zinc plated, and hot-dipped galvanized bolts are not acceptable unless specifically indicated on the Drawings.

2. All stainless-steel bolts and nuts shall be coated with a chloride-free anti-galling lubricant that shall be similar to Ramco TRX-Synlube, Ramco Anti-Seize, Husky Lube “O” Seal, or an approved equal. The anti-galling lubricant on piping for potable water systems shall be ANSI/NSF 61 certified.

2.04 DIELECTRIC CONNECTORS

A. Dielectric pipe fittings/insulators and unions shall be used to prevent galvanic action wherever valves or piping of dissimilar metals connect. This shall be particularly the case for copper, brass and bronze piping connecting to cast iron or steel piping systems.

B. Dielectric unions shall be used for 2-inch and smaller connections. Steel union nuts shall meet ASTM A575 requirements. The steel or ductile iron connection end shall have a steel body and shall have accurately machined taper tapped pipe threads in accordance with ASME B2.1. The copper connection end shall be a copper solder joint that meets requirements of ASTM B88. Dielectric unions shall be rated for at least 250 psi at 210 degrees F.

C. Dielectric flange unions shall be used for connections 2 1/2-inch and larger. Cast iron flanges shall meet ASTM A126; the copper solder end shall meet ASTM B62 and the pipe thread shall meet ASME B2.1. Dielectric flange unions shall be rated for at least 175 psi at 210 degrees F.

D. Dielectric unions and flange unions shall be as manufactured by Epco Inc., Cleveland, OH or approved equal.

E. Flange insulating kits shall be as acceptable to the Engineer, as manufactured by PSI or approved equal.

F. Insulated sleeve couplings and flange adaptors shall be similar to those units as specified elsewhere.

2.05 PLUGS AND CAPS

A. Provide standard plug or cap as required for testing, plugs, caps suitable for permanent service.

B. Plug or cap or otherwise cover all piping work in progress.

2.06 MISCELLANEOUS ADAPTORS

A. Between different types of pipe and/or fittings special adapters may be required to provide proper connection. Some of these may be indicated on the Drawings or specified with individual types of pipe or equipment. However, it is the Contractor's responsibility to ensure proper connection between various types of pipe, to structures and between pipe and valves, gates, fittings and other appurtenances. Provide all adapters as required, whether specifically noted or not.

B. As required, these adapters shall be suitable for direct bury, with proper dielectric insulation and as a minimum, if metallic (not stainless steel or galvanized), with two (2) coats of Coal Tar Epoxy.

2.07 VENTS AND DRAINS

A. One-half- (1/2) inch vents shall be provided at the high point in each system. Vent connections may be tapped, provided the tap will accept three full threads on the bronze nipple.

B. One and one-half- (1/2) inch drains shall be provided to permit drainage of each system located on the invert of the blind flange; provide hose-end valve.

2.08 SHOCK ABSORBERS (WATER HAMMER ARRESTORS)

A. See Specification Section 15400, Plumbing.

2.09 LINE STRAINERS

A. "Y" Type Strainers

1. Manual strainers furnished for pipe diameters smaller than 2-inch shall be "Y" type, capable of removing solids 0.01-inch in diameter and larger. The strainer body shall be of semi-steel construction for steel pipe and brass or bronze for copper pipe and shall conform to the latest revision of ASTM A278, Class 30. Strainer elements, including woven wire mesh, shall be constructed of stainless steel.

2. The design of the strainer body shall be such that the cleanout plug and screen may be easily removed to permit inspection and cleaning without disassembly of the inlet and outlet piping. End connections shall be ANSI screwed pipe threads.

3. Sufficient spare screen shall be furnished for replacement of all "Y" type units at least once. The strainers shall be designed for a maximum operating pressure of 150 psig. They shall be as manufactured by Watts, Eaton, or approved equal.

B. Manual Basket Strainer

1. Manual basket strainers shall be furnished for pipe diameters 2-inch in diameter and larger, as shown on the Drawings. The strainer body shall be of cast iron construction. The strainer elements, including woven wire screen, shall be constructed of Type 304 stainless steel. The design of the basket strainer body shall be such that the bolted lid and basket may be easily removed for inspection and cleaning without disassembly of the inlet and outlet piping.

2. A trap with a blow-off port shall be provided for removing any material that may settle at the bottom. The strainers shall be designed for a maximum operating pressure of 150 psig and shall be 74-DS as manufactured by Watts, Eaton, or approved equal.

3. Proper blowoff piping with valve shall be supplied and run to nearest drain.

2.10 SERVICE CLAMPS (NOT USED)

2.11 CLEANOUTS

A. See Specification Section 15400, Plumbing.

2.12 FLOOR DRAINS

A. See Specification Section 15400, Plumbing.

2.13 QUICK CONNECT COUPLINGS

A. Couplings shall be of the cam and groove type consisting of a male adapter conforming to MIL-C-27487. Male adapters shall be designed to receive a female coupler without requiring threading, bolting, or tools. Connections shall remain tight and leakproof under pressures up to 100 psig. Each adapter shall be furnished with a dust cap complete with a 18-inch long security chain of corrosion resistant material. Couplings shall be by Civacon, a Division of Dover Corporation; Ever-tite, or approved equal.

B. Adapters shall be furnished in accordance with the Drawings, or as required by the installation.

2.14 MECHANICAL SLEEVE SEALS

A. Mechanical sleeve seals shall be used to secure and seal the annular space around all new sleeved and core-drilled wall penetrations.

B. A single seal shall be provided for all sleeve and cores in walls up to 14-inch thick; dual sleeves shall be provided in larger walls.

C. Galvanized steel wall sleeves and concrete core diameter shall be sized sufficiently larger to accommodate the modular elements, per the manufacturer’s recommendations.

D. Bolts and hardware shall be stainless steel. Pressure plates shall be corrosion-resistant acetal resin.

E. Mechanical sleeve seals shall consist of modular bolted, synthetic rubber sealing elements, Link Seal by Thunderline Corp. or approved equal.

2.15 FLANGED CONNECTORS

A. Pump and Equipment Flexible Connectors

1. The flexible connectors shall be expansion/vibration joints of the single arch type of butyl rubber construction with carcass of high-grade woven cotton or suitable synthetic fiber and individual solid steel ring reinforcement. Soft rubber fillers shall be integrally cured into the arches to provide a smooth flow path to prevent settling of material into the arch. Joints shall be constructed to pipeline size and to meet working pressures and corrosive conditions similar to the line where installed. Joints shall have full faced fabric reinforced butyl flanges integral with the body.

2. Split steel or ductile iron back-up rings shall be provided to ensure a good joint. Rings shall be designed for mating with ANSI Standard minimum 150 lb flanges. All joints shall be finish coated with Hypalon or approved equal paint.

3. Expansion/vibration joints shall be furnished with control (harness) units. Harness units shall consist of minimum two (2) drilled plates, stretcher bolts, and rubber washers backed by metal washers. The stretcher bolts shall prevent over-elongation of the joint. Extra nuts shall be provided on the stretcher bolts on the inside of the plate to prevent over compression. All nuts, bolts and plates shall be galvanized.

4. The manufacturer of the expansion joints shall be a member of the Rubber Expansion Joint Division of the Fluid Sealing Association. Expansion joints shall be Style 1025 filled arch by General Rubber Corp., South Hackensack, NJ or similar products of Mercer Rubber; Goodall Rubber; Garloc; Red Valve Co., Inc.; Proco Products Inc., Stockton, CA or approved equal.

5. In addition to other locations shown on the Drawings, expansion joints shall be utilized in all exposed piping, within 1-ft of a building expansion joint, and on the suction and discharge side of all compressors and rotating machinery, as close to the unit as possible.

B. Flexible Connectors

1. Provide one flexible connector for the seal water connection to each pump stuffing box. Connectors shall be of hose of Buna-N or similar resilient material, with fiber reinforcement, rated minimum 150 psi with bronze or Type 304 stainless steel NPT end fittings and shall be 12-inch in length. Connectors shall be for the purpose of isolating pump vibration from the seal water piping.

2.16 EXPANSION JOINTS

A. Single- and Multiple-Arch Type Bellows

1. The expansion joints shall be of the rubber spool type, soft rubber filled with single-, double-, or triple-arch steel reinforced expansion joint, as indicated on the Drawings, suitable for 120 degrees F service, unless otherwise indicated.

2. The rubber used shall be suited for service with water, including three-ply abrasion resistant liner.

3. Provide galvanized retaining rings to mate with adjacent pipe flanges.

4. The expansion joints shall be designed for the axial movements shown on the Drawings along with the maximum axial force required to compress the joint. The joints shall prevent axial, lateral and rotational movement and vibration from being transmitted to the piping and equipment and shall be suitable for 100 psig operating pressure unless otherwise indicated.

5. Provide guides for each expansion joint where indicated on the plans.

B. Metal Bellows

1. Expansion joints shall be hydraulically formed (with dies on the outside only) and having only longitudinal seam welds. These seams shall have the same strength, physical properties and thickness as the parent metal without grinding. Expansion joints, bellow, and internal sleeves shall be made of Type 304 stainless steel with carbon steel flanges at each end. The entire inside length of the expansion joint shall be straight. Manufacturer to provide lifting lugs at each flange for ease in handling and removal sheet metal coverage for any expansion joint.

2. Expansion joints shall be designed to prevent rotational movement and vibration from being transmitted to the piping and equipment and shall be suitable for 25 psig operation pressure unless otherwise specified.

3. Expansion joints shall be suitable for continuous operating temperature range of 200 to 300 degrees F.

4. Hinged or Gimbal expansion joints shall be used at horizontal and vertical bends in strict accordance with the standards of the EJMA, Inc.

5. Drilling and facing of flanges shall match or be suitable for use with equipment or companion flanges.

6. Guides shall be furnished with all bellows style expansion joints.

7. Manufacturer shall warrant this product to be suitable for the proposed conditions and shall furnish drawings for approval giving materials of construction, including gauge of corrugated element, maximum test pressure force to compress joint, bellows spring rate, shear force and end moment due to calculated traverse only. Manufacturer shall also furnish evidence of completing cycle life testing for the maximum diameter to be installed and shall indicate such assured cycle life test results on material submitted for approval.

C. Flexible Metal Hose

1. Flexible metal hose shall be constructed of corrugated inner tubing of tin-bronze or Type 321 stainless steel and shall have an outer shield of wire-braid of either tin-bronze or Type 321 stainless steel.

2. The flexible hose connectors shall have a length not less than five (5) times the nominal pipe diameter.

3. The connectors shall have 150 psi flanged ends in all sizes and shall be suitable for pressure up to 150 psig and temperatures to 400 degrees F.

4. Flexible hose connectors shall be manufactured by Flexonics; Metraflex or approved equal.

2.17 HARNESSING AND RESTRAINT

A. Where harnessed couplings or adapters are noted, they shall conform to AWWA Manual M11 except as modified by the Drawings or this Section.

B. Unless otherwise noted, size and material for tie rods, clamps, plates and hex nuts shall be as shown on the Drawings, or, if not shown on the Drawings, shall be as required in AWWA Manual M11. Manufactured restraining clamp assemblies shall be as manufactured by Stellar Corporation, Columbus, OH, or approved equal.

C. Restrained joints (such as welded, locking mechanical joints) shall be of the type specified with the individual type of pipe. If not specified, restrained (locking) mechanical joint pipe shall be of the manufacturer's standard design utilizing a locking device (ring or ears) integrally cast with the pipe.

D. For up through 18-inch diameter ductile iron pipe only, the following may be used as an alternative to other restraint system:

1. The optional mechanical joint restraints shall be incorporated in the design of a follower gland. The gland shall be manufactured of ductile iron conforming to ASTM A536. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts as specified with the pipe.

2. The restraint mechanism shall consist of numerous individually activated gripping surfaces to maximize restraint capability. The gripping surfaces shall be wedges designed to spread the bearing surfaces on the pipe. Twist-off nuts, sized same as tee-head bolts, shall be used to ensure proper actuating of restraining devices. When the nut is sheared off, standard hex nut shall remain.

3. The mechanical joint restraint device for ductile iron pipe shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1.

4. The mechanical joint restraint devices shall be of the type listed below or approved equal.

5. For Ductile Iron Pipe: EBAA Iron, Inc. Megalug 1100 series for up to 12-inch only.

E. The Contractor shall be responsible for anchorage including restraint as noted elsewhere in Division 15.

2.18 PRESSURE GAUGES

A. Bosses, connections, or nipples for gauges shall be provided as acceptable to the Engineer. Unbossed tappings shall not be acceptable. Where gauge tappings are not available in the suction or discharge nozzle, the necessary tapping in the adjacent piping shall be made.

B. In addition to the locations shown on the Drawings, pressure gauges shall be furnished and installed on the upstream and downstream sides of pressure reducing stations and in the suction and discharge nozzle of all pumps, compressors and similar equipment.

Additional pressure gauges shall be furnished and installed as specified with individual equipment.

C. Gauges shall be furnished as part of a complete factory assembly, including gauge, snubber, liquid fill, bar stock ball valve isolation valve and threaded red brass connecting piping.

D. Unless otherwise noted, gauge rating shall be from 0 to at least 2.5 percent higher than the rating of the pipe it is connected to.

E. For Liquid Service

1. Pressure gauges shall have a 300 series stainless steel/ABS or FRP/Aluminum case and shall be 4 1/2-inch nominal diameter with a full-sized Type 316 stainless steel Bourdon tube and a 300 series stainless steel movement. The gauges shall be liquid filled with glycerin and shall be provided with a filler/breather cap. The socket shall be 1/4-inch NPT Type 316 stainless steel with a bottom connection and the dial shall be a white background with black markings. Gauges shall be ANSI Grade A plus or minus 1 percent of scale and shall have a blow-out back design.

2. Gauges shall be manufactured by U.S. Gauge; Ashcroft; Trerice or approved equal.

F. Air Service

1. Unless otherwise noted, pressure gauges for low pressure air pipelines shall have a range of 0 to 15 psig.

2. Pressure gauges shall have a 300 series stainless steel/aluminum case and shall be 4 1/2-inch nominal diameter with a Type 316 stainless steel Bourdon tube and a 300 series stainless steel movement. The socket shall be 1/2-inch NPT Type 316 stainless steel with a bottom connection. Gauges shall have an accuracy of at least plus or minus 0.25 percent of scale. Gauges shall be furnished with needle valve isolation.

3. Gauges for air service shall be Model 5840 as manufactured by Marsh Instrument Co., Skokie, IL or approved equal.

G. Gauges shall be furnished from standard ranges of the manufacturer, with dual range (ft and psi) scales, as shown on the Drawings.

2.19 DIAPHRAGM SEALS FOR GAUGES

A. Diaphragm seals shall be installed for all pressure gauges and pressure switches not on clean water lines and as shown on the Drawings, to protect pressure gauges and pressure switches from contact with the fluid in the pipeline. Gauges shall be furnished as part of a complete factory assembly, including gauge, snubber, diaphragm seal, liquid fill, bar stock isolation valve and threaded red brass interconnecting piping. Furnish also a 1/4-inch backflushing connection and ball valve.

B. Diaphragm seals shall be minimum 2 1/2-inch diameter, or as required for the connected pressure gauges. The diaphragm shall be "thread attached" to both piping and pressure switches or gauges. Furnish mineral oil fill between the diaphragm seal and the gauge.

1. Diaphragm seals shall have an upper housing of cadmium plated carbon steel, with the lower housing of material specifically chosen according to the fluid type and pressure being monitored with Type 304 stainless steel bolts. Diaphragms shall be Teflon.

2. Each diaphragm seal shall be connected to its respective piping or equipment with threaded red brass pipe and fittings. Pipe size and diaphragm tap size shall match the size of the gauge tap on the equipment, but shall not be less than 3/4-inch, except for connections to plant water piping which shall be minimum 1/2-inch. Furnish a ball valve shut-off valve between the pipeline or equipment and the diaphragm seal.

3. Each diaphragm seal shall have a minimum 1/4-inch NPT flush connection with ball valve and gauge tap to match the size of the gauge.

4. Furnish pulsation dampeners adequate to prevent pulsation and/or vibration of the gauge indicator under all system operating conditions.

5. Pump gauges shall connect to the diaphragm seal by a flexible Type 304 stainless steel capillary tube. Gauges shall be mounted on a support stand independent of the pump and piping, to minimize vibration of the gauges caused by vibration of the equipment or piping. Mount both the suction and discharge gauges at the same elevation. Furnish supports as specified in Section 15140, or attach gauges to the seal water assembly support (where applicable).

6. Diaphragm seals shall be Type SG by Mansfield and Green; Ashcroft or approved equal.

C. Where installed on chlorine lines, or lines leading to chlorine ejectors, seals shall be special chlorine-resistant type. All other materials shall be certified corrosion resistant for seal location and fluid.

D. Diaphragm seals for chemical piping pressure gauges shall be equal to Series 30 threaded-end (1/2-inch to 1-inch diameter piping) or Series 40 wafer flange (1 1/2-inch to 2-inch diameter piping) as manufactured by Red Valve. Body shall be PVC or Type 304 stainless steel with PVC end caps and diaphragms shall be Hypalon.

2.20 THERMOMETERS (NOT USED)

2.21 SPRAY NOZZLES (NOT USED)

2.22 CHEMICAL DIFFUSERS

A. Chemical diffusers shall be provided for the purpose of dispersing diluted chemical solutions into the process flow as indicated on the Drawings. Diffusers shall be of Schedule 80 PVC or CPVC pipe and constructed to the details shown on the Drawings.

2.23 DIFFUSER SOCKETS

A. Diffuser sockets for chemical diffusers shall locate the diffuser and help hold the diffuser in place. Sockets shall be cast iron flange and flare fittings, Fig. No. F-1440 as manufactured by Clow Corp. or approved equal.

2.24 APPURTENANCES AND MISCELLANEOUS ITEMS

A. All gaskets, glands, bolts, nuts and other required hardware shall be provided for connection of piping and appurtenances. Bolts and nuts shall be high strength, Type 316 stainless steel.

B. All gaskets for flanges shall be full face and suitable for 200 degrees F operating temperature unless higher temperature required on individual systems and the fluids carried. See also Division 1.

C. Plugs, caps, and similar accessories shall be of the same material as the pipe and of the locking type, unless otherwise noted.

D. Unions shall be of the same material as the pipe, except for dielectric connections.

E. Special protective tape shall be fabric reinforced petroleum tape by Denso Inc., Houston, TX or approved equal.

2.25 COLOR CODING AND LABELING

A. General

1. Provide a complete color-coding system consisting of preprinted labels and banding by Brady; Seton or approved equal. Field painting shall be specified in Section 09902, Finish Painting.

2. Piping system identification shall comply with the requirements of ANSI A13.1.

3. Colors listed are general. Actual colors will be selected based on a comparison to the existing plant color codes, except as otherwise indicated; samples shall be furnished for all pipe paint colors; with chips from existing piping where new service lines are connecting.

4. Banding

   a. Unless special spacing is listed in schedule, apply banding to pipe at connections to equipment, valves, branch fittings, at wall, floor, or ceiling boundaries and at intervals not greater than 5-ft.

5. Labels and Directional Arrows

   a. Apply labels with directional arrows at connections to equipment, valves, branch fittings, at least one wall, floor, or ceiling boundary within a room and at intervals not greater than 36-ft.

b. At each label, arrows indicating direction of flow shall point away from label. If flow may be in both directions, use double headed arrows.

c. Lettering shall bear the full pipe system name as scheduled.

d. Lettering height shall be as follows:

Outside Pipe Diameter	Minimum Letter Height
3/4-inch to 1 1/4-inch	1/2-inch
1 1/2-inch to 2-inch	3/4-inch
2 1/2-inch to 6-inch	1 1/4-inch
8-inch to 10-inch	2 1/2-inch
Over 10-inch	3 1/2-inch

e. Two (2) labels minimum each room, crawl space or compartment, unless otherwise approved.

PART 3 EXECUTION

3.01 GENERAL

A. All dirt, scale, weld splatter, water and other foreign matter shall be removed from the inside and outside of all pipe and sub-assemblies prior to installing.

B. All pipe joints and connections to equipment shall be made in such a manner as to produce a minimum of strain at the joint.

C. Install piping in a neat manner with lines straight and parallel or at right angles to walls or column lines and with risers plumb. Run piping so as to avoid passing through ductwork or directly under electric light outlets, and/or interference with other lines (or extending beyond furring lines as determined by Architectural Drawings). All work shall be accomplished using recognized methods and procedures of pipe fabrication and in accordance with the latest revision of applicable ANSI Standards, ASME Codes and Pipe Fabrication Institute Standards.

1. Use full length of pipe except where cut lengths are necessary. Do not spring or deform piping to make up joints.

2. Pipe shall be cut square, not upset, undersize or out of round. Ends shall be carefully reamed and cleaned before being installed. Bending of pipe is not permitted. Use fittings for all changes in direction.

3. Do not use bushings except where specifically approved by the Engineer. Reducers shall be eccentric to provide for drainage from all liquid-bearing lines and facilitate air removal from water lines.

4. Verify the locations and elevations of any existing piping and manholes before proceeding with work on any system. Any discrepancies between the information shown on the Drawings and the actual conditions found in the field shall be reported

at once to the Engineer. No claim for extra payment will be considered if the above provision has not been complied with.

5. Where lines of lower service rating tie into services or equipment of higher service rating the isolation valve between the two shall conform to the higher rating.

6. Mitering of pipe to form elbow is not permitted.

7. All piping interiors shall be thoroughly cleaned after installation and kept clean by approved temporary closures on all openings until the system is put in service. Open pipe ends shall be subjected to recleaning and retesting.

8. End caps on pre-cleaned pipe shall not be removed until immediately before assembly. All open ends shall be capped immediately after completion of installation.

9. Provide temporary strainers within the piping ahead of every piece of equipment. The strainers shall be cleaned and reinserted immediately before start-up. The strainers shall be kept in service until at least seven (7) days after the equipment has been put in service.

D. Test Connections

1. Provide 1/2-inch female NPT test connection equipped with 1/2-inch brass plug on all pump suction and discharge lines. Where indicated on the Drawings, test connections should be equipped with bar stock valve and gauge. Provide test connections at all steam traps. The connection shall be located on the discharge side of the trap between the trap and the first valve. It shall consist of a 1/2-inch branch connection terminated with a gate valve.

E. Installation of Expansion Joints and Flexible Connectors

1. Piping systems shall be aligned prior to installation of expansion fittings. Alignment shall be provided by fitting a rigid pipe spool in place of the expansion joint. Prior to testing of the piping system, the pipe spool shall be replaced with the specified expansion or flexible fitting.

2. In addition to the locations noted on the Drawings and in PART 2, expansion fittings and anchors shall be located and spaced as specified by the Expansion Joint Manufacturer's Association. The expansion joints/flexible connectors shall not be installed during times of temperature extreme or in a fully compressed or fully expanded condition.

F. Installation of Pipeline Appurtenances

1. All pipeline appurtenances shall be installed as required and in accordance with the manufacturer's recommendations, as acceptable to the Engineer.

2. Gauges, meters and similar in-line items shall be isolated from testing pressures in excess of the rated pressure of the assembly.

3. Use Teflon tape on all screwed fittings.

G. Installation of Unions

1. Use unions to allow dismantling of pipe, valves, and equipment.

H. Welding

1. Welding shall be in accordance with ANSI B31 and AWS B3.0.

2. Install welding fittings on all welded lines. Make changes in direction and intersection of lines with welding fittings. Do not miter pipes to form elbows or notch straight runs to form tees, or any similar construction. Do not employ welder who has not been fully qualified in above specified procedure and so certified by approved welding bureau or similar locally recognized testing authority.

I. Installation of Flanged Joints

1. Make flanged joints with bolts; bolt studs with nut on each end; or studs with nuts where one flange is tapped. Use number and size of bolts conforming to same ANSI Standard as flanges. Before flanges pieces are assembled, remove rust resistant coating from machined surfaces, clean gaskets and smooth all burrs and other defects. Make up flanged joints tight, care being taken to prevent undue strain upon valves or other pieces of equipment.

3.02 TESTING

A. Test all pipelines for water/gas tightness as specified in the Piping or System Sections. Furnish all labor, testing plugs or caps, pressure pumps, pipe connections, gauges and all other equipment required. Testing shall be performed in accordance with one or more of the testing procedures appended to this Section as specified in each Piping or System Section. All testing shall be performed in the presence of the Engineer.

B. Repair faulty joints or remove defective pipe and fittings and replace as approved by the Engineer. Retest.

3.03 DISINFECTION

A. After satisfactory testing, all potable and protected water distribution systems shall be thoroughly disinfected with a solution of not less than 50 ppm of available chlorine. The disinfecting solution shall be allowed to remain in the system for a period of three (3) hours after which time all valves and faucets shall be opened and the system shall be flushed with clean water.

B. Water being flushed from structures or pipelines after disinfection with a chlorine residual of 2 mg/l or greater, shall be treated with a dichlorination solution, in a method approved by the Engineer, prior to discharge.

HYDROSTATIC TEST

SCOPE: This test shall be used to hydrostatically test piping systems for structural integrity and leaks. The test shall be performed at ambient temperature unless otherwise specified.

1.0 TEST FLUID

1.1 Water should be used as the test fluid whenever possible. In those systems where water cannot be used the test fluid may be either the one to be used in the system or the one agreed upon by the Engineer and the Contractor.

2.0 TEST EQUIPMENT

2.1 Water – Of sufficient capacity to deliver the required test pressure.

2.2 Strainer – On inlet side of the pump to prevent foreign matter from entering the system.

2.3 Valves – Shall be provided on the suction and discharge side of the pump.

2.4 Heater – To allow heating of the test fluid when elevated temperatures are required for test.

2.5 Relief Valve – Set at a pressure to relieve at 20% to 25% above the required test pressure.

2.6 Pressure Gauge(s) – Capable of reaching 50% over the test pressure. These should be located at the pump discharge and any other place deemed convenient by the Contractor.

2.7 Pressure gauges and relief valves shall be checked for accuracy before use in test procedures.

3.0 PREPARATION FOR TEST

3.1 Determine the fluid to be used for the test and, if other than ambient temperature is required, what the test temperature will be.

3.2 When a fluid other than water is used for a test, the equipment used for the test shall be of a material compatible with the test fluid. Normally this would be equal to the piping material.

3.3 Vents shall be provided at the high points of the system and drains provided where means of venting or draining do not exist.

3.4 Remove or block off, all relief valves, rupture discs, alarms, control instruments, etc., that shall not be subjected to the test pressure.

3.5 All discs, balls, or pistons from check valves shall be removed if they interfere with filling of the system. Open all valves between inlet and outlet of the section to be tested.

3.6 Connect pump and provide temporary closures for all of the external openings in the system. Use caution to ensure that the closures are properly designed and strong enough to withstand the test pressure.

3.7 All joints, including welds, are to be left uninsulated and exposed for examination during test.

3.8 A joint previously tested in accordance with this Section may be covered or insulated.

3.9 Piping designed for vapor or gas shall be provided with additional temporary supports, if necessary, to support the weight of the test liquid.

3.10 Expansion joints shall be provided with temporary restraint for additional pressure under test or shall be isolated from the test.

3.11 Flanged joints, where blanks are inserted to isolate equipment during the test, need not be tested.

4.0 TEST PRESSURE

4.1 The hydrostatic test pressure shall be 150% the design pressure unless otherwise specified in the System Section.

5.0 TEST PROCEDURE

5.1 Allow the test fluid to enter the system. Open vents to allow displacement of all entrapped air. For all pipelines exceeding 500-ft in length, the maximum rate of filling shall be limited to that which produces a maximum nominal flow velocity of one foot per second in the pipe to be tested.

5.2 Close vents and restrict personnel in the test area to those involved in the test.

5.3 Raise the pressure slowly with the pump until the predetermined test pressure is reached. Maintain pressure for duration of time specified in System Section, keeping personnel at a safe distance.

5.4 Reduce the pressure about 20% and hold it at that point while the entire system is carefully inspected for leaks, cracks, or other signs of defects.

5.5 If defects are found, the pressure shall be released, the system drained, the defects corrected and the test repeated.

5.6 After a satisfactory test has been completed, the line shall be drained.

6.0 FLUSHING

6.1 Lines tested with water shall be completely drained.

6.2 Lines shall be flushed, after test.

7.0 TEST RECORDS

7.1 Records shall be maintained of all tests performed.

7.2 Test records shall include:

A. Date of Testing
B. Identification of Piping Tested
C. Test Fluid
D. Test Pressure
E. Signatures of Contractor and Engineer

7.3 If leaks are found, they shall be noted on the record. After correction, retesting as specified for original test.

7.4 Records of test shall be maintained by the Contractor. Provide two (2) copies to the Engineer and one (1) copy to the Owner as part of the Project Record Documentation (see Section 01781).

SERVICE PRESSURE TEST

SCOPE: This test shall be used to test piping systems using service pressure and the fluid for which the system is used.

It shall not be used to test piping systems conveying combustible or flammable liquids or systems that comply with ANSI B31.

1.0 TEST FLUID

1.1 The fluid for which the system is designed shall be the test fluid.

2.0 TEST EQUIPMENT

2.1 A pressure gauge capable of registering 25 psi over the design pressure shall be installed down-stream from the supply shut-off valve if one is not included in the system.

3.0 PREPARATION FOR TEST

3.1 Insulated lines shall have all joints left exposed until completion of the test.

4.0 TEST PRESSURE

4.1 The test pressure shall be equal to the maximum pressure that the line will be subjected to under normal operating conditions as determined by the Engineer.

5.0 TEST PROCEDURE

5.1 Liquids

5.1.1 See that all personnel not involved in the test vacate the area.

5.1.2 Allow the system fluid to enter the system slowly while venting the air at the extreme far and uppermost points. For all pipelines exceeding 500-ft in length, the maximum rate of filling shall be limited to that which produces a maximum nominal flow velocity of one foot per second in the pipe to be tested.

5.1.3 When the system is full and all air is vented, close the vents.

5.1.4 Allow the pressure in the system to build up to the full line pressure.

5.1.5 Inspect entire system for leaks.

5.2 Gas or Vapor (Including Compressed Air and Steam)

5.2.1 See that all personnel not involved in the test vacate the area.

5.2.2 In systems that do not have a pressure gauge near the main shut-off valve, a gauge shall be installed.

5.2.3 Allow the system fluid to enter the system slowly until the full operating pressure is reached.

5.2.4 Shut off main supply valve. Observe the gauge for 15 minutes. The pressure gauge shall not drop during this time.

5.2.5 If the gauge pressure drops indicating the presence of a leak, visually inspect the systems and use soap suds or commercially available leak detectors to locate the leak(s).

5.3 If leaks are found, the lines shall be relieved of pressure, purged if necessary and repaired. Tests shall be repeated for repaired sections.

6.0 TEST RECORDS

6.1 Records shall be maintained of all tests performed.

6.2 Test records shall include:

A. Date of Testing
B. Identification of Piping Tested
C. Test Fluid
D. Test Pressure
E. Signatures of Contractor and Engineer

6.3 If leaks are found, they shall be noted on the record. After correction, retesting is required.

6.4 Records of test shall be maintained by the Contractor. Provide two (2) copies to the Engineer and one (1) copy to the Owner as part of the Project Record Documentation (see Section 01781).

PNEUMATIC TEST

SCOPE: This procedure for a pneumatic test of piping systems shall be used when water, or other liquid, cannot be introduced into the line, or as a supplement to a hydrostatic test.

IT SHALL NOT BE USED TO TEST NON-METALLIC (PLASTIC) PIPE.

1.0 GENERAL

1.1 There is a hazard in using gases for test fluids because of their compressibility.

1.2 Gases shall never be used unless there is ample justification and always in a safe manner. See Section 3.0.

2.0 TEST GASES & PRESSURES

2.1 Compressed air shall normally be used. Other gases may be used when specified or directed by the Engineer.

2.2 Test pressures shall be 110% of the anticipated maximum operating pressure, but not exceeding 100 psig and not less than 5 psig at the highest point in the system.

3.0 SAFETY

3.1 All pneumatic tests shall be done under the supervision of Contractor and in the presence of the Engineer.

3.2 New Construction: The Engineer's permission shall be secured before testing.

3.3 Renovation Projects: The Owner representative and the Engineer must be informed and their permission secured before testing.

3.4 Only those people actively participating in the test shall be allowed in the test area.

3.5 Safety glasses and hard-hats must be worn.

4.0 EQUIPMENT

4.1 Building supply air to deliver the required test pressure if available, or Contractor shall provide a compressor capable of the required test pressure.

4.2 Valves shall be provided on the discharge side of the pump.

4.3 Relief valve to relieve at 10% to 15% over the test pressure.

4.4 Pressure Gauge(s) capable of reaching 50% over the test pressure. A gauge shall be located on the pump discharge and other location as required.

5.0 TEST PROCEDURE

5.1 Increase the pressure in the line gradually, in steps, to the specified pressure. Checks shall be made at 25 psig and at 25 psig intervals until the test pressure is reached using sound, soap solution or a drop in indicated pressure.

5.2 When the specified pressure for the test is reached, shut off the valve in the supply line from the pump.

5.3 Maintain the test pressure long enough to visually inspect all joints or a minimum of 10 minutes. There shall be no drop in the test pressure in this time.

5.4 Leaks shall be repaired and the line retested. All leaks shall be noted on the Test Record form.

5.5 After satisfactory completion of the test, vent the line and allow it to return to atmospheric pressure. Connection can then be made to the supply line.

6.0 TEST RECORDS

6.1 Records shall be maintained of all tests performed.

6.2 Test records shall include:

A. Date of Testing
B. Identification of Piping Tested
C. Test Fluid
D. Test Pressure
E. Signatures of Contractor and Engineer

6.3 If leaks are found, they shall be noted on the record. After correction, retesting is required.

6.4 Records of test shall be maintained by the Contractor. Provide two (2) copies to the Engineer and one (1) copy to the Owner as part of the Project Record Documentation (see Section 01781).

END OF SECTION

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SECTION 15140

PIPE HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals and install pipe hangers, supports, concrete inserts and anchor bolts including all metallic hanging and supporting devices for supporting non-buried piping as shown on the Drawings and as specified herein.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 01300 – Submittals

B. Division 3 – Concrete

C. Section 05500 – Miscellaneous Metal

D. Section 09902 – Finish Painting

E. Division 15 – Mechanical

F. Section 15051 – Piping – General Requirements

G. Section 15100 – Valves and Appurtenances

1.04 REFERENCE STANDARDS

A. American National Standards Institute (ANSI), latest edition:

1. ANSI B31.1 Power Piping.

B. ASTM International (ASTM), latest edition:

1. ASTM A36 Standard Specification for Carbon Structural Steel.

2. ASTM A307 Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

C. Manufacturer's Standardization Society (MSS), latest edition:

1. MSS SP-58 Pipe Hangers and Supports - Materials, Design and Manufacture.

2. MSS SP-69 Pipe Hangers and Supports - Selection and Application.

D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 SUBMITTALS

A. Submit, in accordance with Section 01300, Submittals, complete sets of shop drawings of all items to be furnished under this Section. Submittals shall include complete layouts, schedules, location plans and complete total bill of materials for all pipe support systems.

B. Submittals shall include a representative catalog cut for each different type of pipe hanger or support indicating the materials of construction, important dimensions, and range of pipe sizes for which that hanger is suitable. Where standard hangers and supports are not suitable, submit detailed drawings showing materials and details of construction for each type of special hanger and support.

C. Submittals shall include complete piping drawings indicating type of hanger and support, location, magnitude of load transmitted to the structure and type of anchor, guide and other pipe supporting appurtenances. Submittals shall use detail numbers as shown on the Drawings to indicate type of support proposed wherever possible.

D. Types and locations of pipe hangers and supports shall also be shown on the piping layouts for each piping submittal as specified in Division 15 Pipe Sections.

E. Submit complete design data for pipe support systems to show conformance with this Section.

1.06 QUALITY ASSURANCE

A. All hangers, supports and appurtenances shall conform to the latest applicable requirements of ANSI B31.1.0, except as supplemented or modified by the requirements of this Section.

B. All hangers, supports and appurtenances shall be of approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions. 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-feet of water-filled 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. 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.

1.07 DELIVERY, STORAGE AND HANDLING

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.

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. The details shown on the Drawings are intended to indicate the generally desired methods of support under normal conditions. Develop final details and any details associated with special conditions not already covered to meet the system conditions specified in each Division 15 pipe section.

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. 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. Any structural steel members required to brace any piping from excessive dislocation shall conform to the applicable requirements of Section 05500, Miscellaneous Metal, 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 end 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 in stainless steel unless otherwise noted on the plans. Interior clamps on plastic pipe shall be plastic coated. Supports for copper pipe shall be copper plated or shall have a 1/16-inch plastic coating. All rods, clamps, hangers, inserts, anchor bolts, brackets and components for exterior pipe, pipe within outdoor structures, or pipe in wetted structures shall be of 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 loads between supports.

H. All un-insulated non-metallic piping such as PVC, CPVC, etc., shall be protected from local stress concentrations at each support point. Protection shall be provided by galvanized steel protection shields or other method as approved by the Engineer. Where pipes are bottom supported 180-degrees, arc shields shall be furnished. Where 360-degree arc support is required, such as U bolts, protection shields shall be provided for the entire pipe circumference. 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 as specified under respective pipe insulation. Provide galvanized protection shields as specified in Paragraph 2.01.H 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; isolators similar to Elcen, Figure No. 228; or copper plated or PVC coated hangers and supports.

K. Pipe supports shall be provided as follows:

1. Cast iron and ductile iron piping shall be supported at a maximum support spacing of 10-ft with a minimum of one support per pipe section at the joints.

2. Steel and stainless-steel piping 2 1/2-inch or larger diameter shall be supported at a maximum support spacing of 10 feet with a minimum of one support per pipe section at the joints.

3. Support spacing for steel and stainless-steel piping 2-inch and smaller diameter and copper tubing shall not exceed 5 feet.

4. Supports for multiple PVC plastic piping shall be continuous wherever possible. Individually supported PVC pipes shall be supported as recommended by the manufacturer except that support spacing shall not exceed 4-feet. Multiple, suspended, horizontal plastic PVC pipe runs, where possible, shall be supported by ladder type cable trays such as the Electray Ladder by HuskyBurndy; the Globetray by the Metal Products Division of United States Gypsum; or approved equal. Ladder shall be of mild steel construction. Rung spacing shall be 12-inches. Tray width shall be approximately 6-inches for single runs and 12-inches for double runs. 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. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners similar to Globe, Model MCAC; HuskyBurndy, Model SCR or approved equal. Spacing between clamps shall not exceed 9-feet. The cable trays shall provide continuous support along the length of the pipe. 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.

5. All vertical pipes shall be supported at each floor or at intervals of not more than 12-feet by approved pipe collars, clamps, brackets, or wall rests and at all points necessary to insure rigid construction.

6. Pipe supports shall not induce point loadings, but shall distribute pipe loads evenly along the pipe circumference.

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

8. 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. Pump housings shall not be utilized to support connecting pipes.

9. 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 Anvil International, Portsmouth, NH; Carpenter & Patterson, Inc., Woburn, MA; F & S Central, Brooklyn NY; Elcen Metal Products Co., Franklin Park, IL and Unistrut Northeast, Cambridge, MA; or approved equal. 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.

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.

2.02 SINGLE PIPE HANGERS

A. Single pipes shall be supported by hangers suspended by stainless steel rods from structural steel members, concrete ceilings and beams, bottom of trapeze hangers and wall-mounted steel angle brackets.

B. Hanger rods shall be stainless steel. The strength of the rod shall be based on its root diameter.

C. Except as otherwise specified herein, pipe hangers shall be adjustable clevis type similar to Anvil, Figure No. 65, 260 and 590 as required. Hangers shall be stainless steel.

D. Steam cleaning piping shall be supported by adjustable type pipe roller supports. Roller support shall have cast iron roll and sockets, steel roll rod and continuous threaded galvanized rods and hex nuts similar to Anvil, Figure No. 177.

E. Hanger rods shall be attached to concrete structures using concrete inserts similar to F&S Figures 180, 571 or 150. Inserts shall be malleable iron, or steel with galvanized finish. Beam clamps, C clamps or welded beam attachments shall be used for attaching hanger rods to structural steel members. Where necessary and approved by the Engineer, double expansion shields shall be used for attaching to concrete structures.

F. Where pipes are near walls, beams, columns, etc., and located an excessive distance from ceilings or underside of beams, welded steel wall brackets similar to Carpenter and Patterson, Figure No. 69-68, 84 or 139 shall be used for hanging pipe. Brackets shall be stainless steel. Where single pipes rest on top of bracket pipe supports, attachments shall meet requirements as specified under multiple pipe hangers.

2.03 MULTIPLE PIPE HANGERS

A. Suspended multiple pipes, running parallel in the same horizontal plane, which are adjacent to each other shall be suspended by trapeze type hangers or wall brackets. Trapeze hangers shall consist of stainless-steel channel supported from galvanized threaded rod or attached to concrete walls, columns or structural steel support members as required to meet the intent of this Section. Channel shall be similar to F&S, Figure 710, rods, concrete inserts, "C" clamps, beam clamps, welded beam attachments and expansion shields shall be as specified in Paragraph 2.02 above.

B. Except as otherwise specified herein pipe anchors used for attaching pipe to trapeze or multiple pipe wall brackets shall be anchor or pipe chairs similar to F&S, Figures 158, 419, 160A, 160B as required. Material of construction shall be stainless steel. Chair "U" bolts shall be tightened to allow freedom of movement for normal expansion and contraction except where pipe must be anchored to control direction of movement or act as a thrust anchor.

2.04 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 as shown on the Drawings and as specified herein.

B. Pipes 3 inches in diameter and larger shall be supported by adjustable stanchions similar to F&S, Figure 427, constructed of galvanized steel. Stanchions shall provide at least 4-inches adjustment and be flange mounted to floor.

C. Pipes less than 3 inches in diameter shall be held in position by supports fabricated from steel "C" channel, welded post base similar to Unistrut, Figure P2072A and pipe clamps similar to Unistrut, Figures P1109 thru P1126. 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. Wherever possible, supports shall be fastened to nearby walls or other structural member to provide horizontal rigidity. More than one pipe may be supported from a common fabricated support. All supports unless specified elsewhere shall be galvanized.

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

2.05 WALL SUPPORTED PIPES

A. Single or multiple pipes located adjacent to walls, columns, or other structural members, whenever deemed necessary, shall be supported using welded stainless-steel wall brackets similar to Carpenter and Patterson, Figure No. 69-78, 84, or 134; or "C" channel with steel brackets similar to Unistrut pipe clamps. All members shall be securely fastened to wall, column, etc., using double expansion shields or other method as approved by the Engineer. Additional wall bearing plates shall be provided where required.

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

C. All supports shall be stainless steel.

2.06 BASE ANCHOR SUPPORT

A. Where pipes change direction from horizontal to vertical via a bend, a welded or cast base anchor support shall be installed at the bend to carry the load. The bend anchor shall be fastened to the floor and double expansion shields or other method as approved by the Engineer.

B. Where shown on the Drawings, pipe bends shall be supported using concrete anchor posts. Pipes shall be securely fastened to concrete supports with suitable metal bands as required and approved by the Engineer.

2.07 VERTICAL PIPE SUPPORTS

A. Where vertical pipes are not supported by a Unistrut system as specified in Paragraph 2.08 below, they shall be supported in one of the following methods.

1. For pipes 1/4-inch to 2-inches in diameter, an extension hanger ring shall be provided with an extension rod and hanger flange. The rod diameter shall be as recommended by the manufacturer for the type of pipe to be supported. The hanger ring shall be stainless steel or PVC clad depending on the supported pipe. The hanger ring shall be equal to Carpenter & Paterson, Figure No. 81 or 81CT. The anchor flange shall be galvanized malleable iron similar to Carpenter and Patterson, Figure No. 85.

2. For pipes equal to or greater than 1/2-inch in diameter extended pipe clamps similar to Carpenter and Patterson, Figure No. 267 may be used. 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 No. 220.

3. Pipe riser clamps shall be used to support all vertical pipes extending through floor slabs. Riser clamps shall be stainless steel similar to Carpenter and Patterson, Figure No. 126. Copper clad or PVC coated clamps shall be used on copper pipes. 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 12-feet shall be supported by approved pipe collars, clamps, brackets, or wall rests at all points required to insure a rigid installation.

2.08 SPECIAL SUPPORTS

A. Pipe supports shall be provided for closely spaced vertical piping systems as shown on the Drawings or as otherwise required to provide a rigid installation. The support system shall consist of a framework suitably anchored to floors, ceilings and walls and be as manufactured by the Unistrut Corporation; Globe-Strut by the Metal Products Division of U.S. Gypsum; or approved equal.

B. Vertical and horizontal supporting members shall be U-shaped channels similar to Unistrut, Series P1000. Vertical piping shall be secured to the horizontal members by pipe clamps or pipe straps equal to Unistrut, Series P1100M and Series P2558. All components shall be of stainless steel.

C. The assemblies shall be furnished complete with all nuts, bolts and fittings required for a complete assembly including end caps for all members.

D. The design of each individual framing system shall be the responsibility of the Contractor. Shop drawings, as specified above shall be submitted and shall show all details of the installation, including dimensions and types of supports. In all instances the completed frame shall be adequately braced to provide a complete rigid structure when all the piping has been attached.

E. 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 in accordance with applicable provisions of Section 05500, Miscellaneous Metal, have anchor hardware similar to items previously specified herein, shall meet the minimum requirements listed below and be subject to the approval of the Engineer.

1. Pipe support systems shall meet all requirements of this Section and all related Sections.

2. Complete design details of the entire pipe support system shall be provided for review by the Engineer in the submittals specified in Paragraph 1.03 above.

3. The pipe support system shall not impose loads on the supporting structures in excess of the loads for which the supporting structure is designed.

2.09 SURFACE PREPARATION AND SHOP PRIME PAINTING

A. All surfaces shall be prepared and shop painted as part of the work of this Section. Surface preparation and shop painting shall be as specified in Section 09902 Finish Painting.

PART 3 EXECUTION

3.01 INSTALLATION

A. All pipes, horizontal and vertical, requiring rigid support shall be supported from the building structure by approved methods. Supports shall be provided at changes in direction and elsewhere as shown in the Drawings or specified herein. 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. 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. Pump housings shall not be utilized to support connecting pipes.

D. Inserts for pipe hangers and supports shall be installed on forms before concrete is placed. Before setting these items, all Drawings and figures shall be checked which have a direct bearing on the pipe location. 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.

3.02 TESTING

A. All pipe support systems shall be tested for compliance with this Section. After installation, each pipe support system shall be tested in conjunction with the respective piping pressure tests. 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.

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SECTION 15160

ELECTRIC ACTUATORS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide and install electrical actuators as shown on the drawings or specified herein.

B. The torque ratings and gear ratios shall be sized to match the requirements of the gates.

C. The actuators shall be supplied with controls for Open/Close or modulating as specified herein.

D. Actuators for the Grit Classification System shall be supplied as part of the Grit Removal Equipment Package

E. Actuators for the Filter Backwash System shall be supplied as part of the Pile Cloth Media Filter package

F. Actuators associated with the UV Channel Weir Gates (WG-11, WG-12) shall be supplied as part of the UV equipment package.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 01300 – Submittals

B. Section 01782 – Operation and Maintenance Data

C. Section 01810 – Equipment Startup and Testing

D. Section 11243 – Pile Cloth Media Filter

E. Section 11260 – UV Disinfection System

F. Section 11280 – Slide Gates

G. Section 11282 – Weir Gates

H. Section 11322 – Grit Removal Equipment

I. Section 15100 – Valves and Appurtenances

1.04 SUBMITTALS

A. See Section 01300, Submittals for submittal procedures.

B. Submit manufacturer's product data including the following:

1. Valve or Gate reference designator
2. Torque rating
3. Gear ratio
4. Control diagram
5. Performance testing certifications

1.05 PROJECT SITE CONDITIONS

A. Coordinate the work of this Section with the work of other Sections. Verify at the site both the dimensions and work of other trades that adjoin items of work in this Section before commencement of items specified herein.

B. Field measurements shall be taken at the site to verify or supplement indicated dimensions and to ensure proper coordination of all other construction items.

1.06 WARRANTY

A. Actuators shall be warranted from defects in materials and workmanship for a period of 12 months from the date of completion and acceptance by the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Powered actuators shall be multi-turn type and shall be Limitorque "MX", or Rotork "IQ Series", or approved equal.

2.02 GENERAL

A. The actuators shall be suitable for use on a nominal 480VAC, three-phase power supply as shown in Part 4 Equipment Schedules, and are to incorporate motor, electronic drive or integral reversing starter, local controls, terminals, remote controls, and indication connections housed within a self-contained, sealed enclosure.

B. Actuators installed in hazardous locations as noted on the Electrical Drawings, area classification sheets of the Electrical Drawings, or on the gate operator schedule shall be FM certified explosion proof for Class 1 Division 1 & 2, Groups C & D.

C. Actuators shall be configured as required to provide for part turn or multi-turn and be coupled with gearboxes as required to obtain the speed and operating torque as required for the valve it controls.

D. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of travel irrespective of the power supply connection sequence.

E. In order to maintain the integrity of the enclosure, setting of the torque levels, position limits, and configuration of the controls shall be carried out without removal of the actuator covers.

F. Actuators shall be capable of non-intrusive configuration without requiring removal of any actuator covers. Configuration of actuator functions shall be by use of a handheld infrared linked device, laptop or PDA with compatible wireless communication capability, or by local control switches and 32-character LCD display mounted on the actuator housing. The display language shall be English.

G. Modulating actuators shall contain proportional control unit and be capable of 1,200 starts per hour, Open/Close valve actuators shall not require a proportional control unit and be capable of 60 starts per hour.

H. Where shown on the Instrumentation Drawings, actuators shall have a digital control module to allow valves to be positioned remotely via a 2-wire non-proprietary field bus protocol. The digital control module shall be equipped with serial communication ports to allow actuation to be linked by a 2-wire local area network utilizing Modbus function code (report by exception) and arranged in a self-healing ring configuration, with multi-drop taps to each actuator.

I. The motor operated controller shall include the motor, operator unit gearing, limit switch gearing, limit switches, control power transformer, position transmitter (when required), torque switches, bored and key-wayed drive sleeve for non-rising stem valves, declutch lever, and auxiliary handwheel as a self-contained unit. Valve contacts shall be capable of handling the current equivalent of a NEMA 1 size starter.

J. Each actuator shall be supplied with a start-up kit including installation instructions, wiring diagrams, and spare cover screws and seals to provide for losses during commissioning.

K. Commissioning tools shall not form an integral part of the actuator and must be removable for secure storage.

2.03 ACTUATOR SIZING

A. The actuator shall be sized to guarantee valve or gate closure at the specified differential pressure. The safety margin of motor power available for seating and unseating the gate shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage ten percent (10%) below nominal.

2.04 ENVIRONMENTAL

A. Actuators shall be suitable for indoor and outdoor use. The actuator shall be capable of functioning in an ambient temperature ranging from –20 degrees F (-20°F) to 140 degrees F (140°F), up to 100 percent (100%) relative humidity.

2.05 ENCLOSURE

A. The actuators shall be O-ring sealed, watertight to NEMA 6P/IP68 and shall at the same time have an inner watertight and dustproof O-ring seal between the terminal compartment and the internal electrical elements of the actuator.

B. The motor and all other internal electrical elements of the actuator shall be protected from ingress of moisture and dust when the terminal cover is removed for cabling.

C. The enclosure must allow for temporary site storage without electrical supply connection.

D. All external fasteners shall be stainless steel.

2.06 MOTOR

A. The electric motor shall be class F insulated with a time rating of at least 15 minutes at 104 degrees F (104°F), or twice (2X) the gate stroke time, whichever is greater, at an average load of at least 33 percent (33%) maximum gate torque.

B. The motor shall be specifically designed and built by the actuator manufacturer for electric actuator service. Commercially available motors shall not be acceptable. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel regardless of the connection sequence of the power supply. All motors shall be of high starting torque design, capable of delivering rated torque when power is turned on.

C. Electrical and mechanical disconnection of the motor shall be possible without draining lubricant from the actuator gearcase.

2.07 GEARING

A. Power gearing shall consist of hardened steel spur or helical gears and alloy bronze or hardened steel worm gear, all suitably lubricated, designed for 100 percent (100%) overload, and effectively sealed against entrance of foreign matter. Steel gears shall be hardened to at least 350 Brinell. Planetary or cycloidal gearing, aluminum, mild steel, or nonmetallic gears will not be acceptable. Gearing shall be designed to be self-locking so that actuation of a torque switch or electronic torque protection device by a torque overload condition will not allow the actuator to restart until the torque overload has been eliminated. If a secondary gearbox is required, it shall be designed to withstand the locked rotor torque of the actuator.

2.08 HAND OPERATION

A. A handwheel shall be provided for emergency operation, engaged when the motor is declutched by a lever, the drive being restored to power automatically by starting the motor.

B. Provision shall be made for the hand/auto selection to be locked in either position.

C. The handwheel drive must be mechanically independent of the motor drive and any handwheel gearing should be such as to permit emergency manual operation in a reasonable time. Clockwise operation of the handwheel shall give closing movement unless otherwise specified.

D. Continuous mechanical dial indication of valve and position shall be provided. The mechanical dial position indicator shall be in step with the actuator at all times in both the hand wheel and motor operation.

2.09 DRIVE BUSHING

A. The actuator shall be furnished with a drive bushing easily detachable for machining to suit the gearbox input shaft. The manufacturer shall supply any adapters required to connect to the existing gates.

2.10 CONTROLS

A. Capabilities shall be provided to position the valve locally via the Local-Off-Remote selector switch and Open-Stop-Close push buttons.

B. For On-Off service, when in remote, the actuator shall accept one (1) remote signal to open the valve and a second remote signal to close the valve.

C. For modulating service when in remote, the actuator shall accept a 4-20 mA DC position control signal and shall position the valve zero 0-100% Open, with 0% Open at 4 mA and 100% Open at 20 mA. Modulating valves shall also include a 4-20 mA position feedback signal from the actuator to confirm the commanded position of 0 to 100% Open. Modulating valves shall also be capable of moving into a commanded position with Jog Open, Stop, and Jog Close inputs to the actuator for controller applications that do not have 4-20 mA valve position available. In these applications, the controller will supply the maintained discrete inputs to move the valve to the commanded position and remove the input when the 4-20 mA position feedback signal reaches the desired setpoint.

D. Limit switches and gearing shall be an integral part of the valve control. The limit switch gearing shall be made of bronze or stainless steel and shall be fully lubricated, intermittent type and totally enclosed to prevent dirt and foreign matter from entering the gear train. Limit switches shall be capable of adjustment to trip at any point between fully opened valve and fully closed valve. Limit and torque switches shall be provided for stopping valve in both directions. Mid-travel switches shall be provided as required. Set position shall not be lost if over travel occurs in either manual or electric modes of operation.

E. The valve position transmitter shall be a gear actuated, two-wire device, producing 4-20 mA DC signal proportional to 0–90-degree valve position or to 0-100% of valve travel. The transmitter shall be provided with easily accessible zero and span adjustment potentiometers. The valve actuator shall be provided with a local digital display integral with the operator with a 0-100% scale. The DC power supply shall be provided integral with the operator and powered from the internal control power supply. The positioner board shall provide repeatable accuracy to 0.25% of span. There shall be separate trim pots on the positioner board for zero, span and dead band adjustment.

F. The speed of the actuator shall be the responsibility of the system supplier with regards to hydraulic requirements and response compatibility with other components within the control loop. Each valve controller shall be provided with a minimum of two (2) limit switch functions, one (1) for opening and one (1) for closing. Each limit switch will have two (2) normally open and two (2) normally closed contacts. Gear limit switches must be geared to driving mechanism and in step at all times whether in motor or manual operation. Provision shall be made for two (2) extra sets of limit switches as described above, each to have two (2) normally open and two (2) normally closed contacts. Each valve controller shall be equipped with a double torque switch. The torque switch shall be adjustable and will be responsive to load encountered in either direction of travel. The limit and torque switch contacts shall be silver inlay type.

G. Each actuator shall include monitor relays to remotely indicate fault signal for indication of power failure, phase failure, thermal switch tripped, torque switch tripped between travel stops and Local-Off-Remote selector switch position.

H. The operator shall be equipped with Open-Stop-Close pushbuttons, a Local-Off-Remote selector switch and electronic display all mounted on the operator. Provide a separate remote operating station where operator will not be mounted between 2 and 5 feet above the operator platform, or where otherwise shown on the Drawings.

I. The actuator electronic drive or reversing starter, control transformer, and local controls shall be integral with the valve actuator to prevent breathing and condensation.

J. The local controls shall have a provision to rotate through increments of 90 degrees to suit valve and actuator orientation.

2.11 WIRING AND TERMINALS

A. Internal wiring shall be of tropical grade PVC insulated stranded cable of 5-amp minimum rating for control circuits and of appropriate size for the motor 3-phase power. Each wire shall be clearly identified at each end.

B. The terminals shall be of the stud type embedded in a terminal block of high tracking-resistance compound. The 3-phase power terminals shall be shrouded from the control terminals by means of an insulating cover.

C. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal. The terminal compartment of the actuator shall be provided with three (3) threaded cable entries.

D. The Contractor shall verify the required length of all integral cabling prior to ordering materials.

E. Each actuator shall be provided with a commissioning kit consisting of a wiring diagram and an installation and operation manual. A separate wiring diagram shall be provided inside the terminal cover. No special tools, devices or parts shall be required for commissioning.

F. Actuators shall have separately sealed motor and control compartments. All operators shall have space heaters in their limit switch, motor, and control compartments.

PART 3 EXECUTION

3.01 INSTALLATION

A. The Contractor shall coordinate with Division 11 and 15 requirements for installation of the actuators to the respective gates or valves.

3.02 TESTING

A. Each actuator must be shop performance tested, and individual test certificates shall be supplied without additional charge to the Owner. Test certificates shall be submitted prior to shipment of gate actuators. The test equipment shall simulate a typical gate load, and the following parameters shall be recorded:

1. No load current
2. Current at maximum torque setting
3. Stall current
4. Torque at maximum torque setting
5. Stall torque
6. Test voltage and frequency
7. Flash test voltage
8. Actuator output speed

3.03 FIELD QUALITY CONTROL

A. Furnish the services of a factory trained representative, specifically trained on the type of equipment specified. The manufacturer's representative shall have complete knowledge of proper installation, operation, and maintenance of the equipment to inspect the final installation, supervise test runs of the equipment, and instruct representatives of the Owner in the proper operation and maintenance.

PART 4 EQUIPMENT SCHEDULE

4.01 OPERATOR SCHEDULE

A. This section is provided for the convenience of the Contractor and does not relieve the Contractor of the responsibility of providing all operators required by the complete set of Contract Documents including the Drawings and other sections of the Specifications. Please note that this schedule does not include actuators provided as part of equipment packages specified elsewhere.

B. Influent Building:

Motorized Actuator Schedule				
Location	**Identifier**	**Type**	**Size**	**Service**
Bar Screen Channel No. 1	SG-01	Slide Gate	72”x96”	Open/Close
Bar Screen Channel No. 1	SG-02	Slide Gate	72”x96”	Open/Close
Bar Screen Channel No. 2	SG-03	Slide Gate	72”x96”	Open/Close
Bar Screen Channel No. 2	SG-04	Slide Gate	72”x96”	Open/Close
Grit Chamber No. 1 Influent	SG-05	Slide Gate	44”x96”	Open/Close
Grit Chamber No. 2 Influent	SG-06	Slide Gate	44”x96”	Open/Close
Wet Weather Diversion Structure – Dry Weather	WG-01	Weir Gate	72”x60”	Open/Close
Wet Weather Diversion Structure – Wet Weather	WG-02	Weir Gate	72”x60”	Open/Close

C. Biological System:

Motorized Actuator Schedule				
Location	**Identifier**	**Type**	**Size**	**Service**
BNR Basin 01	WG-06	Weir Gate	96”x60”	Open/Close
BNR Basin 02	WG-07	Weir Gate	96”x60”	Open/Close

D. UV Disinfection and Post Aeration:

Motorized Actuator Schedule				
Location	**Identifier**	**Type**	**Size**	**Service**
Filter Cell No. 1	WG-10	Weir Gate	120”x36”	Open/Close
Filter Cell No. 2	WG-11	Weir Gate	120”x36”	Open/Close
Filter Cell No. 3	WG-12	Weir Gate	120”x36”	Open/Close
Filter Cell No. 4	WG-13	Weir Gate	120”x36”	Open/Close
UV Channel No. 1	SG-12	Slide Gate	44”x60”	Open/Close
UV Channel No. 2	SG-13	Slide Gate	44”x60”	Open/Close

END OF SECTION

SECTION 15250

THERMAL INSULATION FOR PIPING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies the basic materials and methods of installation for insulation for Chemical Solution Delivery and Sample piping systems. Specific uses and applications are specified in the following:

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 15051 – Piping – General Requirements

B. Section 15064 – Plastic Pipe and Fittings

C. Section 15072 – Ductile Iron Pipe and Fittings

1.04 SUBMITTALS

A. Submit, in accordance with Section 01300, the following for each insulation by System: manufacturer's product data showing conformance with this Section for all required insulation, jackets, covers, coatings, adhesives, fasteners, supports and appurtenances; complete manufacturer's instructions for installation of all required items.

B. All submittals shall contain a statement that Sections defining specific insulation types and thickness, and all other referenced Sections have been read and complied with. The certification statement shall specify the specific Sections and be made by all of the following that are applicable, the Contractor, sub-contractor and the vendor. The statement shall be an individual statement for each party involved and shall be included with every submittal and resubmittal.

C. All materials deliveries must have accompanying manufacturer's certifications attesting to satisfactory results of product testing showing conformance with this Section. All materials shall meet all safety requirements of the NFPA, UL, and ASTM guidelines.

D. For units that will be shipped exposed, provide a description of the protective packaging that will be used during transit

E. In general, corrections or comments or lack thereof, made relative to submittals during review shall not relieve the contractor from compliance with the requirements of the drawings and specifications. Submittals are for review of general conformance with the design concepts of the project and general compliance with the contract documents. The contractor is responsible for the final design conforming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating the work of all trades, and performing the work in a safe and satisfactory manner.

F. All insulation of the same class shall be the product of a single manufacturer; however, all the insulation types need not be the products of one manufacturer.

1.05 QUALITY ASSURANCE

A. The insulation materials to be furnished under this section shall be essentially the standard products of manufacturers regularly engaged in the manufacture of insulation systems. The chosen manufacturers shall have furnished materials of the specified type that has been in successful operation for at least 5 years.

B. Several manufacturers are indicated as acceptable for each type of insulation in these specifications. The Insulation Sub-contractor shall be responsible for determining that all insulation supplied for the project is suitable for installation in the spaces indicated. The Insulation Sub-contractor shall also ensure that all materials used are compatible and in compliance with applicable codes and standards. In case of a conflict between this section and any state law or local ordinance, the latter shall govern. Contractor shall also verify that each component of the insulation systems is compatible with all other parts of the system; and that all necessary devices and accessories have been provided.

C. The Owner and Engineer reserve the right to sample and test any materials after delivery and to reject all components represented by a sample that fails to comply with the specified requirements.

1.06 DELIVERY, STORAGE AND HANDLING

A. All materials shall be inspected for size, quality, and quantity against approved shop drawings upon delivery.

B. Delivery schedule of all equipment shall be coordinated with the Contractor. Equipment ready for shipment prior to the agreed-on shipping date shall be stored without cost to the Owner by the manufacturer.

C. All equipment shipped that is exposed such as on a flatbed truck shall be protected during transit. The equipment shall be protected from moisture, road salt, dirt and stones or other materials thrown up from other vehicles. Electrical components shall be protected

as above, but with special attention to moisture. The method of shipment protection shall be defined in the submittals.

D. All materials shall be suitably packed for shipment and long-term storage. Each package shall be labeled to indicate the project and the contents of each package. Where applicable, equipment numbers shall be marked on the container.

E. All materials shall be stored in a covered dry location off of the ground. When required to protect the materials they shall be stored in a temperature-controlled location.

1.07 DEFINITIONS

A. Particular terminology used under this Section is defined as follows:

1. Exposed Piping – Piping visible from the floor level and includes all piping in the water treatment plant building

2. Ventilated Spaces – Areas supplied with outdoor air on a continuous or intermittent basis. The outdoor air may be heated and/or cooled or untreated

3. Heated Spaces – Areas where heat is supplied to maintain a minimum temperature during the heating season

4. Unheated Spaces – Areas where heat is not applied and there is no minimum temperature during the heating season

5. Conditioned Spaces – Areas that are provided with heating and mechanical cooling

6. Non-Conditioned Spaces – Areas that are not provided with mechanical cooling.

7. Indoor Piping – Piping within a building that is not exposed to the weather

8. Outdoor Piping – Piping that is not within a building and which is exposed to the weather

PART 2 PRODUCTS

2.01 GENERAL

A. All materials and integrated insulation assemblies furnished shall have flame spread ratings of not over 25 (fire resistive), smoke developed rating of not over 50 and fuel contributed rating of not over 50, as established by tests conducted in accordance with Interior Federal Standard No. 00136B, entitled “Interior Federal Standard Flame-Spread Properties for Materials” and the National Fire Code of the NFPA including but not limited to NFPA 255, UL 723, AND ASTM E84. The treatment of jackets or facings to impart flame and smoke safety must be permanent. (The use of water-soluble treatment is prohibited.) Exception allowed for closed cell foam insulation and PVC fitting covers.

B. The toxicity of the solvents used shall not exceed a maximum allowable concentration of 200 ppm or the latest value published by the American Conference of Governmental Industrial Hygienists and OSHA.

C. Adhesives, coatings, and vapor barrier materials shall be compatible with the insulation as recommended by the insulation manufacturer. Adhesives should include VOC data. All adhesives used on the interior of the building defined as inside the weatherproofing system shall have a VOC content not greater than 80 g/L. Submit a certified statement attesting to the approval of the materials by the insulation manufacturer. Adhesives and coatings shall be manufactured by Foster Div.; H.B. Fuller Co.; Childers Products Co.; or approved equal. H.P. Fuller and Childers Product Numbers are listed below by adhesive/coating types. All testing shall be done on materials of the same densities and installed thicknesses as the materials being installed. Insulation materials which have been treated with a flame-retardant additive to meet the required flame spread and smoke developed ratings are not acceptable.

1. Lagging adhesive: 3036, CP50, AMV-1
2. Vapor barrier coating: 3035, CP30
3. Vapor seal adhesive: 8575, CP82
4. Duct adhesive: 8520, CP82
5. Sealing compound adhesive: 3045, CP70
6. Weatherproof mastic: 3501, CP101

D. If mineral fiber is used to insulate pipe fittings, then they shall be jacketed with PVC jacketing material. This PVC jacketing material shall be of the same material as any other PVC jacketing material used when indicated on other piping systems.

E. Jackets for fittings shall be one piece, factory molded to the contour of the fitting. The PVC jacket and fitting covers shall have a minimum thickness of 0.020 inches when installed indoors and 0.030 inches when installed outdoors. PVC jacketing shall be Johns Manville "Zeston 2000 Series".

2.02 INSULATION WITH VAPOR BARRIER (TYPE I-3)

A. Cold piping systems with vapor barrier include but not limited to:

1. Chemical solution piping
2. Sample Piping
3. Odor control piping as identified on the plans
4. Compressed air piping as identified on the plans

B. Insulation Material - Molded rigid fiberglass sectional pipe insulation rated to 500 degrees Fahrenheit (500°F). The insulation shall have a minimum density of 3.5 pounds-per-cubic-foot (pcf) and a maximum "K" factor of 0.24 at 75 degrees Fahrenheit (75°F) mean temperature.

C. Jacket

1. Outdoor Piping - Jacket shall be factory or field applied 0.016-inch thick aluminum.

D. Fittings Covers

1. Outdoor Piping - Preformed aluminum covers.

E. Acceptable manufacturers shall be Manville Corp.; Certain-Teed; Owens-Corning Fiberglas or approved equal.

2.03 HEAT TRACING FOR EXPOSED WATER AND CHEMICAL PIPING

A. Where shown on the Drawings, or referenced in other Specification Sections, provide, and install heat tracing equipment by Chromalox or approved equal to prevent water pipe, compressed air, or chemical pipe freeze and pipe burst as defined herein.

B. The self-regulating cables shall consist of two (2) 16 AWG nickel-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heating cable to be cut to length in the field. A modified polyolefin dielectric jacket shall cover the heating cable. To provide a ground path and to enhance the heating cable's ruggedness, the heating cable shall have a braid of tinned copper, as required per Section 427-23 of the NEC. Provide an outer jacket composed of modified polyolefin (-CR). For installation on plastic piping, the heating cable shall be applied using aluminum tape (AT-1).

C. In order to provide rapid heat-up, and to prevent overheating of fluids and plastic pipe, the heating cable shall have the following minimum self-regulating indices:

Heating Cable	S.R. Index (W/°F)	S.R. Index (W/°C)
3 W/ft.	-0.020	-0.036
5 W/ft.	-0.045	-0.080
8 W/ft.	-0.058	-0.104

D. In order to facilitate longer circuit lengths and smaller breaker sizing, the heating cable shall have the following maximum inrush current at 50 degrees Fahrenheit (50°F), 10 degrees Celsius (10°C).

Heating Cable	Maximum Inrush @ time = 1 sec	Maximum Inrush @ time = 10 sec	Maximum Inrush @ time = 300 sec
3 W/ft., 120V	58 mA/ft.	54 mA/ft.	41 mA/ft.
5 W/ft., 120V	155 mA/ft.	128 mA/ft.	66 mA/ft.
8 W/ft., 120V	210 mA/ft.	180 mA/ft.	83 mA/ft.
3 W/ft., 240V	38 mA/ft.	36 mA/ft.	20 mA/ft.
5 W/ft., 240V	92 mA/ft.	80 mA/ft.	33 mA/ft.
8 W/ft., 240V	127 mA/ft.	106 mA/ft.	41 mA/ft.

E. The heating cable for metal-pipe and plastic-pipe freeze protection shall be sized according to the table below. The required heating cable output rating is in watts per foot at 50 degrees Fahrenheit (50°F). (Heating cable selection is based on 1 inch of fiberglass insulation.)

Pipe size (in)	0°F Minimum Ambient Temperature
3 or less	5 watts
4	5 watts
6	8 watts
8	2 runs - 5 watts
10	2 runs - 8 watts

F. The heating cable shall operate online voltage of 120 volts without the use of transformers.

G. The heating cable shall be SRF cable as manufactured by Chromalox or approved equal.

H. Power connection, end seal, splice, and tee kit components shall be applied in the field. The accessories shall be Chromalox DL series or approved equal.

I. A ground-fault device for equipment protection shall protect heating cable circuit.

J. Supply all required accessories and install per manufacturer recommendations.

K. If heating plastic pipe, band the heat cable to aluminum tape to evenly distribute heat.

L. All installed equipment must be UL Listed.

PART 3 EXECUTION

3.01 GENERAL

A. Do not apply insulation prior to testing and acceptance of piping and/or equipment. Insulation shall not be applied to damp or frosty surface. Clean dust, dirt, grease, and moisture from surfaces of pipe and ducts before applying insulation or insulation adhesives. Nameplates and equipment certification and data tags affixed to any piece of apparatus shall not be covered. Where two (2) layers of insulation are used, stagger all joints both ways. Secure each layer independently. Continue insulation and jacketing through walls, partitions, floors, and pipe sleeves.

B. The Contractor shall not install any equipment or materials until the Owner and Engineer have approved all submittals. If any equipment or materials are installed prior to approval of the submittals, it shall be at the Contractor's risk.

C. Insulation, adhesives, coatings, and vapor barrier materials shall be applied in accordance with manufacturer’s recommendations. Do not apply these materials when ambient temperature is above or below the maximum and minimum ambient temperature respectively, specified as limits by the manufacturer.

D. All penetrations through a vapor barrier for hangers, instruments, etc., shall be sealed to provide a complete vapor barrier. The use of staples or other fasteners that penetrate the vapor barrier is not permitted.

E. Insulation systems that require a vapor barrier shall be installed with an intact vapor barrier that covers the entire pipe, duct, or piece of equipment to be insulated. All edges of insulation that do not abut another piece of insulation shall have the vapor barrier extended and sealed to the item being insulated. All penetrations through the insulation such as for thermowells, test ports, dampers, nameplates, or other items shall have the vapor barrier extend over the edges of the insulation and sealed to the item being insulated. Where items are mounted on piping a standoff shall be provided to protect the vapor barrier. The vapor barrier shall be sealed to the standoff.

F. For insulated items exceeding 100 square feet, or 20 feet in length, extend the vapor barrier to the item being insulated to reduce the area or length within a single enclosed area to the dimensions listed above.

3.02 INSTALLATION OF PIPING INSULATION

A. Contractor shall install all insulation materials as specified herein for the piping systems, ductwork, and equipment that are not factory insulated. Unless otherwise indicated, all mechanical piping, ductwork, equipment, and accessories with an operating temperature in excess of 140°F or below 60°F shall be insulated. Preformed sectional insulation and jacketing shall be used where possible. The use of blanket insulation will be limited to fittings that cannot be insulated with sectional insulation. All joints on preformed and fabricated insulation shall be accurately fitted to eliminate voids. Voids shall be eliminated by refitting or replacing the insulation. End joints shall be firmly butted to adjoining sections of insulation.

B. Outdoor piping insulation shall be installed so as to keep the insulation dry. Joints shall be located to prevent the entrance of water. Breaks in jacketing caused by vertical connections or instruments shall be protected by hoods or cones. Where there are breaks in the jacket, plastic moisture barriers shall be provided under the jacketing to protect the insulation. Insulation and jacketing of valves shall be waterproofed. Insulation and jacketing of the valve shall be removable to allow servicing of the valve.

C. Vapor seal adhesive shall be used to seal seams and to butt sections on all cold piping if self-sealing laps are not provided. The use of staples or any other fastening method that would penetrate the vapor barrier will not be permitted on cold piping systems. Staples may be used on hot piping systems where there is no potential for condensation.

D. Metal or plastic jacketing shall have its joints staggered from those of the insulation. Joints between jacketing and insulation shall be a minimum of three (3) inches.

E. Metal or plastic jacketing shall have a minimum 3-inch overlap on longitudinal joints and end joints. Longitudinal joints in horizontal piping shall have the outer lap of the joint pointed down to shed water. The end of the outer lap shall be located at the 5 or 7 o'clock positions.

F. Where piping is provided with electric or steam heat tracing the insulation shall not be installed until the heat tracing has been tested and accepted. Insulation shall be sized to allow for the heat tracing line without deforming the insulation. Piping systems with electrical heat tracing shall have warning labels attached to the outside of the pipe thermal insulation weather barrier to indicate the presence of electric heat tracing. Labels shall be located every 10 feet of pipe, alternating on either side. The labels shall be black on yellow, weatherproof, mylar, with pressure sensitive adhesive and at least 2 inches by 6 inches minimum.

G. Where supports, anchors, or guides are in direct contact with cold piping, insulate the item in contact a distance of four (4) times the insulation thickness. Insulation thickness shall be sufficient to provide a cold face temperature that does not exceed 150 degrees F. Clamps and nonwelded support devices shall be contained within the insulation. The space within insulating saddles at pipe hangers shall be filled with insulation.

H. On vertical risers exceeding 15 feet in height, provide intermediate support for the insulation. For carbon steel pipe, this support shall consist of angle clips or other suitable devices welded to the pipe at about 15 feet on centers and concealed by the pipe covering. On noncarbon steel piping, clamps, or other nonwelded devices shall be used.

I. Unless otherwise specified insulate all valves, control valves, fittings, pipe specialties and all other components that could be construed as being part of the piping system. Insulate valve bonnets to a point just below the stuffing box.

J. Bridge flanges, unions, and pipeline strainers with block or sectional insulation wired in place. Wire shall be black steel, annealed. Stop the pipe insulation a sufficient distance to allow removal of flange bolts without disturbing the pipe insulation and extend the block, at least two (2) inches over the adjacent pipe insulation. Flange covers shall be designed for removal without damaging the pipe insulation. Fill voids with blanket insulation.

K. For calcium silicate insulation applied to piping, half sections shall be butted tightly together with joints staggered. Sections shall be held in place with 18-gauge black annealed wire at 9-inch intervals, with ends twisted and bent downwards to penetrate the insulation. All gauges specified refer to US standard gauge. Voids shall be filled with insulating cement.

L. Packages or factory containers shall bear the manufacturer's stamp or label with the name of the manufacturer and description of materials.

3.03 INSULATION FOR COLD PIPING WITH VAPOR BARRIER (TYPE I-3)

A. Installation

1. Apply insulation in thicknesses indicated. Laps and joints shall be sealed using self-sealing laps or outward clinch staples. Laps in horizontal piping shall be at the top.

2. Where factory applied aluminum jacket is used factory supplied aluminum closures with sealing compound shall be used at all joints. Seams shall be located to shed water. All seams of exposed insulation and jackets shall be in the least visible location.

3. Where field applied aluminum jacket is used, the jacket shall be attached with aluminum draw bands located within three (3) inches of each joint and 24 inches on center maximum. Jacket piping shall have joints arranged to shed water.

4. Fittings shall be wrapped with blanket insulation to provide the same insulation value as required for straight piping. Aluminum fitting covers shall be attached by aluminum draw bands with joints sealed with sealing compound adhesive and located to shed water.

END OF SECTION

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SECTION 15251

MECHANICAL INSULATION FOR BUILDING MECHANICAL

PART 1 GENERAL

1.01 SCOPE

A. This section covers the furnishing and installation of insulation, jackets, and accessories for the following mechanical systems:

1. Piping
2. Ductwork

B. Building insulation materials are specified in other sections. Insulation for mechanical equipment which is to be applied at the factory prior to shipment is specified in the individual equipment sections.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 GENERAL

A. Materials furnished and installed under this section shall be in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by Engineer.

B. Coordination

1. Contractor shall be responsible for coordinating the installation of insulation with the installation of the items or systems to be insulated. Each item or system shall be tested and accepted by Engineer before installation of the insulation materials.

2. Contractor shall verify that each component of the insulation systems is compatible with all other parts of the system; that all insulation materials are appropriate for the

intended applications; and that all necessary devices and accessories have been provided.

3. All insulation of the same class shall be the product of a single manufacturer; however, all the insulation types need not be the products of one manufacturer.

C. General Equipment Stipulations

1. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

D. Governing Standards

1. Except as modified or supplemented herein, all work covered by this section shall be performed in accordance with all applicable municipal codes and ordinances, laws, and regulations. In case of a conflict between this section and any state law or local ordinance, the latter shall govern.

2. All work shall comply with UL, NFPA, and ASTM safety requirements.

E. Metal Thickness

1. Metal thickness and gauges specified herein are minimum requirements. Gauges refer to US Standard gauge

F. Surface Burning Characteristics

1. Insulation, jackets, tapes, and adhesives to be used indoors shall have a composite flame spread rating not to exceed 25 and a composite smoke developed rating of 50 when tested by UL 723, NFPA 255, or ASTM E84. All testing shall be done on materials of the same densities and installed thicknesses as the materials being installed. Insulation materials which have been treated with a flame-retardant additive to meet the required flame spread and smoke developed ratings are not acceptable.

G. Painting and Identification

1. Field painting and identification shall be as specified in the Finish Painting section.

1.04 SUBMITTALS

A. Drawings and Data

1. A complete list of materials and catalog cuts, together with detailed specifications, materials performance data, installation instructions, parts, devices, and accessories furnished, shall be submitted in accordance with the Submittals Procedures section. Information shall include certified test results to show compliance with UL, NFPA, and ASTM safety requirements.

1.05 QUALITY ASSURANCE

A. Manufacturer Experience

1. A manufacturer shall have furnished material of the type specified which has been in successful operation for not less than the past 5 years.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Shipping shall be in accordance with the Materials, Transportation and Handling section. Handling and storage shall be in accordance with the Materials, Transportation and Handling section.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers shall be as listed in the respective product description paragraphs.

2.02 MATERIALS

A. Pipe Insulation

1. Type PMF1 Insulation

a. Type PMF1 mineral fiber pipe insulation shall be Johns Manville "Micro-Lok", Knauf "Pipe Insulation" or Owens-Corning.

b. Type PMF1 pipe insulation shall be a one-piece molded glass fiber material with all-purpose jacket. The all-purpose jacket shall be factory-applied, fiberglass reinforced vapor barrier type, with white kraft bonded to aluminum foil and self-sealing adhesive lap. The insulation shall be suitable for a temperature range of 0°F to 850°F, shall have a maximum thermal conductivity (k) of 0.24 Btu in/hr ft2 °F at 75°F, and shall conform to ASTM C547.

2. Type PFC1 Insulation

a. Type PFC1 flexible cellular elastomeric pipe insulation shall be Armacell "AP/Armaflex" or K-Flex USA "Insul-Tube" for unslit insulation and Armacell “AP/Armaflex SS” or K-Flex USA “Insul-Lock Seam-Seal” for factory pre-slit insulation. Flexible cellular polyolefin foam insulation shall be IMCOA "Imcolock" or Plastic Technology, Inc. “Innofoam”.

b. Type PFC1 pipe insulation shall be one-piece, molded elastomeric or polyolefin foam insulation suitable for a temperature range of -40°F to 180°F, and shall have a maximum thermal conductivity (k) of 0.28 Btu in/hr ft2 °F at 75°F . The insulation shall be suitable for exposure to weather and direct sunlight or, where not indicated to be jacketed, shall be given two coats of an ultraviolet-resistant finish recommended by the manufacturer. Insulation shall conform to ASTM C534 for elastomeric or ASTM C1427 for polyolefin.

B. Duct Insulation

1. Type DMF1 Insulation

a. Type DMF1 semi-rigid type duct insulation shall be Johns Manville "800 Series Spin-Glas", Knauf "Insulation Board", or Owens-Corning “Fiberglas 705”.

b. Type DMF1 exterior insulation for rectangular ductwork shall be a semirigid, 6 pounds per cubic foot density fiberglass material with a factory-applied all service jacket. Insulation suitable for temperatures of up to 150°F, and shall have a maximum thermal conductivity (k) of 0.23 Btu in/hr ft2 °F at 75°F . The insulation shall conform to ASTM C612.

2. Type DMF2 Insulation

a. Type DMF2 flexible type duct insulation shall be Johns Manville "Microlite", Knauf "Friendly Feel Duct Wrap", or Owens-Corning “SOFTR All-Service Duct Wrap”.

b. Type DMF2 exterior insulation for round ductwork shall be 1 lb per cubic foot density flexible fiberglass duct wrap with factory-applied foil-scrim-kraft facing. Insulation suitable for temperatures of up to 250°F , and shall have a maximum thermal conductivity (k) of 0.27 Btu in/hr ft2 °F at 75°F . The insulation shall conform to ASTM C553.

2.03 ACCESSORIES

A. Aluminum Insulation Jackets

1. Aluminum insulation jackets for insulated piping systems shall be furnished and installed as indicated in the insulation schedule herein and where indicated on the Drawings. Aluminum jackets shall be manufactured from alloys 3003 and 3105 conforming with ASTM B209. The aluminum jacket shall have a nominal thickness of 0.024 in., with an embossed finish.
2. Fittings in insulated piping systems and equipment where indicated in the insulation schedule shall be provided with aluminum jackets of the same aluminum jacketing material as the piping systems. The jacket shall have a factory-applied moisture retarder of at least 3 mils permanently bonded to the interior surface and extending the full width of the jacket. The retarder shall consist of Polysurlyn or polyethylene film and kraft paper.

PART 3 EXECUTION

3.01 INSTALLATION

A. General

1. Contractor shall install all insulation materials as specified herein for the piping systems, ductwork, and equipment that are not factory insulated. Insulation materials shall be installed in accordance with the manufacturer's written instructions and recommendations. Surfaces to be insulated shall be cleaned and dried. All work shall

be performed within the temperature ranges recommended by the insulation product manufacturer. Insulation shall be kept clean and dry and shall remain in the factory container until it is installed. Packages or factory containers shall bear the manufacturer's stamp or label with the name of the manufacturer and description of materials.

2. Seams of exposed insulation and jackets shall be in the least visible location.

3. All adhesives used on the interior of the building defined as inside the weatherproofing system shall have a VOC content not greater than 80 g/L.

B. Piping Insulation

1. Type PMF1 Insulation

a. Pipe insulation, vapor retarders, and field applied jackets shall be installed to cover system piping, fittings, and appurtenances. Insulation shall be full factory unit lengths using a single cut piece to complete the run. Abutting cut pieces or scraps shall not be used. End joints and longitudinal seams shall be tightly butted. Insulation for fittings shall be of the same thickness and conductivity as the adjoining pipe insulation.

b. Insulated piping conveying fluids at lower than ambient temperatures shall be jacketed with a continuous vapor barrier. The insulation shall be continuous through hangers and penetrations, except at firewall penetrations, and shall be sealed with vapor barrier coating. The vapor barrier coating shall be applied at intervals not exceeding 15 feet for straight runs and not more that 6 inches from fittings. Fibrous insulation laps and butt strips that are not self-sealing shall be secured with adhesive and stapled. Staples and seams shall be coated with vapor barrier material.

c. On piping 2 inches and larger where the insulation is continuous through the hanger, an insert shall be installed between the support shield and piping. The insert shall be of the same thickness and contour as the adjacent insulation and installed to maintain a continuous vapor barrier through the support. The insert shall be constructed of wood or heavy density insulating material suitable for the system operating temperatures.

2. Type PFC1 Insulation

a. Pipe insulation shall be installed to cover all pipe, fittings, and appurtenances with all seams and joints sealed by a factory or field applied adhesive. Insulation at fittings and appurtenances shall be carefully formed and fitted. Insulation at elbows shall be mitered using segments of pipe insulation.

C. Duct Insulation

1. Insulation for ducts indicated on the Drawings as wrapped shall be installed as specified herein and indicated on the Drawings. Surfaces which are to be insulated shall be cleaned and dried. Insulation shall be kept clean and dry and shall not be removed from the factory container until it is installed. Packages or factory

containers shall have the manufacturer's stamp or label bearing the name of the manufacturer and description of the contents.

2. Duct insulation shall be continuous through hangers and penetrations, except firewall penetrations but shall be interrupted at thermometers, controls, damper linkages, flexible connections, access doors, etc., to avoid interference with their functioning and/or replacement. Insulation jackets shall be continuous across seams, reinforcement, and projections.

3. The duct liner in the corners of the duct sections shall be folded and compressed or shall be cut and fit to ensure overlapping, butted edges. Top and bottom pieces shall overlap the side pieces. Longitudinal seams shall be made only at corners unless duct dimensions and standard liner product dimensions make seams necessary at other locations.

4. The duct liner shall be held to the duct by a coat of waterproof, fire-retardant adhesive applied over the entire duct surface. Where duct dimensions exceed 8 inches on any side, mechanical fasteners shall be used in addition to the adhesive. All exposed edges of the duct liner shall be tightly butted and coated with adhesive.

5. Insulation on ducts conveying air at temperatures below 60°F shall be installed with a continuous vapor barrier seal. Staples and joints shall be sealed with a vapor barrier coating.

6. Type DMF1 Insulation

    a. Type DMF1 semirigid insulation shall be secured to all four sides of the duct with mechanical fasteners, spaced not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. At least two rows of fasteners shall be provided for each side of 12 inches and larger ducts, and one row for each side of ducts smaller than 12 inches. All joints in the insulation shall be sealed with 3 inches wide joint sealing tape or 4-inch-wide strips of jacket material secured with adhesive and staples.

7. Type DMF2 Insulation

    a. Type DMF2 flexible insulation shall be installed with waterproof, fire-retardant adhesive. Insulation jackets shall overlap at least 2 inches and shall be secured under the overlap with adhesive and stapled on 4-inch centers.

D. Aluminum Jacketing

1. Aluminum jacketing for piping systems shall be installed as specified herein and indicated on the Drawings. Jacketing shall be held in place with stainless steel securing bands uniformly spaced at not more than 18 inches to produce tight joints without "bulging". The jacket shall overlap at least 2 inches at longitudinal and circumferential joints. Joints shall be overlapped and sealed with caulk to prevent moisture penetration, and longitudinal joints shall be placed to shed water. Exposed ends of pipe insulation shall be provided with covers constructed of the same material as the jacketing.

2. Elbows shall be jacketed with spirally wrapped aluminum strips or individual mitered segments or gores cut to fit the insulation.

3.02 INSULATION SCHEDULE

INSULATION SCHEDULE				
		Mechanical Insulation		
Service	Size Inches	Type	Thickness Inches	Notes
PIPING - INDOOR (CONCEALED OR EXPOSED)				
Condensate Drain	All	PMC1	1	(3)
Non-Potable Cold Water	Up to 3 4 & larger	PFC1 PFC1	3/4 1	(3) (3)
Potable Cold Water and Deionized Water	Up to 3 4 & larger	PFC1 PFC1	3/4 1	(3) (3)
Potable Hot Water Hot Water Circulating	Up to 1-1/4 1-1/2 & larger	PMF1 PMF1	1 1.5	(9) (9)
Refrigerant Suction and Hot Gas Bypass	Up to 1 1 & larger	PFC1 PFC1	1.5 1.5	
PIPING - OUTDOOR (EXPOSED)				
Refrigerant Suction and Hot Gas Bypass	Up to 1 1 & larger	PFC1 PFC1	1.5 1.5	(1)
DUCTWORK				
Rectangular	Within conditioned space All other indoor locations	DMF1 DMF1	1 2	(6) (5), (6)
Round	Within conditioned space All other indoor locations	DMF2 DMF2	2 3	(6) (5), (6)

EQUIPMENT	
Mechanical Insulation Types:	FC - Flexible Cellular MF - Mineral Fiber MW - Mineral Wool

Notes:

(1) Aluminum jacket.

(2) PVC jackets shall be provided on exposed portions of insulated piping located less than 8 feet above finished floor. On all other portions of the insulated piping system PVC jackets shall be provided only for fittings.

(3) Insulation shall be provided for portions of the piping system which pass through space above finished ceilings or is exposed above equipment, electrical panels, or cabinets.

(4) Insulation shall be provided for exposed portions of the piping system located less than 8 feet above the finished floor or grade.

(5) Insulation shall be provided for outside air plenums and ducts that are located upstream of the heating coil or pass through unheated spaces after the heating coil, unless indicated to be internally lined.

(6) Insulation shall be provided for outside air plenums and ducts, air conditioning supply and return ducts, and dehumidifier reactivation air discharge ducts, unless indicated to be internally lined.

(7) Insulation thickness shall be sufficient to provide a cold face temperature not to exceed 150°F.

(8) The underside of all roof drains shall be insulated to a 1-foot radius from the center of the drain. All roof drain piping within 4 feet of the drain shall be insulated.

(9) Includes 8 feet of the cold-water inlet piping to the water heater storage tank.

A. Unless otherwise indicated in the insulation schedule, all mechanical piping, ductwork, equipment, and accessories with an operating temperature in excess of 140°F or below 60°F shall be insulated.

END OF SECTION

SECTION 15400

PLUMBING

PART 1 GENERAL

1.01 SCOPE

A. This section covers the furnishing and installation of materials, appliances, fixtures, equipment, and appurtenances associated with the plumbing systems as specified herein and as indicated on the Drawings. Additional requirements for plumbing systems shall be as indicated in the schedules on the Drawings. Suitable connections shall be provided for each fixture, piece of equipment, and appurtenance.

B. Pipe materials, valves, thermal insulation, and pipe supports which are not an integral part of the fixture or piece of equipment and are not specified herein are covered in other sections.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 GENERAL

A. Materials furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the manufacturer unless exceptions are noted by Engineer.

B. Coordination

1. Contractor shall verify that each component of the plumbing system is compatible with all other parts of the system; that all piping, fixtures, and appurtenances are appropriate; and that all devices necessary for a properly functioning system have been provided.

2. Where two or more units of the same class of equipment are required, they shall be the product of a single manufacturer; however, all the component parts of the system need not be the products of one manufacturer.

3. Where several manufacturers' names have been listed in this section as possible suppliers, only the products of the first manufacturer listed have been checked for size, functions, and features.

C. General Equipment Stipulations

1. The General Equipment Stipulations shall apply to all equipment and materials provided under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

D. Seismic Design Requirements

1. Seismic design requirements for products specified herein shall be as indicated in the Meteorological and Seismic Design Criteria section.

E. Governing Standards

1. Except as modified or supplemented herein, all work covered by this section shall be performed in accordance with all applicable municipal codes and ordinances, laws, and regulations. In case of a conflict between this section and any state law or local ordinance, the latter shall govern.

2. All work shall conform to the requirements of AGA, ASTM, NFPA, and UL safety requirements.

F. Power Supply

1. Unless otherwise specified, power supply to equipment with motors shall be as indicated on the Drawings. Power supply for controls shall be 120 volts, 60 Hz, single phase unless otherwise required for a properly operating system.

G. Metal Thickness

1. Metal thicknesses and gages specified herein are minimum requirements. Gages refer to US Standard gage.

H. Mechanical Identification

1. Mechanical identification shall conform to the requirements of the Basic Mechanical Building Systems Materials and Methods section.

1.04 SUBMITTALS

A. Drawings and Data

1. Complete assembly and installation drawings, and wiring and schematic diagrams, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the Submittals Procedures section. Device tag numbers indicated on the Drawings shall be referenced on the wiring and schematic diagrams where applicable. The data and specifications to be submitted for each unit shall include, but shall not be limited to, the following:

Equipment, Piping Accessories, and Appurtenances
- Name of manufacturer
- Type and model
- Construction materials, thicknesses, and finishes
- Capacities
- Pressure and temperature ratings
- Overall dimensions
- Piping connection sizes and locations
- Net weight
- Horsepower [kW]
- Power requirements
- Wiring diagrams

Plumbing Fixtures
- Name of manufacturer
- Type and model
- Construction materials, thicknesses, and finishes
- Water consumption data
- Overall dimensions
- Rough-in dimensions
- Piping connection sizes and locations
- Net weight

Seismic Design Requirement
- Confirmation of compliance with the requirements of the Meteorological and Seismic Design Criteria section

B. Operations and Maintenance Data and Manuals

1. Adequate operation and maintenance information shall be supplied as required in the Submittals Procedures section. Operation and maintenance manuals shall be submitted in accordance with the Submittals Procedures section.

2. Operation and maintenance manuals are required for electronic trap priming panels, water closets, urinals, faucets and flush valves, emergency fixtures, wash fountains, electric water coolers, food waste disposers, water heaters, circulating pumps, hose reels, expansion tanks, neutralization tanks oil interceptors.

1.05 QUALITY ASSURANCE

A. Welding Qualifications

1. All welding procedures and welding operators shall be qualified by an independent testing laboratory in accordance with the applicable provisions of AWS Standard Qualification Procedures. All procedure and operator qualifications shall be in written form and subject to Engineer's review. Accurate records of operator and procedure qualifications shall be maintained by Contractor and made available to Engineer upon request.

B. Qualification

1. The plumbing system installer shall be licensed as stipulated by the authority having jurisdiction.

C. Manufacturer's Experience

1. Unless the equipment manufacturer is specifically named in this section, the manufacturer shall have furnished equipment of the type and size specified which has been in successful operation for not less than the past 5 years.

D. Construction

1. Plumbing fixtures shall be constructed in accordance with the following standards:

Enameled Cast Iron	ANSI/ASME A112.19.1M
Vitreous China	ANSI/ASME A112.19.2M
Stainless Steel	ANSI/ASME A112.19.3M
Faucets	ANSI/NSF 61
Emergency/Safety Fixtures	ANSI Z358.1

2. Electric water coolers shall be UL listed and certified in accordance with the Air Conditioning and Refrigeration Institute (ARI) Standard 1010. All materials in contact with water shall comply with the Reduction of Lead in Drinking Water Act. All plumbing fittings and fixtures intended to convey or dispense water for human consumption shall comply with the requirements of NSF/ANSI 61 and NSF/ANSI 372 for lead-free.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section.

1.07 EXTRA MATERIALS

A. Extra materials shall be furnished for each type and size of plumbing fixture or equipment as required, in the quantities indicated below.

Part	Number Required
Flushometer valve repair kits	1 per 5 fixtures
Flush valves	1 per 5 fixtures
Water closet seats	1 per 10 fixtures
Faucet washer cartridge and O-ring kits	1 per 5 fixtures
Electric water heater elements	1 per heater
Water heater relief valves	1 per heater

B. Extra materials shall be packaged with labels indicating the contents of each package. Each label shall indicate manufacturer's name, equipment name, part nomenclature, part number, address of nearest distributor, and current list price. Extra materials shall be delivered to Owner as directed.

1. Extra materials subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping.

PART 2 PRODUCTS

2.01 SERVICE CONDITIONS

A. All plumbing fixtures and equipment shall be designed and selected to meet the specified conditions.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

A. All fixtures and equipment shall be designed to meet the performance and design conditions specified herein and indicated on the Drawings.

B. Dimensional Restrictions

1. Layout dimensions will vary between manufacturers and the layout area indicated on the Drawings is based on typical values. Contractor shall review the contract Drawings, the manufacturer's layout drawings, and installation requirements and shall make any modifications required for proper installation subject to acceptance by Engineer.

2.03 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers shall be as listed in the respective product description paragraphs.

2.04 MANUFACTURE AND FABRICATION

A. Anchor Bolts and Expansion Anchors

1. Anchor bolts, expansion anchors, nuts, and washers shall be as indicated in the Special Provisions section unless otherwise indicated on the Drawings.

B. Surface Preparation

1. All iron and steel surfaces, except motors and speed reducers, shall be shop cleaned by sandblasting or equivalent, in strict conformance with the paint manufacturer's recommendations. All mill scale, rust, and contaminants shall be removed before shop primer is applied.

C. Shop Painting

1. All steel and iron surfaces shall be protected by suitable coatings applied in the shop. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment. Coatings shall be suitable for the environment where the equipment is installed. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with an oil resistant enamel or universal type primer suitable for top coating in the field with a universal primer and aliphatic polyurethane system.

2. Surfaces to be coated after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of the specified primer.

3. Surface finish damaged during installation shall be repaired to the satisfaction of Engineer. Field painting shall conform to the requirements of the Protective Coatings section.

D. Equipment Bases

1. Unless otherwise indicated or specified, all equipment shall be installed on concrete bases at least 6 inches high. Each unit and its drive assembly shall be supported on a single baseplate of neat design. Baseplates shall have pads for anchoring all components. Baseplates will be anchored to the concrete base with suitable anchor bolts.

E. Special Tools and Accessories

1. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

F. Piping Systems

1. Unless otherwise specified herein, piping system materials shall be as specified in other sections.

G. Valves

1. Unless otherwise specified herein, valves indicated to be a part of the plumbing systems shall be as specified in other sections.

2.05 WATER SUPPLY PIPING ACCESSORIES

A. Water Hammer Arresters

1. Water hammer arresters shall be either bellows or piston type. Bellows type arresters shall consist of a stainless-steel shell, a factory charged and sealed compression chamber, a stainless steel or elastomer bellows, and a stainless-steel threaded adapter. Piston type arresters shall consist of a seamless Type L copper shell, a seamlessly spun and factory charged air chamber, a factory lubricated double or triple Oring sealed piston, and a threaded copper adapter. Water hammer arresters shall be tested and certified in accordance with American Society of Sanitary Engineering (ASSE) Standard 1010. Arresters shall be rated for a maximum working pressure of 350 psig and a temperature range of 33° F to 250° F . Water hammer arresters shall be Smith “Hydrotrol”, Josam “75000 Series Absorbotron”, Wade “Shokstop”, or Sioux Chief “Hydra-Rester”.

B. Trap Primers

1. Electronic Trap Priming Panel

a. Electronic trap priming panels shall be provided as indicated by the plumbing drawings denoted by a symbol “TPP” and an identifying number. One half-inch copper tubes shall run from the electronic trap priming panel to the traps. Trap primers shall be mounted in accessible locations. Electronic trap priming panels shall consist of a panel, timer, 120 V solenoid, calibrated manifold system and shall be manufactured by Precision Plumbing Products Inc. “PTS Series”, Zurn, MIFAB, or equal. Reference the plumbing drawings for the number of priming tubes required per trap priming panel.

C. Thermostatic Mixing Valves

1. Thermostatic mixing valves shall comply with ASSE 1017, shall be bronze or brass body, with stainless steel flow control components, threaded end connections, rotating handle adjustment, lockable setpoint, and hot and cold check stops. Valves shall be suitable for flow ranges and have temperature adjustment ranges as indicated in the schedules. Temperature adjustment range shall be 85°F to 120°F . Accuracy shall be within 3° F of setpoint. Thermostatic mixing valves shall be manufactured by Symmons, Leonard, or Powers.

D. Vacuum Relief Valves

1. Vacuum relief valves shall have bronze or brass bodies rated for 200 psig and shall be provided with male threaded inlet connections. The valves shall open at 1/2-inch water column vacuum and shall have a venting capacity of at least 15 cubic feet per minute. Vacuum relief valves shall be Watts Regulator “Model LFN36”, Cash Acme “VR801”, or Apollo Valves “Model VR”.

E. Thermometers

1. Thermometers shall be Weksler Instruments “Adjust Angle”, Ashcroft “Series EI Everyangle”, or Weiss Instruments, Inc. “Variangle”.

2. Thermometers shall be bimetal type and shall have a dial at least 4 1/2-inch diameter, with black markings on a white background. Pointer travel shall span not less than 200 degrees nor more than 270 degrees. Each thermometer shall have a stainless-steel case, bezel, fittings, and stem and shall be hermetically sealed, with external pointer adjustment and an acrylic or shatterproof glass window.

3. Each indicator shall be furnished with an angularly adjustable frame for convenient viewing. Unless otherwise indicated, thermometer range shall be 0 to 200°F.

4. Each thermometer shall be furnished with a stainless steel thermowell for installation in the piping systems. The thermowells shall have 3/4-inch NPT thread mounts, a minimum pressure rating of 250 psig, and a nominal 4 inch insertion length.

F. Strainers

1. Strainers shall be provided where indicated on the Drawings. Strainer screen size shall be 20 mesh unless otherwise indicated. The blowoff from each strainer shall be equipped with a shutoff valve.

2. Strainers located in copper piping systems shall be Y-pattern type with bronze body, threaded ends, and monel or stainless-steel screens. Strainers shall be Watts “Series LF777SI”, Apollo Valves “Model YB-LF” or Wilkins “Model YBXL”.

3. Strainers located in ductile iron piping systems shall be Y-pattern type with iron body, flanged ends, and monel or stainless-steel screens. Strainers shall be Hoffman Specialty “Series 400”, or Metraflex “Model TF”.

G. Hose Faucets

1. Hose faucets shall be constructed with nickel or chrome plated cast brass body, solid brass stem, threaded bonnet, and “T” style handle. Hose faucets shall be provided with a 3/4-inch male pipe thread inlet and a 3/4-inch male hose thread outlet unless otherwise indicated on the Drawings. Hose faucets shall be Prier Brass “Model C-138NP.75”, Arrowhead Brass Products, or Zurn.

2. Where indicated on the Drawings, hose faucets shall be equipped with hose connection vacuum breakers. Hose connection vacuum breakers shall be provided with 3/4 inch hose thread ends, brass or bronze bodies, stainless steel stem, rubber seat, and rubber disc. Hose connection vacuum breakers shall be of tamper-resistant design to prevent removal, and shall comply with ASSE Standard 1011 requirements. Hose connection vacuum breakers shall be equipped with manual drain. Hose connection vacuum breakers shall be Febco “Series 731”, Watts Regulator Company “Series 8” or Wilkins “Model BFP 8”.

H. Wall Hydrants

1. Wall hydrants shall be freezeproof type with bronze body, polished bronze or chrome plated face, integral vacuum breaker, and removable handle key. Wall hydrants shall be provided with 3/4-inch pipe thread inlet and 3/4-inch male hose thread outlet. Wall hydrants shall be ASSE 1019-B approved. Wall hydrants shall be Smith "Model 5619", Zurn "Z1321-C", or Prier "Model C-634".

I. Pressure Gauges

1. Pressure gauges shall be Ashcroft "Duragauge 1279", Weksler, or Weiss Instruments, Inc.

2. Except as modified or supplemented herein, all gauges shall conform to the requirements of ANSI B40.1. Accuracy shall be ANSI Grade A or better. Gauges shall be indicating dial type with Ctype phosphor bronze Bourdon tube, stainless steel rotary geared movement, phenolic open-front turret, stainless steel or phenolic ring, case, adjustable pointer, and acrylic or shatterproof glass window.

3. The dial shall be 4 1/2 inch in diameter with black markings on a white background. The units of measurement shall be psi and shall be indicated on the dial face. The pointer shall span not less than 200 degrees nor more than 270 degrees. The range shall be selected so that the normal operating reading is near the midpoint of the scale.

4. Each gauge shall be provided with a threaded end ball-type shutoff valve as specified in the Ball Valves section.

5. All stem-mounted gauges shall be provided with 1/2-inch NPT connections.

J. Diaphragm Seals

a. Pipe-mounted diaphragm seals shall be provided where indicated on the Drawings. Diaphragm seals shall be thread-attached type with cleanout ANSI Type 316 stainless steel diaphragm, plated carbon steel upper housing, and stainless-steel lower housing. The diaphragm seal shall be of "continuous" design to safely contain the process fluid in the event of gauge failure or removal from the system under pressure. The lower housing shall be provided with a tapped 1/4-inch NPT flushing connection and an MxF stainless steel needle valve. Each gauge isolator and the gauge served shall be factory assembled, filled with a suitable fluid, and calibrated as a unit.

b. Gauge isolators shall be as manufactured by Ashcroft "Type 101", Weksler, or Weiss Instruments, Inc.

2.06 DRAINAGE AND VENT PIPING ACCESSORIES

A. Cleanouts

1. Cleanouts shall be provided where indicated on the Drawings and required by the referenced codes, and shall be of the required type.

2. Floor cleanouts shall consist of a two-piece body, a threaded plug, an adjustable head, and a cover. Cleanouts installed in floors that include a waterproofing membrane shall be provided with a flashing flange and membrane clamp. Cleanouts installed in partition walls shall be provided with an access cover and frame with a securing screw installed over the cleanout plug. Wall cleanout covers shall be stainless steel. Cleanouts installed in exposed piping shall consist of a ferrule or threaded adapter and a cast brass or bronze plug installed in a T-pattern, 90-degree drainage fitting.

3. Cast iron cleanouts shall be manufactured by Smith, Josam, or Wade. Polypropylene cleanouts shall be manufactured by Orion, Enfield, or Zurn. PVC cleanouts shall be manufactured by Sioux Chief, Plastic Oddities, or Zurn.

B. Funnel Receptors

1. Funnel receptors shall consist of cast iron funnels with cast iron dome type bottom strainers. Funnel receptors shall be provided with waterstop flange and threaded or no-hub outlet connections suitable for connection to the waste piping. Funnel receptors connected to chemical resistant waste systems shall be furnished with a factory applied chemical resistant interior coating. Unless otherwise indicated, funnel receptors shall be installed 1 inch above the finished floor.

2. Funnel receptors shall be Smith “Series 3800 Figure SQ-3-1793-DBS”, Josam, or Wade.

C. Floor Drains

1. Floor drains shall be of the types specified herein and indicated on the Drawings. Floor drains shall have a two-piece body, a flashing collar, an adjustable head, and a grate. A trap primer connection shall be provided when indicated on the Drawings. Floor drains installed in floors that include a waterproofing membrane shall be provided with a flashing flange and membrane clamp.
2. Cast iron floor drains shall be manufactured by Smith, Josam, or Wade. Polypropylene floor drains shall be manufactured by Orion, Enfield, Zurn. PVC floor drains shall be manufactured by Sioux Chief, Plastic Oddities, or Zurn.

D. Modular Trench Drain System

1. Modular trench drain systems shall be of the types specified herein and indicated on the Drawings. The modular trench drain system shall include pre-sloped channel drain sections, end caps, outlet connections, grating, and all other components and accessories required for a complete installation. Drainage channels and related components shall be constructed of corrosion resistant polymer concrete. The grating shall be suitable for extra heavy traffic. The modular trench drain system shall be manufactured by Smith ACO, ABT Polydrain, or ACO Polymer Products.

E. Vent Flashings

1. Plumbing vent flashings shall be furnished and installed as indicated on the Drawings.

2.07 PLUMBING FIXTURES AND ACCESSORIES

A. General

1. Plumbing fixtures shall be provided with all required supports, fasteners, supply and drain fittings, gaskets, and escutcheons required for a complete installation.

B. Water Closets

1. Water closets shall be of vitreous china, with an elongated bowl and siphon jet flushing action. The type and water use of water closets shall be as indicated on the Drawings. All water closets shall be provided with anchor bolt caps. Flush valve type water closets shall be provided with top spud connections for flushometer valves. Flush tank type water closets shall be provided with factory installed tank liners. Field installed liner kits will not be acceptable. Water closets shall be manufactured by American Standard, Kohler, or Eljer.

2. Seats

a. Water closet seats shall be white, solid plastic, contoured, elongated open front type without cover, with concealed check and stainless-steel hinges. The seats shall be manufactured by American Standard, Kohler, Eljer, or Church.

3. Flush Valves

a. Flush valves for top spud type water closets shall be exposed type, with a chrome plated brass body, an externally adjustable diaphragm, an angle stop, a renewable valve seat, a tailpiece, a vacuum breaker, a wall flange, a spud nut and flange, and a 1-inch NPT water supply connection. Flush valves shall be Sloan “Royal 111”, Delaney, or Zurn.

4. Supply Set

a. A supply set consisting of a 1/2-inch NPT brass angle loose key stop valve, a copper supply tube, and an escutcheon plate shall be furnished for each tank type water closet. All supply components shall be polished chrome.

5. Chair Carriers

a. Wall-mounted water closets shall be provided with adjustable chair carriers. The carriers shall be suitable for the chase depth and piping arrangement and shall consist of a heavy-duty cast iron body, complete with a drainage fitting, pylon feet, a drainage nipple, fitting and fixture gaskets, a positioning frame or template, and mounting hardware. Chair carriers shall be manufactured by Smith, Josam, or Wade.

C. Urinals

1. Urinals shall be of the type and water use as indicated on the Drawings. Urinals shall be of vitreous china, wall mounted, with an elongated rim and washout flushing

action, and shall be provided with a top spud connection for a flushometer valve. Urinals shall be manufactured by American Standard, Kohler, or Eljer.

2. Flush Valves

   a. Flush valves shall be exposed type, of chrome plated brass with an externally adjustable diaphragm, an angle stop, a renewable valve seat, a tailpiece, a vacuum breaker, a wall flange, a spud nut and flange, and a 3/4-inch NPT water supply connections. Flush valves shall supply a maximum of 1 gallon per flush, and shall be Sloan “Royal 186”, Delaney, or Zurn.

3. Supports

   a. A fixture support system, including support legs, upper and lower bearing plates, and bearing studs shall be provided for urinals mounted on all walls other than masonry. Urinals mounted on masonry walls shall be provided with suitable anchor bolts. Urinal supports shall be manufactured by Smith, Josam, or Wade.

D. Lavatories

1. Lavatory types, dimensions, and water use shall be as indicated on the Drawings. Lavatories shall be of vitreous china, constructed with overflow drains and soap depressions. Countertop lavatories shall be self-rimming, and shall be provided with suitable adhesive and/or fastening clamps. Wall-mounted lavatories shall be drilled for a concealed arm carrier. Faucet drillings shall be 4 inches on center unless otherwise indicated. Lavatories shall be manufactured by American Standard, Kohler, or Eljer.

2. Faucets and Trim

   a. Lavatory faucets shall be 4 inches on center, of polished chrome, with a vandal-resistant single-lever handle and all-brass or copper waterways. Each faucet shall be provided with a flow restrictor, a cast brass grid strainer or pop-up drain as indicated on the Drawings, and a 1 1/4-inch cast brass tailpiece. Flow restrictors shall limit water flow as required by the applicable codes and standards. Supply sets consisting of 1/2-inch NPT brass angle loose key stop valves, copper supply tubes, and escutcheon plates shall be furnished for each lavatory faucet. All supply components shall be polished chrome. Where indicated to be ADA compliant and exposed to human contact, lavatory supplies shall be insulated. Lavatory faucets and supply sets shall be manufactured by American Standard, Kohler, or Eljer.

3. Traps

   a. Lavatory traps shall be at least 1 1/4 inch in diameter, cast brass with polished chrome finish, with an escutcheon flange and a cleanout plug. Where indicated to be ADA compliant and if exposed to human contact, lavatory traps shall be offset, insulated type.

   b. When insulation is needed, lavatory supplies and traps may be pre-insulated or furnished with an insulation kit for field installation. Insulating material shall be

flame retardant closed cell vinyl. The supply insulating kit shall be snap form type or shall be provided with ties. The trap insulation material shall not require the use of ties or mechanical fasteners to be held in place. Pre-insulated traps and supply insulation kits shall be McGuire Products “ProWrap”. Trap and supply insulation kits shall be as manufactured by IPS Corporation-Truebro, Plumberex, or Buckaroos, Inc.

4. Supports

   a. Wall-hung lavatories shall be provided with a complete fixture support system, including support legs, bearing plates, concealed arms, and anchor bolts. The support legs shall be mounted within the partition wall. For lavatories mounted on masonry walls, support legs may be omitted. Lavatory supports shall be manufactured by Smith, Josam, or Wade.

E. Showers

1. Shower type, dimensions, and water use shall be as indicated on the Drawings.

2. Built-up Shower Stalls:

   a. Each built-up shower stall shall be provided with a pressure-balanced single lever mixing valve, a shower head, an arm, and a flange. The shower valve shall include integral service stops and an adjustable stop screw. The shower head shall be of adjustable spray pattern type, with volume control, a swivel ball joint, and an integral flow control device. ADA compliant units shall include a hand-held shower head with swivel fitting, a 69-inch stainless steel flexible hose, a support rod, and an in-line vacuum breaker. All exposed components shall be polished chrome.

F. Stainless Steel Sinks

1. Sink types, dimensions, hole punching, metal gage, and water use shall be as indicated on the Drawings.

2. Stainless steel sinks shall be seamless Type 304 stainless steel, with smooth radius interior corners. All exposed surfaces of sinks shall be machine polished to a bright finish and the underside shall be fully undercoated. Countertop mounted sinks shall be self-rimming with compartment and faucet deck recessed below the outer edge of the sink. Wall mounted sinks shall have integral stainless steel support brackets and shall be furnished with a wall hanger. Sinks shall be provided with mounting clips, support legs, and all other hardware as indicated in the schedules. Stainless steel sinks shall be manufactured by Elkay, Just, or Advance Tabco.

3. Faucets:

   a. Sink faucets shall be polished chrome, with a vandal-resistant single-lever handle. All waterways shall be constructed of brass or copper. Faucets shall be provided with a brass spout, an aerator, and a flow restrictor. Supply sets consisting of 1/2 inch NPT brass angle loose key stop valves, copper supply tubes, and escutcheon plates shall be provided. All supply components shall be

polished chrome. Sink faucets and supply sets shall be manufactured by American Standard, Kohler, or Eljer.

4. Drain Assembly

a. All required drainage accessories, including strainers, tailpieces, and traps, shall be provided. Basket strainers shall be heavy gage stainless steel, with a removable conical strainer plate and a neoprene stopper. Tailpieces shall be chrome-plated brass. Sink traps shall be at least 1 1/2 inches in diameter, cast brass, with polished chrome finish, an escutcheon flange, and a cleanout plug.

G. Janitors Sinks

1. Janitors sink types, dimensions, manufacturers, and models shall be as indicated on the Drawings.

2. Mop sinks shall be floor mounted and constructed of pearl-gray terrazzo. Mop sinks shall be provided with an integral 20 gage thick stainless steel threshold cap, a 6-inch drop at threshold, and a shoulder at least 11/4 inches wide. A 3-inch cast brass drain and stainless-steel strainer, and where indicated, a 20-gage thick stainless steel splash panel shall be provided for each sink. Mop sinks shall be manufactured by Stern-Williams, Fiat, or Florestone Products Company, Inc.

3. Service sinks shall be wall mounted, and shall consist of a 10 -inch-deep cast iron bowl coated with acid resistant enamel, a stainless-steel rim guard, a plain or drilled back as indicated on the Drawings, and a heavy gage metal wall bracket. Service sinks shall be manufactured by American Standard, Kohler, or Eljer.

4. Faucets

a. Sink faucets shall be rough plated brass, with lever handles, a threaded spout, a vacuum breaker, a wall brace, and a pail hook. The distance from the wall to the center of the spout outlet shall measure approximately 7 1/2 inches. Sink faucets shall be as manufactured by American Standard, Kohler, or Eljer.

5. Drain Assembly

a. Mop sinks shall be provided with a 3-inch cast brass drain and a stainless-steel strainer. Service sinks shall be provided with a 3-inch cast iron P-type trap standard, with a stainless-steel strainer, a cleanout plug, and a threaded outlet.

H. Emergency Fixtures

1. Emergency fixtures, including showers, eye/face washes, and combination shower/eye/face wash units shall be furnished and installed as indicated on the Drawings. Emergency fixtures shall be manufactured by Haws, Guardian, or Encon.

2. Indoor Emergency Eyewash Fixtures

a. Indoor emergency eyewash fixtures shall be pedestal mounted or wall mounted as indicated on the Drawings. Eyewash fixtures shall be provided with a

stainless-steel receptor, ABS plastic heads, a stay-open ball valve, a push plate actuator, and a universal emergency sign. Wall mounted units shall also be provided with a wall bracket and a chrome plated trap. All necessary accessories required for a complete installation shall be provided.

3. Indoor Emergency Shower Fixtures

    a. Indoor ceiling-mounted emergency shower fixtures shall be suitable for vertical supply pipe and flush ceiling mounting, with a pipe support bracket, a chrome plated brass shower head, a stay-open ball valve, a stainless-steel pull-rod actuator, and a universal emergency sign. The ball valve shall be located above the ceiling. All necessary piping, support brackets, escutcheons, and accessories required for a complete installation shall be provided.

4. Indoor Combination Units

    a. Combination emergency shower/eye/face wash fixtures shall be pedestal mounted, with a stanchion, a floor flange, a deluge shower, an aerated eye/face wash, an eye/face wash dust cover, stay-open ball valves, interconnecting piping, and a universal emergency sign. The shower shall be stainless steel or ABS plastic with a stainless-steel pull rod actuator. The eye/face wash receptor shall be stainless steel with push plate and foot pedal actuators.

5. Corrosion Resistant Combination Units

    a. Corrosion resistant combination emergency shower/eye/face wash fixtures shall be pedestal mounted, with 2 1/2-inch schedule 80 PVC stanchion, floor flange, deluge shower, aerated eye/face wash, eye/face wash dust cover, stay-open stainless steel ball valves, interconnecting piping, and universal emergency sign. The shower shall be stainless steel or ABS plastic with stainless steel pull rod actuator. The eye/face wash receptor shall be stainless steel or plastic with push plate actuator.

6. Alarm Systems

    a. An audible and visual alarm system shall be provided when indicated on the Drawings. The alarm system shall activate based on water flow when either the emergency shower or eyewash fixture is operated. The alarm system shall provide local, remote, or local and remote alarm indication as indicated on the Drawings. The water flow switch shall be provided with double-pole double-throw contacts rated 5 amperes at 125 volts, suitable for remote alarm annunciation. The audible alarm shall provide an intermittent signal rated at 90 dB at 10 feet. The alarm light shall be amber, flashing type. The alarm system shall be pre-wired and shall be furnished with all necessary junction boxes, conduit, wire, and accessories for a complete installation. The alarm system shall be suitable for a 120-volt power supply.

7. Tempered Water Blending Valves

    a. Tempered water blending valves shall be designed specifically for providing tempered water to emergency shower and eyewash fixtures. Each valve shall

contain thermostatic elements, integral cold-water bypass, and positive hot water shutoff to prevent scalding. Blending valves shall have bronze or brass bodies with threaded inlet and outlet connections and shall be provided with isolation check valves on the hot and cold supplies to the unit. Each unit shall include hot, cold, and blended water temperature gauges and shall be factory set for a blended water temperature of 70°F.

b. Tempered water blending valves serving eyewash fixtures, a single shower, or a single combination unit shall be suitable for a flow range of 3 to 25 gallons per minute and shall be Haws “Model 9201”, Guardian “G3700”, or Lawler “Model 911E. Tempered water blending valves serving multiple showers or multiple combination units shall be suitable for a flow range of 3 to 60 gallons per minute and shall be Haws “Model 9202”, Guardian “G3900” or Lawler “Model 911”.

I. Electric Water Coolers

1. Electric water cooler type, capacity, manufacturer, and model shall be as indicated on the Drawings. Water coolers shall be wall mounted, mechanically refrigerated type, and shall deliver 50°F water at the specified rate, based on 80° F inlet water temperature and a room temperature of 90° F . The water coolers shall consist of a heavy gage steel cabinet, an insulated cooling tank, a stainless-steel receptor, copper water lines, a water pressure regulating valve, an adjustable thermostat, bottle filling station with built in filter and a 3wire power cord with a polarized plug. The refrigeration unit shall consist of a hermetically sealed spring mounted compressor and an air-cooled condenser. Electric water coolers shall be suitable for a 120-volt, 60 Hz, single phase power supply, shall be UL and ARI listed, and shall be manufactured by Elkay, Oasis, or Halsey Taylor.

2.08 PLUMBING EQUIPMENT

A. General

1. Plumbing equipment shall be provided with all supports, fasteners, fittings, and escutcheons required for a complete installation.

B. Water Heaters and Accessories

1. Water heaters shall be furnished and installed where indicated on the Drawings. Heater type, storage capacity, recovery rate, energy input, power supply requirements, manufacturer, and model shall be as indicated on the Drawings.

2. Commercial Grade Electric Storage Water Heaters

a. Electric storage water heaters shall be commercial type, with a glass-lined tank and one or more heating elements. The heater shall be provided with a cold-water inlet tube (top inlet), a magnesium anode, polyurethane foam insulation, a drain valve, and adjustable thermostats. Heating elements shall be sheathed immersion type, low or medium watt density, and shall be field replaceable. Heater tanks shall be ASME stamped for a working pressure of at least 125 psig . Each heater shall be equipped with an ASME rated pressure-temperature relief

valve of suitable capacity. Heaters shall be UL and NSF listed, and shall meet ASHRAE Standard 90.1 for energy efficiency. The water heaters shall be manufactured by State Industries Inc., A. O. Smith, or Lockinvar.

3. Circulating Pump

   a. A circulating pump shall be furnished and installed where indicated on the Drawings. Pump capacity, power requirements, manufacturer, and model shall be as indicated on the Drawings.

   b. The circulating pump shall be an in-line unit with a bronze body, bronze fitted, mechanical seals, a stainless steel or ceramic shaft, and at least 1/2-inch NPT connections. The circulating pump shall be controlled by a 7day time clock provided with the pump. Initial time clock setting shall energize the pump at 6:00 am and de-energize the pump at 6:00 pm each day. The time clock shall be suitable for a 120-volt single phase power supply, and shall have contacts rated for 10 amperes ac. The circulating pump shall be manufactured by Bell & Gossett, Thrush, or Taco.

C. Neutralization Tanks

1. Neutralization tank volume, connection sizes, manufacturer, and model shall be as indicated on the Drawings.

2. Neutralization tanks shall be of heavy-duty construction, rotomolded in one piece from polyethylene resins. Inlet, outlet, and vent fittings molded from the same resins as the tank shall be triple welded to the tank body at the locations indicated on the Drawings. A full diameter extension constructed of the same material as the tank shall be provided where required to raise the access cover to at or just below the floor level as indicated on the Drawings. When indicated on the Drawings, the tank shall be provided with a minimum 17-inch bolted manway cover. The cover shall be provided with a 6-inch cleanout plug and stainless-steel fasteners. The tank shall be filled with hard limestone or marble chunks, 2 to 3 inches in diameter to the level recommended by the manufacturer. Neutralization tanks shall be manufactured by Enfield, Orion, or Town & Country Plastic, Inc.

D. Hose Reels

1. Hose reel type, capacity, manufacturer, and model shall be as indicated on the Drawings.

2. Each hose reel shall be provided complete with a hose storage drum, a handle crank winding mechanism, a spring-actuated pin lock, and a heavy-duty frame suitable for anchoring to concrete or masonry wall or floor supports. Unless indicated on the Drawings to be stainless steel, hose reels shall be carbon steel with a baked epoxy enamel finish. When indicated on the Drawings, hose reels shall be provided with a water supply swivel joint rated at 600 psig. The hose storage drum shall be provided with a brass male hose adapter suitable for use with the specified hose. The hose reels shall be manufactured by Hannay, Potter-Roemer, or Reelcraft.

E. Interceptors

1. Interceptor type, capacities, connections, manufacturer, and model shall be as indicated on the Drawings.

2. Multi-Stage Basin Oil Interceptor:

a. Multi-stage basin oil interceptors shall be suitable for removing oil, floating solids, and sediment. The interceptor shall be designed to minimize turbulence and shall prevent trapped contaminants from being resuspended and discharged from the interceptor. The interceptor shall consist of a basin or basins with the number of stages as indicated on the Drawings. HDPE rotational molded oil / sediment interceptor with liquid holding capacity of indicate in schedule. Unit shall include: 3/8" uniform wall thickness, deep seal trap covered by H-20 traffic rated solid ductile iron covers,
sediment bucket (3/8" Dia. holes, 1/2" apart) within adjustable top assembly system, internal air relief by-pass and sample port access. The interceptor shall be as manufactured by MIFAB, Zurn.

b. The basin and baffles shall be constructed of fiberglass reinforced plastic at least 3/8 inch thick. The interceptor shall be provided with tie down lugs, inlet and outlet connections, cleanout, sample port, vent ports for each stage, access extension collar and frame, and access cover. Interior piping shall be schedule 40 PVC. The access extension collar shall raise the access cover to the floor level. The extension shall be provided with a gasketed vapor tight cast iron access cover with lifting rings. The cover shall be at least 24 inches in diameter and shall be suitable for a live load of at least 150 psf.

F. Expansion Tanks

1. Expansion tank capacities, connections, manufacturer, and model shall be as indicated on the Drawings.

2. Expansion tanks shall be welded steel diaphragm type, ASME tested and stamped for a working pressure of 125 psig , with a flexible diaphragm and a charging valve. Floor-mounted tanks shall be provided with a suitable mounting base. The tanks shall be suitable for use with potable water and shall be factory pre-charged to the indicated pressure. Expansion tanks shall be manufactured by Amtrol, State Industries Inc., or Watts.

2.09 COLOR

A. Vitreous china, cast iron, enameled steel, and composite plumbing fixtures shall be white unless otherwise indicated. Other plumbing fixtures shall be the manufacturers standard color. Plumbing equipment shall have the manufacturer's standard color and finish unless otherwise indicated in the schedules.

2.010 ELECTRICAL

A. Electrical controls and disconnects shall be furnished and installed under the Division 16 - Electrical sections, except where specified herein. All electrical controls shall have enclosures suitable for the environment and NEMA rating as indicated on the electrical Drawings.

PART 3 EXECUTION

3.01 INSPECTION

A. Equipment installed in existing facilities with limited access shall be suitable for being installed through available openings. Contractor shall field verify existing opening dimensions and other provisions for installation prior to submittal of bids.

3.02 PREPARATION

A. Surface Preparation

1. All surfaces to be field painted shall be dry and free of dirt, dust, sand, grit mud, oil, grease, rust, loose mill scale, or other objectionable substances, and shall meet the recommendations of the paint manufacturer for surface preparation. Cleaning and painting operations shall be performed in a manner which will prevent dust or other contaminants from getting on freshly painted surfaces. Oil and grease shall be completely removed by use of solvents or detergents before mechanical cleaning is started. The gloss of previously painted surfaces shall be dulled if necessary for proper adhesion of topcoats.

3.03 INSTALLATION

A. Materials furnished under this section shall be installed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

B. Unless otherwise indicated, sleeves shall be provided for all pipe penetrations through concrete and masonry walls. Sleeves and sealing requirements shall be as indicated in the Miscellaneous Piping and Accessories Installation section and as indicated on the Drawings.

C. Not all required reducing fittings and unions are indicated. Additional fittings and unions shall be provided as needed to connect all equipment and appurtenances.

D. Insulating fittings shall be provided to prevent the contact of dissimilar metals in piping systems.

E. When located indoors, fuel gas pressure regulator vents and fuel train vent valves shall be piped to the exterior of the building in accordance with the applicable codes and standards.

F. Piping shall not be routed over or in front of electrical switchboards or panels unless acceptable to Engineer.

G. Water Supply Piping and Accessories:

1. Water hammer arresters shall be provided in the hot and cold-water supply piping at all quick closing valves, at solenoid valves, and at plumbing fixtures. When not indicated on the Drawings, arresters shall be located and sized by Contractor in accordance with PDI Standard No. WH201. Contractor shall submit arrester location and sizing plans to Engineer for approval prior to installation. Where possible, water hammer arresters shall be installed in an accessible location.

2. Water supply piping to hose faucets and hose valves shall be secured with a pipe support within 6 inches of the fixture.

3. Scald protection valves shall be installed per manufacturer's recommendation, adjacent to the actuation valve for each emergency shower and the eye/face wash where indicated in the schedules. Drain piping from valves shall be secured to adjacent unit support and routed to nearest funnel receptor and discharge with an air gap.

H. Drainage and Vent Piping and Accessories

1. Unless otherwise indicated or required by code, horizontal sanitary drainage piping 3 inches in diameter or smaller shall be installed at a uniform slope of 1/4 inch per foot ; horizontal sanitary drainage piping larger than 3 inches in diameter shall be installed at a uniform slope of 1/8 inch per foot ; horizontal storm drainage piping shall be installed at a uniform slope of 1/8 inch per foot .

2. All cast iron drainage piping which is buried beneath floors shall be encased in at least 6 inches of concrete. A joint shall be provided in the piping within 12 inches of each end of the encasement. For buildings supported by piers or piles, the concrete encasement shall be reinforced and connected to the floor slab.

3. Plastic drainage pipe buried beneath floors shall not be encased. For buildings supported by piers or piles plastic drainage piping which is buried beneath floors shall be supported with stainless steel pipe supports per ASTM F2536.

4. Drainage fittings shall be installed to convey flow in the piping in the intended direction. To the extent possible, changes in direction shall be made by sweep type fittings. Quarter-bends and sanitary tee fittings shall not be installed for vertical to horizontal or horizontal to horizontal changes of direction.

5. Plumbing vents through roofs shall be located at least 12 inches from a parapet or from the intersection of a cant with the roof deck, and shall be installed with watertight flashings. Plumbing vents shall be located no closer to operable windows or air intakes than is allowed by the applicable code.

6. Vents connecting to horizontal sanitary piping shall connect above the centerline of the piping and shall rise at an angle of not less than 45 degrees from the horizontal to a point at least 6 inches above the flood level rim of the fixture served before offsetting horizontally.

7. Floor drains shall be adjusted to the correct elevation for proper drainage. Heads of fastening screws shall be flush with the grate surface.

8. Cleanouts on drainage piping inside structures shall be located where indicated on the Drawings. Additional cleanouts shall be provided where required by the applicable code or authority having jurisdiction. Cleanouts located in drainage risers shall be located 12 inches above the finished floor.
9. Unless otherwise indicated or required by the applicable code, cleanout size shall equal the line size for 4 inch and smaller drainage piping, and 4 inch in diameter for drains larger than 4 inch . Proper clearance shall be provided for access to cleanouts. Floor cleanouts shall be installed flush with the finished floor.

10. Floor drains, trench drains, floor sinks, funnel receptors, and bell-up drains indicated to be equipped with traps shall be provided with deep seal “P” traps located as close to the drain as possible.

I. Plumbing Fixtures and Accessories

1. Plumbing fixtures shall be set level and plumb, and shall be securely attached to the floor or wall. Unless otherwise indicated on the Drawings, each fixture shall be mounted at the height recommended by the manufacturer. Where required to be in compliance with ADA, fixtures shall be mounted at the heights established by the Federal Government.

2. Fixtures shall be sealed to the floor or wall with a sealant as specified in the Joint Sealants section. The color of sealant shall match the color of the fixture.

3. Fixture traps shall be easily removable for servicing and cleaning. Escutcheons shall be placed at all locations where fixture supply or drain piping penetrates walls, floors, or ceilings.

4. Water piping at stop valves, shower heads, and flush valves shall be rigidly secured to blocking. Drop-ear elbows shall be used whenever possible. All water supply piping shall be cleaned and flushed before the plumbing fixtures are installed.

5. Shutoff valves located in the tempered water (TW) supply piping to safety fixtures and shutoff valves in the potable water branch piping to the TW system shall be provided with tags bearing the legend “WARNING: DO NOT CLOSE VALVE WITHOUT AUTHORIZATION”. The tags shall have an orange background and black lettering not less than 1/2 inch in height. Other features of the tags shall be as indicated in the Mechanical Identification paragraph.

J. Plumbing Equipment

1. Plumbing equipment shall be installed in accordance with the manufacturer’s recommendations. Adequate clearance shall be provided for access to all components which may require adjustment, servicing, or replacement.

2. Water heaters shall be installed in accordance with AGA, NSF, NFPA, and UL requirements. Storage type water heaters shall be cleaned and flushed before being connected to the potable water system. Water heater relief valves shall be piped to

the nearest drain or as indicated on the Drawings, and shall terminate the appropriate air gap distance above the drain. Unless otherwise indicated, water heater thermostats shall be set such that the maximum water temperature does not exceed 140° F.

3.04 FIELD QUALITY CONTROL

A. Installation Check

1. An installation check by an authorized representative of the manufacturer of equipment specified herein is not required.

2. The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

3. All costs for these services shall be included in the Contract Price.

B. Startup and Testing

1. Field performance tests shall be conducted to demonstrate that each system is functioning as specified and to the satisfaction of Engineer.

2. If inspection or tests indicate defects, the defective work or material shall be replaced, and inspection and tests repeated. All repairs to piping shall be made with new materials. Caulking of threaded joints or holes will not be acceptable.

3.05 ADJUSTING

A. All devices shall be adjusted for proper flow and quiet operation. Faucet and supply assemblies shall be adjusted or repaired to eliminate leaks. All drains shall be checked for proper operation.

3.06 PROTECTION

A. Plumbing fixtures, equipment and appurtenances shall be protected from damage immediately after installation.

3.07 CLEANING

A. After completion of testing and immediately before the final inspection, plumbing fixtures, equipment, piping, and appurtenances shall be thoroughly cleaned. Cleaning materials and methods shall be as recommended by the manufacturer. All faucet aerators shall be removed, cleaned, and reinserted.

B. Any stoppage, discoloration, or other damage to parts of the building, its finish, or furnishings shall be repaired at no additional cost to Owner.

3.08 DISINFECTION

A. Before the potable water system is placed in operation, it shall be disinfected in accordance with the requirements of the local authority having jurisdiction. In the absence of local requirements, the following disinfection method shall be used:

1. The system shall be purged with clean potable water until all dirt and other substances are flushed from the system.

2. The system shall be filled with a water/chlorine solution containing at least 50 parts per million [50 mg/L] of available chlorine and allowed to stand for 24 hours; or the system shall be filled with a water/chlorine solution containing at least 200 parts per million [200 mg/L] of available chlorine and allowed to stand for 3 hours.

3. The system shall be purged with clean potable water until the chlorine is flushed from the system.

4. The procedure shall be repeated if a bacterial examination indicates that contamination remains present in the system.

3.09 OPERATOR INSTRUCTION AND TRAINING

A. After completion of the field testing, operator instruction and training on equipment and system operation shall be provided for industrial grade water heaters (4 hours). The training should provide a complete overview of all equipment, testing, adjusting, operation, and maintenance procedures. The training shall take the form of classroom instruction and shall cover:

1. Documentation in the final Operation and Maintenance Manuals
2. Use the Operation and Maintenance Manuals
3. Equipment and system startup and shutdown
4. System operation procedures for all modes of operation
5. Procedures for dealing with abnormal conditions and emergency situations for which there is a specified system response

B. The training shall take the form of classroom sessions at the project site conducted by the equipment manufacturer representatives who are knowledgeable and familiar with the project. Hands-on instruction and training will be conducted so that actual operation and maintenance of the equipment and systems can be performed by Owner upon completion of the training. The length of the operator instruction and training shall be.

C. At least two weeks prior to the proposed date for the operator instruction and training session, Contractor shall notify Engineer and shall submit an outline for the proposed operator instruction and training session. The proposed outline shall be approved before any training is conducted.

D. Training shall be in accordance with the demonstration and training specification.

END OF SECTION

SECTION 15500

HEATING, VENTILATING, AND AIR CONDITIONING

PART 1 GENERAL

1.01 SCOPE

A. This section covers the furnishing and installation of heating, ventilating, and air conditioning (HVAC) equipment, devices, and appurtenances associated with the HVAC systems.

B. Piping, pipe supports, valves, and accessories which are not an integral part of the equipment or are not specified herein are covered in other sections.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 GENERAL

A. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by Engineer.

B. Coordination

1. Contractor shall verify that each component of the system is compatible with all other parts of the system; that all piping, ductwork, materials, fans, and motor sizes are appropriate; and that all devices necessary for a properly functioning system have been provided.

2. Where two or more units of the same class of equipment are needed, they shall be the product of a single manufacturer; however, all the component parts of the system need not be the products of one manufacturer.

3. Where individual equipment paragraphs specify the requirement for local service, each manufacturer shall have a local service center, or with written consent of Engineer, shall be able to provide service from other locations within 24 hours. The service center shall be equipped and staffed to service the system and shall maintain a local parts supply. Information on equipment manufacturers' representatives shall be included with the submittals.

4. Where several manufacturers' names have been listed in this section as possible suppliers, only the products of the first manufacturer listed have been checked for size, functions, and features.

C. General Equipment Stipulations

1. The General Equipment Stipulations shall apply to all equipment and materials furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

D. Governing Standards

1. Except as modified or supplemented herein, all work covered by this section shall be performed in accordance with all applicable municipal codes and ordinances, laws, and regulations. In case of a conflict between this section and any state law or local ordinance, the latter shall govern.

2. All work shall comply with UL safety requirements.

E. Power Supply

1. Power supply to equipment with motors shall be as indicated in schedules on the Drawings. Power supply for controls shall be 120-volt, 60 Hz, single phase unless otherwise required for a properly operating system.

F. Metal Thickness

1. Metal thickness and gages specified herein are minimum requirements. Gages refer to US Standard gage.

G. Mechanical Identification

1. Mechanical identification shall conform to the requirements of the Basic Mechanical Building Systems Materials and Methods section.

1.04 SUBMITTALS

A. Drawings and Data

1. Complete assembly and installation drawings, and wiring and schematic diagrams, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the Submittals Procedures section. Device tag numbers indicated

on the Drawings shall be referenced on the wiring and schematic diagrams where applicable. The data and specifications for each unit shall include, but shall not be limited to, the following:

a. Makeup Air Units

1) Name of manufacturer

2) Type and model

3) Construction materials, thickness, and finishes

4) Input and output heating capacities

5) Filter velocities

6) Overall dimensions and required clearances

7) Net weight and load distribution

8) Performance curves with the specified operating point clearly identified for each unit, type, and model, with capacity in cubic feet per minute as the abscissa and brake horsepower, static pressure, and efficiency as the ordinate. The fan curves shall include a family of curves for at least 5 different rotative speeds on a single chart

9) Certified AMCA standard test code sound power output data for the fan outlet and casing when operating at the specified volume flow rate. Sound data shall list dB re 10-12 watts in each octave band, with midrange frequencies starting at 63 Hz and ending at 8,000 Hz

10) Multiline wiring diagrams clearly indicating factory installed and field installed wiring with all terminals identified

11) Electrical requirements including voltage, number of phases, and amperage

12) Where specified, information on equipment manufacturers' representatives

b. Fans

1) Name of manufacturer

2) Type and model

3) Construction materials, thickness, and finishes

4) Overall dimensions and required clearances

5) Net weight and load distribution

6) Performance curves with the specified operating point clearly identified for each unit, type, and model, with capacity in cubic feet per minute as the abscissa and brake horsepower, static pressure, and efficiency as the ordinate. The fan curves shall include a family of curves for at least 3 different rotative speeds on a single chart

7) Certified AMCA standard test code sound power output data for the fan outlet and casing when operating at the specified volume flow rate. Sound data shall list dB re 10-12 watts in each octave band, with midrange frequencies starting at 63 Hz and ending at 8,000 Hz

8) Where specified, information on equipment manufacturers' representatives

c. Equipment (not specifically listed)

1) Name of manufacturer
2) Type and model
3) Construction materials, thickness, and finishes
4) Manufacturer's performance data
5) Overall dimensions and required clearances
6) Net weight and load distribution
7) Wiring diagrams

d. Sheet Metal Ductwork

1) Sheet metal duct fabrication drawings indicating dimensions of individual shop and field fabricated sections, top and/or bottom duct elevations, joint locations, and dimensions of duct from walls or column rows

2) Pressure and seal classifications

3) Reinforcement types and spacing

4) Joint and seam types

5) Hanger and support types, spacing, and attachment methods

6) Access panel and door construction, sizes, and locations

7) Duct sealant, adhesive, gasket, and tape information

8) Coatings

9) Ductwork materials and thicknesses

10) Product data demonstrating compliance with ASHRAE 62.1

e. Temperature Controls

1) Published descriptive data on each item of equipment and accessories, indicating all specific characteristics and options and identified with the designation used herein and on the Drawings.

2) Schematic control diagrams giving specific data on all settings, ranges, actions, adjustments, and normal positions. Although schematic, these diagrams shall, as closely as possible, represent the actual system with all significant equipment and devices identified and located relative to each other. These diagrams shall also show detailed multiline wiring with all terminals accurately identified. The wiring diagrams shall show the internal connections of the temperature control panels and all field wiring to equipment remote from the control panels, including wiring to Owner-furnished equipment. The wiring diagrams shall be complete, showing all connections necessary to place the temperature control systems in operation. Wiring diagrams shall be detailed to the degree necessary for field construction and shall include all related wiring.

3) Sequence of operation for each system corresponding to the control schematics.

4) Detailed panel construction drawings, including description of all materials and finishes, complete internal wiring and piping schematics, panel face layout, and complete data on all mounted components.

5) Space thermostat schedule indicating the types of covers and means of adjustment for each space.

6) Conduit and wire types.

7) Where specified, information on equipment manufacturers' representatives.

B. Operation and Maintenance Data and Manuals

1. Adequate operation and maintenance information shall be supplied as required in the Submittals Procedures section. Operation and maintenance manuals shall be submitted in accordance with the Submittals Procedures section. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

2. In addition to the requirements of the Submittals Procedures section, the operation and maintenance manuals shall include a listing of all filter locations, types, sizes, and quantities associated with each piece of equipment.

1.05 QUALITY ASSURANCE

A. Quality assurance shall comply with the requirements of the Basic Mechanical Building Systems Materials and Methods section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and Storage shall be in accordance with the Product Storage and Handling Requirements section.

1.07 EXTRA MATERIALS

A. Extra materials shall be furnished for the equipment as specified in the individual equipment paragraphs.

B. Extra materials shall be packaged in accordance with the Product Delivery Requirements section, with labels indicating the contents of each package. Each label shall indicate manufacturer's name, equipment name, equipment designation, part nomenclature, part number, address of nearest distributor, and current list price. Extra materials shall be delivered to Owner as directed.

C. Extra materials subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping.

PART 2 PRODUCTS

2.01 SERVICE CONDITIONS

A. All equipment shall be designed and selected to meet the specified conditions.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

A. Equipment and coil capacities shall be as indicated on the schedules. Where equipment is provided with special coatings, unit capacities shall be corrected to account for any efficiency losses from the selected special coating.

B. Each fan's operating selection point on the fan curves shall be selected to the right of the peak pressure/efficiency point and below the lowest point along the fan curve to the left of the peak pressure/efficiency point.

C. Dimensional Restrictions

1. Layout dimensions will vary between manufacturers and the layout area indicated on the Drawings is based on typical values of the first manufacturer listed. Contractor shall review the contract Drawings, the manufacturer's layout drawings, and installation requirements and shall make any modifications required for proper installation subject to acceptance by Engineer. At least 3 feet of clear access space shall be provided on all sides of the unit unless otherwise indicated.

D. Elevation

1. Equipment shall be designed to operate at the elevation indicated in the Meteorological and Seismic Design Criteria section. All equipment furnished for

sites above 2000 feet above sea level shall be properly derated to operate and meet the specified capacities at the site conditions.

2.03 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers shall be as listed in the respective product description paragraphs.

2.04 MATERIALS

A. Makeup Air Units

1. Makeup air units, denoted by the symbol “MAU” and an identifying number, shall be 100 percent outside air, constant volume type, and shall be completely assembled, wired, and tested at the factory. Electric units shall be Engineered Air “LMK”, Greenheck “Model MSX” or Hastings HVAC, Inc. “SBE”.

2. Where indicated in the schedules on the Drawings, makeup air units including sensor and control elements shall be given a special coating resistant to the corrosive atmosphere indicated.

3. Where indicated in the schedules on the Drawings, makeup air units that are specified for multiple airflow rates shall be provided with a factory fitted VFD.

4. The manufacturer of the equipment provided shall have a local service center.

5. Extra Materials:

Extra Materials	**Quantity**
Sets of matched belts per unit	1
Sets of air filters per unit	2

6. Construction

a. The casing of the makeup air unit shall be of sectionalized construction consisting of a fan section, heating section, filter section, and, when located outdoors, an inlet hood. Where indicated in the schedules on the Drawings, a louvered inlet is acceptable as alternate to hood. The unit housing shall be constructed of heavy gage galvanized paint grip carbon steel or aluminized steel, braced and reinforced with steel framework as needed for the operating pressures. The cabinet and casing shall be provided with protective coatings as follows, use two coats of corrosion resistant epoxy for all interior components. Use one coat corrosion resistant epoxy and one coat corrosion resistant polyurethane on exterior components. Controls panels, wiring connections and other sensitive electronics shall be provided with Heresite, E-coat, microguard, or equal. Hinged and gasketed doors with lever type handles shall be furnished to provide access to all internal components.

b. The fan, heating, and accessory sections shall be internally insulated with 1 inch thick, 11/2 pound per cubic foot density mat-faced cleanable fiberglass insulation

securely fastened to the panels. When available, the heating section shall be internally insulated with 1 inch thick, 11/2 pound per cubic foot density foil-faced fiberglass insulation. Where the insulation is not installed below the floor, the insulation shall be protected by a metal liner. Surfaces in contact with the airstream shall comply with the requirements of ASHRAE 62.1. The insulation shall meet the requirements of NFPA.

c. Makeup air units installed outdoors shall be of weatherproof construction, with roof panels overlapping the side panels on all sides. Seams in roof panels shall be constructed of triple-break seams or roof panels pitched for drainage. All exterior joints shall be factory sealed weather tight.

d. Makeup air units installed outdoors shall have a stormproof weather hood with bird screen sized for 100 percent outside air mounted on the unit inlet. Units having louvered inlet shall also have a bird screen or aluminum mesh filter on them. The hood shall include a two-position motorized control damper which opens when the unit is energized and closes when it is de-energized unless a discharge damper is indicated in the schedules on the Drawings. Where a discharge damper is indicated, only the inlet hood shall be provided.

7. Fan Section

a. The makeup air units shall be equipped with centrifugal fans with backward inclined blades which shall be dynamically balanced and tested after being installed in the factory assembled fan section. Fan construction shall be welded aluminum. Fan wheel and housing shall be provided with an epoxy coating. Bearings shall be heavy-duty, self-aligning, grease lubricated type for units with wheel diameters greater than 18 inches and permanently lubricated or grease lubricated for units with wheel diameters 18 inches and smaller.

b. Static pressure values indicated in the schedules are external to the complete unit. The heating section, filter, and housing losses are not included. An allowance of 0.35-inch water column shall be used for filter losses.

8. Motor and Drive

a. Units located outdoors shall have internally mounted motors. Units located indoors shall have fan motors mounted either in or on the fan housing. Internally mounted motors shall be installed on a steel base mounted on internal vibration isolators and coated with the manufacturer’s standard protective coating. Where unit is installed in a seismic area, seismic restraints shall be provided. Externally mounted motors shall be installed on integral casing framework on the exterior of the casing. Units with externally mounted motors shall be furnished with vibration isolator units as indicated in the schedules on the Drawings. External belts and drive assemblies shall be protected by a belt guard with tachometer opening.

b. Fan drive motors shall be as specified in the electrical paragraph.

c. Makeup air units with smaller than 10 horsepower motors shall have Vbelt driven fans with adjustable pitch sheaves and units with 10 horsepower and larger

motors shall have fans with fixed sheaves. Adjustable sheaves shall be selected so that the fan speed at the specified conditions is selected at the mid-position of the sheave range. Fixed sheaves shall be replaced as necessary with sheaves of the proper size during the air system balancing to provide the required fan speed for the specified airflow. Multiple belts shall be provided in matched sets.

9. Heating Section

   a. Each unit shall be designed for use with electric coils.

10. Electric Coil Section

   a. Heating coils shall be finned tube, zero clearance type, with 80 percent nickel and 20 percent chromium resistance elements.

   b. Elements for finned tubular coils shall be centered in stainless steel tubes filled with compacted magnesium oxide and copper plated fins brazed to the tube.

   c. Controls shall be completely factory wired and shall include disconnecting backup and safety contactors, transformers, fusing, disconnect switch, automatic reset thermal cutout, manual reset thermal cutout, and differential pressure airflow switch. Controls panels, wiring connections and other sensitive electronics shall be provided with Heresite, E-coat, microguard, or equal. The heating coil shall be furnished with a silicone-controlled rectifier (SCR) control unit. The SCR control unit shall be suitable for operation at 32° to 132° F and shall be solid-state proportioning type, designed to modulate the heater output from 0 to 100 percent. For heating coils over 50 KW, a vernier proportional control system can be used as an option. The vernier control system shall consist of an SCR control stage sized at 125 percent to 150 percent of the other electronic step-controlled heating stages. The vernier stage shall be used to modulate the heating output between the step-controlled stages providing fully proportional control over the entire heating coil capacity. The electric heat elements and controls shall be suitable for operation on 480 volts, 60 Hz, 3 phase power.

11. Filter Section

   a. Filter sections for makeup air units shall be of the flat or angular arrangement and shall be selected to limit the filter velocity to 350 feet per minute at design conditions unless otherwise indicated in the schedules on the Drawings. Access doors shall be provided for removal of filters from either side of the section. The filters shall be 2-inch pleated type and shall conform to the Air Filters paragraph.

12. Controls

   a. Each unit shall be furnished with a complete control system consisting of fan starters and overload devices, an airflow proving switch, control circuit fuses, and a factory installed integral disconnect switch. Where a factory installed integral disconnect switch is not available as a standard option, a disconnect switch for field installation on the unit shall be provided. Controls shall be suitable

for interfacing with and enacting the control sequence and concept indicated on the Drawings.

b. A factory installed electronic discharge air temperature sensor and controller shall be provided. The controls shall include controls to lock out the heating section when the outside air temperature is above the outdoor air inlet sensor setpoint.

c. An equipment control panel, denoted by the symbol “ECP” and an identifying number, shall be furnished with the makeup air unit and located where indicated on the Drawings. The panel shall be NEMA Type 12 and shall allow for remote operation of the unit with a “Winter-SummerOff” switch, a supply temperature setpoint adjustment, and indicating lights for fan on, heat, safety lockout, and dirty filters. Where indicated in the sequence of operations, a room override thermostat shall be mounted on the panel.

13. Accessories

a. Makeup air units indicated or shown to be curb mounted shall be furnished with a roof mounting curb. The curb shall be constructed of 14-gauge thickness zinc-coated steel with a nominal 2 by 4 inch wood nailer strip and with supply air opening were indicated on the Drawings. The curb shall be a minimum of 16 inches high. The curb shall be approved by the National Roofing Contractors Association.

B. Heaters

a. Heaters of the types, sizes, and capacities specified herein shall be furnished and installed where indicated on the Drawings. All heaters shall be complete with controls and accessories required for satisfactory operation. Heaters shall be UL listed unless otherwise indicated.

b. The manufacturer of the equipment provided shall have a local service center.

1. Electric Duct Heaters

a. Electric duct heaters, denoted by the symbol “EDH” and an identifying number, shall be manufactured by Indeeco or Brasch.

b. Electric duct heaters shall be furnished and installed where indicated on the Drawings, and shall comply with the National Electrical Code.

c. Electric duct heaters shall be finned tube, zero clearance type, with 80 percent nickel and 20 percent chromium resistance elements. Heaters shall have galvanized or aluminized welded steel frames with 2-inch-wide flanges suitable for fastening to the ductwork.

d. Elements for finned tubular coils shall be centered in stainless steel tubes filled with compacted magnesium oxide and stainless-steel fins.

e. Heaters shall be completely factory wired and shall be provided with disconnecting backup and safety contactors, transformers, an automatic reset thermal cutout, a manual reset thermal cutout, a disconnect switch, and a differential pressure airflow switch. All interconnecting wiring shall be enclosed in a terminal box fastened to the heaters and oriented as indicated on the Drawings. The terminal boxes shall be furnished with double doors.

f. Contactors shall be 600-volt rated, 3 pole, UL listed, and shall have a life expectancy for 100,000 operations. A built-in industrial dry type 480/120-volt control transformer shall be furnished to carry the full contactor holding coil load. Transformer primary and secondary windings shall be fused. Secondary windings shall have one lead grounded.

g. The duct heaters shall be furnished with a silicone-controlled rectifier (SCR) control unit mounted in the duct heater terminal box. The control unit shall be suitable for the temperature range of 32° to 132° F, and shall be a solid-state proportioning controller designed to modulate the heater output from 0 to 100 percent. For heating coils over 50 KW, a vernier proportional control system can be used as an option. The vernier control system shall consist of an SCR control stage sized at 125 percent to 150 percent of the other electronic step-controlled heating stages. The vernier stage shall be used to modulate the heating output between the step-controlled stages providing fully proportional control over the entire heating coil capacity. The duct heaters shall be controlled by a thermostat as indicated on the Drawings. The duct heater SCR controller shall be compatible with the signal from the thermostats.

h. The duct heater output in kW shall be as specified at 460-volt, 60 Hz, 3 phase. The heater elements shall be suitable for operation on 480-volt, 60 Hz, 3 phase power.

2. Electric Unit Heaters

a. Electric unit heaters, denoted by the symbol “EUH” and an identifying number, shall have the capacity indicated in the schedules on the Drawings.

3. Electric Unit Heaters (explosionproof).

a. Where indicated on the Drawings to be explosionproof, unit heaters shall be manufactured by Indeeco “Ultra-Safe EXP”, Chromalox “CXH-A”, or Ruffneck “FX4”. Explosionproof electric unit heaters shall be of the fan forced type with a heat exchanger, fan and motor assembly, manual or automatic reset thermal cutout, built-in contactor, factory installed three-pole disconnect switch in NEMA 7 enclosure, and 24-volt control transformer. The heater shall be suitable for use with the power supply indicated in the heater schedule on the Drawings. The heater shall be listed for installation in a Class I, Division 1 or 2, Group D location and shall have an NEC ignition code of T3B or better. Heaters shall be UL listed or FM approved.

b. The heater cabinets shall be constructed of a corrosion resistant cabinet fabricated from an epoxy coated 14-gauge thickness steel with individually adjustable outlet blades. Cabinet fasteners shall be stainless steel.

c. The heat exchanger shall be an efficient liquid to air design utilizing a steel or copper core with aluminum fins. The heat exchanger shall be provided with a coating suitable for use in a corrosive atmosphere consisting of hydrogen sulfide. The heating elements shall be housed in an inhibited propylene or ethylene-glycol heat transfer fluid that is suitable for temperatures down to 49° F. A pressure relief valve shall provide overpressure protection for the heat exchanger.

d. The fan and motor assembly shall consist of an aluminum fan connected to a explosionproof, permanently lubricated ball bearing type motor with built-in thermal overload protection. The motor shall be prewired to the control enclosure providing for a heater that is suitable for use with a single point power connection.

4. Electric Unit Heaters (corrosion resistant)

a. Where indicated on the Drawings to be corrosion resistant, unit heaters shall be manufactured by Indeeco “Triad”, Chromalox “HD3D”, or Ruffneck “CR1 Triton”. Each heater shall include fan and motor assembly, operating and safety controls, disconnect switch, and shall be suitable for use with a single point power supply indicated in the schedules on the Drawings.

b. Heater elements shall be Type 304 or 316 stainless steel, fin tubular type, with stainless steel fittings forming a watertight seal between the elements and the junction box. Unit heater fan motors shall be totally enclosed, permanently lubricated ball bearing type designed to resist corrosion and moisture. The fan blades shall be epoxy coated aluminum and the heater housing shall be at least a 20 gage Type 304 stainless steel. Where indicated on the Drawings to be wall hung, a swivel wall mounting bracket shall be provided.

c. The controls shall include automatic reset thermal cutout, fan delay relay, built-in control and motor contactors, control transformer, and terminal block all housed in a NEMA 4X enclosure. A pilot light visible on the heater exterior shall indicate heater operation.

5. Wall Heaters

a. Wall heaters, denoted by the symbol “WH” and an identifying number, shall be manufactured by Indeeco “WAI”, or Brasch “BWH”.

b. Wall heaters shall be architectural, downflow type; designed for mounting as indicated on the Drawings; and shall include an electric heating element, a thermal limit switch, a fan and motor assembly, and a built-in thermostat. The heaters shall be suitable for use with the specified power supply and shall have the capacity indicated in the schedules on the Drawings.

6. Convection Heaters (explosionproof).

a. Convection heaters, denoted by the symbol “CH” and an identifying number, shall be manufactured by Indeeco “Convector”.

b. The heating element shall consist of grade A Nickel-Chromium heating coils are insulated with ceramics and magnesium oxide from the copper heater tube and fitted with large aluminum fins locked in place.

c. The heater housing shall be constructed of heavy gauge galvanized steel cabinet, painted with a beige powder coat for durability.

d. The heaters shall be factory furnished with wall brackets and be installed as per manufacturer's recommended clearances.

C. Fans

1. Fans shall be rated in accordance with AMCA standards, shall be licensed to bear the AMCA Certified Rating Label unless otherwise indicated in the Fan Schedule on the Drawings, and shall be UL listed. Surfaces in contact with the airstream shall comply with the requirements of ASHRAE 62.1.

2. The manufacturer of the equipment provided shall have a local service center.

3. Each fan shall be complete with an electric motor, factory mounted safety disconnect switch with wiring to the motor, drive, and accessories required for satisfactory operation. Belt-driven fans shall be complete with a Vbelt drive designed for 50 percent overload capacity, sheaves, adjustable base or rails for belt tightening, and a belt guard. Adjustable pitch sheaves shall be furnished for fans with less than 10 horsepower motors and fixed sheaves for 10 horsepower and larger motors. Adjustable sheaves shall be selected so that the fan speed at the specified conditions is at the mid-position of the sheave range. Sheaves shall be replaced with sheaves of the proper size after the air system balancing if necessary, to provide the required fan speed for the specified airflow.

4. Fan drive motors shall be as specified in the Electrical paragraph, unless otherwise indicated. Fans shall be suitable for use with the power supply indicated on the Drawings.

5. Fans indicated in the schedules on the Drawings to be spark resistant construction shall be suitable for installation in a NEC Class I, Division 1 and 2, Group D environment. The fan shall have an AMCA spark resistant construction classification Type B or better and be equipped with non-static belts.

6. The external static pressure values indicated in the schedules on the Drawings are external to the complete unit. Internal fan housing and when furnished, backdraft damper and filter losses are not included. An allowance of 0.35-inch water column shall be used for pleated filter losses.

7. A solid-state variable speed controller shall be provided for each direct-driven fan motor less than 1/2 hp to balance the fan airflows to the specified rates. The speed controller shall have a capacity range of approximately 50 through 100 percent of the design airflow rate specified. The speed controller shall be mounted on or in the fan housing unless otherwise indicated.

8. Electrically commutated motors and fan mounted controls shall be provided where called for in the schedules, and are an option to provide in place of solids state variable speed controllers.

9. Where indicated in the schedules on the Drawings, fans shall be given a special coating resistant to the corrosive atmosphere indicated.

10. Extra Materials

Extra Materials	**Quantity**
Sets of matched belts per fan	1
Sets of air filters per fan	2

11. Duct Fans

a. Duct fans, denoted by the fan type “DF” in the schedules on the Drawings, symbol “EF” and an identifying number, shall be Greenheck “SQ/BSQ”, PennBarry, or Loren Cook. Duct fans shall be of the centrifugal in-line type, and shall be direct or belt driven, as indicated in the schedules on the Drawings. Fan wheels shall be aluminum, backward inclined type, dynamically and statically balanced at the factory.

b. The fan housing shall be square, constructed of steel, and shall be furnished with duct mounting collars. Access doors or panels shall be provided for servicing internal parts without removing the fan from the ductwork. Vibration isolation units shall be provided for each unit. The interior of the fan housing shall be lined with 1-inch fiberglass duct liner.

c. Motors and drives shall be isolated from the airstream. The wheel shaft shall be of ground and polished steel, mounted in heavy-duty, relubricatable or permanently sealed bearings with a minimum L_{50} service life of at least 200,000 hours at the equipment’s maximum cataloged operating conditions.

d. Flexible wiring leads shall be provided from the fan motor to the safety disconnect switch which shall be accessible for servicing without disconnecting the field wiring.

12. Power Roof Ventilators

a. Power roof ventilators, denoted by the fan type “PRV” in the schedules on the Drawings, symbol “EF” and an identifying number, shall be Greenheck “CUBE/G/GB”, PennBarry “Domex”, or Loren Cook “ACE”.

b. Power roof ventilators shall be centrifugal roof mounted type and shall be direct or belt driven as indicated in the schedules on the Drawings. Fan wheels shall be aluminum, backward inclined type statically and dynamically balanced at the factory for quiet, vibration-free operation. Fan housings shall be constructed of aluminum and shall have an aluminum base of the self-flashing type, suitable for mounting on the curbs indicated on the Drawings. Each fan shall be complete

with 1/2-inch mesh aluminum bird screen over all openings, and, where indicated in the schedules on the Drawings, a backdraft damper.

c. Motors and drives shall be mounted outside the airstream. The wheel shaft shall be of ground and polished steel, mounted in heavy-duty, relubricatable or permanently sealed bearings with a minimum L_{50} service life of at least 200,000 hours at the equipment's maximum cataloged operating conditions.

d. A safety disconnect switch shall be mounted in the hood. Where a factory installed integral disconnect switch is not available as a standard option, a disconnect for field installation shall be provided.

13. Propeller Fans

a. Propeller fans, denoted by the fan type "PF" in the schedules on the Drawings, symbol "EF" and an identifying number, shall be Greenheck "Model S/SC" for direct drive and "Model SB/SBC" for belt drive, PennBarry, or Loren Cook.

b. Propeller fans shall consist of a panel frame, wire guard, motor, fan blades, and a disconnect switch. Fan blades shall be constructed of steel. Propeller fans shall be statically and dynamically balanced to ensure quiet, vibration-free operation, and be suitable for mounting as indicated.

c. When indicated in the schedules on the Drawings, a wall mounting kit shall be provided. The wall mounting kit shall consist of a wall collar, motor wire guard, backdraft damper, and weather hood with bird screen.

14. Utility Fans

a. Utility fans, denoted by the fan type "UF" in the schedules on the Drawings, symbol "EF" and an identifying number, shall be high plume dilution type exhaust fan manufactured by Greenheck "Vektor-H", or equivalent.

b. The impellers shall have non-stall and non-overloading performance characteristics, with stable operation at any point on the fan curve. Fan dynamic balance shall not exceed 0.5 mil, peak to peak, at the blade pass area when operating at fan frequency. Rubber-in-shear vibration isolation shall be provided for the system. Fans shall be AMCA B spark resistant construction. PTFE gaskets shall be provided at all companion flanged joints. Fasteners shall be stainless steel. An access door shall be provided for impeller inspection on each fan. Fans and accessories shall have internal drain systems.

c. The discharge nozzle with entrainment wind band for secondary induction shall discharge 250% of the design inlet airflow rate, minimum. Induction shall take place downstream of the fan impeller and shall not influence BHP or static pressure requirements. Each fan/nozzle assembly shall deliver an equivalent stack height of 35 feet above the roof in a 10 MPH wind, minimum.

d. Fan motors shall be equipped with factory installed NEMA 3R disconnect switches. Switches shall be of explosion-proof construction and isolated from the

primary exhaust air stream. Motors shall have an L-50 bearing life of 200,000 hours. Motors shall be visible and accessible from the fan exterior.

e. The system shall be suitable for mounting on a roof curb.

f. All fan and accessory components shall be coated for corrosion resistance; the coating shall be 10 mils, minimum, and suitable for a moist hydrogen sulfide environment. All steel and aluminum surfaces shall be prepared for coating by blasting or chemical etching.

15. Wall Fans

a. Wall fans, denoted by the fan type “WF” in the schedules on the Drawings, symbol “EF” and an identifying number, shall be Greenheck “Model CUE/CUBE/CWB”, PennBarry “Fumex”, or Loren Cook “ACW”.

b. Wall fans shall be suitable for sidewall installation; shall be direct or belt driven, centrifugal type, with aluminum wheels and housing, and a wheel guard located on the discharge side; and shall be statically and dynamically balanced at the factory. The fan motors shall be of adequate size to prevent overloading when operating at the specified capacity and shall be suitable for use with the power supply indicated in the schedules on the Drawings. Each fan shall be complete with 1/2-inch mesh aluminum bird screen over all openings, and, where indicated in the schedules on the Drawings, a backdraft damper.

c. Motors and drives shall be mounted outside the airstream. The wheel shaft shall be of ground and polished steel, mounted in heavy-duty, relubricate or permanently sealed bearings with a minimum L_{50} service life of at least 200,000 hours at the equipment’s maximum cataloged operating conditions.

d. A safety disconnect switch shall be mounted in the hood. Where a factory installed integral disconnect switch is not available as a standard option, a disconnect for field installation shall be provided.

16. High Plume Laboratory Exhaust System

a. High plume laboratory exhaust fans, denoted by the fan type “FEF” in the schedules on the Drawings, symbol “EF” and an identifying number, shall be Greenheck “Model Vektor-H”, or equivalent.

b. Fan housing shall be designed with a high-efficiency inlet to reduce incoming air turbulence and shall be constructed out of welded steel. All steel fan and system components shall be corrosion resistant coated with LabCoat or equivalent coating. No uncoated metal fan parts shall be acceptable.

c. A high velocity conical discharge nozzle shall be supplied by fan manufacturer and be designed to efficiently handle an outlet velocity of up to 6000 FPM (30.48 m/s). Discharge nozzles shall be steel with corrosion resistant coating. Discharge stack caps or hinged covers are not permitted to use.

d. Provide housing drain for removal of rain and condensation.

e. Motor component shall be sealed from the contaminated airstream and have integral cooling vents to fan exterior housing to prevent heat build-up when direct drive fans are provided.

f. Housing shall have a bolted and gasketed access panel allowing for inspection of impeller.

g. Fan impeller shall be centrifugal, backward curved type and shall be statically and dynamically balanced at the factory. Fan impeller shall be manufactured of aluminum (AMCA type B spark resistant) and meet the corrosion resistance requirement similar to other parts.

h. For constant volume systems, the fan shall be connected directly to the exhaust duct without the need of a bypass air plenum.

i. Fan isolation damper of parallel blade design, two position actuated, fabricated of steel or aluminum, and coated with minimum 4 mils of corrosion resistant coating of Hi-Pro polyester resin or equivalent shall be provided, where indicated on the Drawings. The damper actuators shall conform to Heating, Ventilation, and Air Conditioning.

j. Motors for both belt and direct drive fans shall be of premium efficiency, standard NEMA frame, TEFC with a service factor of 1.15 unless otherwise specified.

k. Where specified in the schedules on the Drawing, the fan motor shall be Explosion Proof (EXP) type.

l. When belt driven fans are used, the drive belt and sheaves shall be sized for 200% of the motor horsepower and shall be readily and easily accessible for service. Drive shall consist of a minimum of two belts under all circumstances. Fan shaft shall be 316 stainless steel, coated with corrosion resistant coating.

m. Motor or fan shaft bearings shall be sized for an L-10 life of not less than 100,000 hours in vertical shaft down application.

n. A factory mounted NEMA 4X disconnect switch shall be provided for each fan.

17. Centrifugal Utility Blower

a. Centrifugal utility blower, denoted by denoted by the fan type “UB” in the schedules on the Drawings, symbol “EF” and an identifying number, shall be Greenheck “Model USF”, or equivalent.

b. Utility blowers shall be suitable for indoor or outdoor installation as indicated in the drawings; shall be belt driven, centrifugal type, single width backward inclined type, with aluminum wheel; and shall be statically and dynamically balanced at the factory. The fan motors shall be of adequate size to prevent overloading when operating at specified capacity and shall be suitable for power supply

indicated in the schedules on the Drawings. Each fan shall be complete with ½ inch mesh aluminum bird screen over all openings.

c. Fan housing shall be constructed of heavy gauge steel, finished with a high-performance powder coating electrostatically applied and baked. No uncoated metal fan parts will be allowed.

d. An OSHA compliant belt guard shall be included to completely cover the motor pulley and belt(s). drive belts and sheaves shall be sized for 150% of the fan operating brake horsepower, and shall be easily accessible for service.

e. Movable motor plate with adjustment screws to make belt tensioning operations.

f. Fans installed outdoor shall have a weatherhood, and vibration isolation units shall be provided for each fan.

g. A safety disconnect switch shall be mounted on the fan assembly. Where a factory installed integral disconnect switch is not available as a standard option, a disconnect for field installation shall be provided.

D. Roof Hoods

1. Roof hoods, denoted by the symbol “RH” and an identifying number, shall be Greenheck “Model FGI/FGR”, PennBarry, or Loren Cook.

2. Roof hoods shall be suitable for air intake or exhaust and shall have throat dimensions as indicated in the schedules on the Drawings. The roof hood assembly shall be constructed of aluminum. Each roof hood shall be complete with a weather hood sized to limit the face velocity to 500 feet per minute, a 1/2-inch mesh bird screen of material to match the roof hood assembly over all openings, and a mounting base suitable for installation on a curb as indicated on the Drawings.

3. Where indicated in the schedules on the Drawings, roof hoods shall be given a special coating resistant to the corrosive atmosphere indicated.

E. Dampers

1. Backdraft Dampers

a. Backdraft dampers, denoted by the symbol “BDD” not specified to be furnished with equipment, shall be Arrow United Industries “Type 655”, or Ruskin “BD6”. Backdraft dampers shall be constructed with a 1 by 4 inch by 0.08 -inch-thick extruded aluminum frame. Blades shall be at least 0.070-inch aluminum with blade edge seals mechanically locked to blade edge and aluminum shafts operating in synthetic bearings. The leakage rate shall not exceed 20 cubic feet per minute per ft^2 when tested at 1 in wc for all sizes 24 inches wide and above.

b. Counterbalance backdraft dampers, denoted by the symbol “CBD” not specified to be furnished with equipment, shall be Ruskin “CBD2”, or Arrow United Industries “225B”. Backdraft dampers shall be constructed with a 1 by 4 inch

by 0.08 -inch-thick extruded aluminum frame. Blades shall be at least 0.070-inch aluminum with blade edge seals mechanically locked to blade edge and aluminum shafts operating in synthetic bearings. The leakage rate shall not exceed 20 cubic feet per minute per ft^2 when tested at 1 in wc for all sizes 24 inches wide and above.

2. Control Dampers

   a. Control dampers shall be denoted by the symbol “CD” and an identifying number. Dampers with an area larger than 25 square feet or with any blade dimension exceeding 48 inches shall be built in sections. All dampers shall be carefully inspected before and after installation, and any damper having poorly fitted blades, insufficient framed rigidity, or excessive clearance or backlash in moving parts will be rejected and shall be replaced with an acceptable unit. The leakage rate shall not exceed 4 cubic feet per minute per ft^2 when tested at 1 in wc for all sizes 24 inches wide and above.

   b. Two-position dampers shall have parallel operating blades. Modulating dampers shall have opposed operating blades.

   c. Damper blades shall be installed on a steel shaft operating in synthetic bearings suitable for industrial service. Dampers shall be close-fitting and shall be designed to offer minimum resistance to the airflow when in the fully open position. Damper blade linkage shall be concealed in the frame.

   d. Control dampers shall be given a special coating identical to the coating applied to the connected ductwork and equipment.

3. Duct Mounted Control Dampers

   a. Control dampers mounted in ductwork and equipment curbs shall be Arrow United Industries “Type AFD20” or Ruskin “CD50”. The damper frames shall be constructed of 5-inch Type 6063 T5 extruded aluminum. Damper blades shall be constructed of 6 -inch-wide airfoil-shaped extruded aluminum.

4. Wall Mounted Control Dampers

   a. Control dampers mounted in walls behind louvers shall be Arrow United Industries “Type AFD20” or Ruskin “CD40”. Control damper frames shall be constructed of 4 by 1 inch 6063 T5 extruded aluminum. Damper blades shall be constructed of 4 -inch-wide airfoil-shaped extruded aluminum.

5. Volume Control Dampers

   a. Volume control dampers shall be denoted by the symbol “VCD”.

   b. Galvanized volume control dampers in round ductwork shall be Arrow United Industries “Type 200 VCRD”, or Ruskin “Model MDRS25”. Volume control dampers in rectangular ductwork shall be Arrow United Industries “Type 1770”, or Ruskin “Model MD35”. Rectangular volume control dampers shall be fabricated of 16-gauge thickness galvanized steel, with a nominal 4 or 5 inch

by 1 inch channel frame, and opposed operating blades. Round dampers shall be fabricated of galvanized steel, with a nominal 7 inch long, 22-gauge thickness frame, and a minimum 20-gauge thickness circular blade.

c. Aluminum volume control dampers in round ductwork shall be Arrow United Industries “Type 75”, or Ruskin “Model CDRS25”. Volume control dampers in rectangular ductwork shall be Arrow United Industries “Type OBDPL-507”, or Ruskin “Model CD51”. Round dampers shall be fabricated of aluminum, with a nominal 7 inch long, 0.080-inch-thick frame, and a minimum 0.080-inch-thick circular blade. Rectangular volume control dampers shall be fabricated with a 1 by 4 or 5 inches by 0.081-inch-thick extruded aluminum frame and opposed operating blades. Blades shall be of .125-inch-thick aluminum with aluminum shafts and ball bearings.

d. The dampers shall be provided with adjustment quadrants and locking devices so arranged that the position of the damper will be indicated, and the damper will not move when locked.

F. Damper Operators

1. The damper operators shall be direct coupled or foot-mounted type. Each operator shall be complete with all necessary crank arms, ball joint connectors, push rods, linkages, and mounting brackets.

2. Each operator shall have sufficient torque to operate the connected control damper based on at least 130 percent of control damper area. Each damper operator shall have at least a 50 inch-pound normal running torque. Where the required damper torque exceeds the damper operator running torque rating, multiple operators or operators with a greater running torque shall be furnished to produce the torque required to operate the damper. Control dampers shall fail to the closed position unless otherwise indicated on the Drawings.

3. Where damper operators are installed in hazardous areas indicated on the Drawings, the operators shall be furnished and installed in explosionproof housings suitable for installation in an NEC Class I, Division 1 and 2, Group D area. Where damper operators are installed outdoors, the operators shall be furnished and installed in weathertight enclosures.

4. Two-position direct coupled electric damper operators shall be Belimo “NFBUPS” or “AFBUPS”, Honeywell “MS4100 Series”, or Johnson Controls. Foot-mounted type electric damper operators shall be Honeywell “Model M4185”, or Johnson Controls “Model M100”.

5. Damper operators shall be spring return and shall have one internal spdt auxiliary switch rated 5 amperes at 120 volts ac or the power supply available from the temperature control system furnished. Damper operators shall be suitable for operation on a 120-volt, 60 Hz, single phase power supply. Auxiliary transformers, where required, shall be factory wired to the damper operator and installed in a NEMA enclosure with a rating equal to or better than the damper operator.

a. Direct coupled two position electric damper operators shall be housed in a galvanized steel or aluminum case. Operators shall use a “V” shaped bolt and cradle design to eliminate slippage on the damper shaft. Single bolt or set screw type designs are not acceptable for round shafts. The operators shall be suitable for direct mounting to shafts up to 1 inch and shall be complete with mounting brackets and damper position indicator.

b. Foot-mounted type two-position electric damper operators shall be housed in a die-cast aluminum case with a mounting flange. Motor and gear train components shall be immersed in oil. Damper operators shall have a 3/8-inch square, double-ended drive shaft.

G. Air Outlet and Inlet Devices

1. Air outlet and inlet devices shall be manufactured by Titus, Price, or Tuttle & Bailey. Air outlet and inlet devices shall be furnished and installed where indicated on the Drawings. Air outlet and inlet devices color shall be as per architectural requirements.

2. Where air outlet and inlet devices are installed in ductwork given a special coating, an identical coating shall be applied to the air outlet and inlet devices.

3. Ceiling Diffusers

a. Diffusers shall be square or rectangular, constructed of the materials indicated in the schedules on the Drawings. Diffusers shall have a key-operated, opposed-blade damper mounted in the neck where indicated in the schedules on the Drawings. Size, location, and direction of airflow shall be as indicated on the Drawings.

4. Registers and Grilles

a. Registers and grilles shall be constructed of aluminum or steel as indicated in the schedules on the Drawings. The front blades of adjustable blade models shall be parallel to the short dimension unless otherwise indicated, and the front blades of fixed blade models shall be horizontal unless otherwise indicated. All registers shall be furnished with key-operated opposed blade dampers. The dampers shall be constructed of the same material as the attached grille.

H. Flexible Connections

1. Flexible connections located indoors shall be Ventfabrics “Ventglas”. Flexible connections installed outdoors or exposed to sunlight or weather shall be Ventfabrics “Ventlon”.

2. Ductwork connections to the air handling equipment, and where indicated on the Drawings, shall be made using fabric connectors with sheet metal collars. The fabric shall be fire resistant, waterproof, mildew-resistant, and airtight. At least 3 inches of fabric shall be exposed. Flexible connections shall be in accordance with the requirements of UL and NFPA.

3. Fabric for flexible connections protected from sunlight and the weather shall be suitable for a temperature range of 20° to 180° F and shall weigh at least 27 ounces per square yard.

4. Fabric for flexible connections exposed to sunlight or the weather shall be suitable for a temperature range of 10° to 250° F and shall weigh at least 24 ounces per square yard.

I. Air Filtration Equipment

1. Pleated Air Filters

a. Pleated air filters shall be American Air Filter “AMAIR 300X” or Farr “30/30”. Filters shall be disposable type, high-loft blend of cotton and synthetic fiber pleated media. The media shall be rated as Class 1 or Class 2 in accordance with UL 900. A metal support grid shall be bonded to the media. The filter frame shall be constructed of rigid, high-strength, moisture-resistant beverage board. The pleated media pack shall be bonded to the inside of the frame. All filters shall have a minimum efficiency reporting value (MERV) based on the ASHRAE 52.2 guidelines of at least MERV 6.

b. One-inch pleated air filters shall have at least 14 pleats per linear foot and at least 1.9 square feet of media per square foot of filter area. One-inch filters shall have a maximum initial resistance of 0.10-inch water column at 300 feet per minute.

c. Two-inch pleated air filters shall have at least 12 pleats per linear foot and at least 4.2 square feet of media per square foot of filter area. Two-inch filters shall have a maximum initial resistance of 0.13-inch water column at 300 feet per minute.

2. Side Access Filter Housings

a. Side access filter housings shall be American Air Filter “Access Air” or Farr “Model 4P Glide/Pack”. Side access filter housings shall be single-stage, factory-fabricated of 16-gauge thickness galvanized steel and shall be equipped with flanges for connection to the ductwork. Access doors shall be 16-gauge thickness galvanized steel and shall be positioned to allow replacement of filters from either side of the housing. Filter housings and doors shall be insulated and of double-wall construction. Filter tracks shall be provided to accommodate nominal 2 -inch-thick disposable filters as described herein. Leakage at the rated airflow shall be less than 1 percent at a 3-inch water column differential.

J. Sheet Metal Ductwork

1. Ductwork, accessories, bracing, and supports shall be constructed of galvanized steel or aluminum. Where more than one material is indicated, ductwork, accessories, bracing, and supports shall be constructed of galvanized steel unless otherwise indicated on the Drawings. Ductwork, turning vanes, and other accessories shall be fabricated in accordance with the latest SMACNA HVAC Duct

Construction Standards unless otherwise indicated. Accessories, bracing, and supports shall be constructed of similar materials as the ductwork.

2. Galvanized ductwork located in air-conditioned spaces shall be constructed of G60 or better lock forming quality in accordance with ASTM A653. All other galvanized ductwork shall be constructed of G90 or better galvanized steel. All welds on galvanized metal shall be cleaned and coated with a zinc-rich paint.

3. Plenums shall be constructed of reinforced 16-gauge thickness galvanized sheet metal.

4. Sheet metal fan boxes shall be fabricated with 12-gauge thickness galvanized sheet metal skin and structural steel framing of sufficient strength to support the fan box and the fan mounted on the box. Drawings of the fan boxes shall be submitted in accordance with the Submittals Procedures section.

5. Aluminum ductwork shall be constructed of aluminum alloy 3003-H14 or better in accordance with ASTM B209.

6. Plenums shall be constructed of reinforced 0.08-inch thickness aluminum sheet metal.

7. Sheet metal fan boxes shall be fabricated with 0.125-inch thickness aluminum sheet metal skin and structural framing of sufficient strength to support the fan box and the fan mounted on the box. Drawings of the fan boxes shall be submitted in accordance with the Submittals Procedures section.

8. Sealants shall be suitable for the duct service and shall maintain leakage integrity at pressures in excess of the ductwork pressure classification.

9. Where indicated on the Drawings, ductwork and accessories shall be given a special coating resistant to the corrosive atmosphere indicated. Where no special coating for ductwork is indicated, the coating shall be as specified in the Finish Painting sections.

10. Spiral ductwork located in air-conditioned spaces shall be factory-fabricated double-wall ductwork assembly with 1” thick insulation, aluminum inner duct and aluminum outer jacket. The construction shall consist of an airtight vapour barrier, aluminum outer pressure shell (0.040” thickness), a 1-inch insulation layer and an aluminum inner layer (0.040” thickness) which completely covered the insulation. Joints for straight duct runs and fittings shall be flanged and gasketed.

11. Ductwork located in outdoor spaces shall be factory-fabricated double-wall ductwork assembly with 2” insulation. The duct shall be constructed of aluminum, and when installed properly must meet Leakage Class 3 system without use of any external sealants. Fittings shall be internally sealed to provide a Leakage Class 3 system. Exposed ducting shall be provided with a weather-proofing jacket “Alumaguard,” or approved equal to ensure UV protection, weather protection and vapor barrier.

K. Flexible Duct and Takeoffs

1. Flexible duct shall be Thermaflex “Type GKM” or Flexmaster “Type 8”. Takeoffs shall be Buckley Air Products “AirTite Bellmouth BMD”.

2. Flexible duct shall be a galvanized or vinyl-coated spring steel helix, bonded to a polymer liner, and wrapped with glass fiber insulation suitable for use in heating and cooling systems. The insulation shall provide an “R” value of at least 4.2 ft2·hr F/BTU. The outer jacket shall be a vapor barrier of fire-retardant polyolefin or polyethylene material. The flexible duct shall be listed under UL 181 as Class 1 flexible air duct and shall comply with the latest edition of NFPA 90A.

3. Takeoffs for the flexible duct shall be bellmouth type manufactured of the same material as the associate ductwork with a neoprene gasket and predrilled holes. Each takeoff shall be equipped with a balance damper constructed of 26-gauge thickness galvanized steel. Scoops or other obstructions in the main duct will not be acceptable.

L. Access Doors

1. Access doors shall be fabricated in accordance with the latest SMACNA HVAC Duct Construction Standards. Access doors shall be double skin insulated type for insulated ductwork and single skin type for non-insulated ductwork. Insulated doors shall be insulated with the same thickness insulation as the duct in which it is installed. Duct-mounted access doors and panels shall be fabricated of the same material as the ductwork, with sealing gaskets and quick-fastening locking devices. Where access doors are insulated, a sheet metal cover shall be installed over the insulation.

M. Temperature Controls

1. The temperature control components and systems shall be manufactured by Honeywell; Johnson Controls; or Siemens Building Technologies, Landis Division. Where manufacturers are not specified, materials and equipment furnished shall meet the performance and design requirements indicated.

2. The manufacturer of the equipment provided shall have a local service center.

3. Performance and Design Requirements

a. Contractor shall coordinate with the Work to make certain that the field wiring associated with the work of this section is completed in accordance with the requirements of the heating, ventilating, and air conditioning equipment furnished and their interconnection. Where cable and conduit are not indicated on the Drawings but is needed for a complete and functional control system in accordance with the sequence of operation it shall be provided as specified herein. The control wiring shall be installed so that all HVAC equipment will function as described in the HVAC sequence of operation.

b. Conduit and control wiring for all control circuits needed between all field mounted HVAC controlling and indicating devices, such as, but not limited to,

damper actuators, thermostats, temperature control panels, pressure differential switches, control switches, motor starters, and the HVAC equipment, shall be furnished and installed as specified in the Electrical Wiring paragraph. Cable and conduit for all HVAC power circuits shall be as specified in the Wire and Cable section.

4. Tolerances

   a. Unless otherwise indicated, the controls shall maintain space temperatures within ±2° F, and the relative humidity within ±5 percent of the setpoint.

5. Thermostats

   a. Where indicated on the Drawings, thermostats shall be constructed of materials resistant to or shall be protected from the corrosive atmosphere indicated. Thermostats specified in the individual equipment paragraphs shall be provided with the respective equipment.

6. Two Position Wall Mounted Thermostats

   a. Two position wall mounted thermostats shall be Honeywell “T631A Airswitch”, Penn Controls “A19BAC1”, or Siemens Building Technologies.

   b. Two position wall mounted thermostats shall be line voltage type. The thermostats shall have a range of approximately 35° F to 100° F with a nonadjustable differential of 3.5° F. The thermostats shall have a spdt switch rated for 1 horsepower.

7. Low Limit Thermostats

   a. Low limit thermostats shall be Honeywell “L480”, Penn Controls “Model A11B1”, or Siemens Building Technologies.

   b. Low limit thermostats used for low temperature cutout shall be capillary, line-voltage type, complete with spst switches. The sensing elements shall be at least 20 feet long. The thermostat shall be responsive to the lowest temperature along the measuring element, shall have a range of approximately 35° F to 45° F , and shall be automatically reset.

8. Modulating Duct Mounted Thermostats

   a. Modulating, duct mounted thermostats shall be Honeywell “Model T991”, Penn Controls “Model A80ABA-2”, or Siemens Building Technologies.

   b. Modulating, duct mounted thermostats shall be modulating, proportional control, low voltage type. The thermostats shall have a range of approximately 10° F to 90° F with an adjustable throttling range of approximately 5° F to 24° F, and shall be furnished with a duct mounting kit.

9. Explosion-proof Thermostats

   a. Explosion-proof wall-mounted thermostats controlling equipment in NEC Class I, Division 1 and Division 2, Group D areas shall be Honeywell “Model T6051B”, Johnson Controls, or Siemens Building Technologies.

   b. Duct-mounted thermostats controlling explosionproof equipment in NEC Class I, Division 1 and Division 2, Group D areas shall be Indeeco “Model T94A70”

10. Programmable Wall Mounted Thermostats

   a. Programmable, wall mounted thermostats shall be Honeywell “Model T7300”, Penn Controls, or Siemens Building Technologies.

   b. Programmable wall mounted thermostats shall be single or multistage as required by the controlled equipment, solid state programmable electronic type configurable for use with a conventional or heat pump system. The thermostats shall have a setpoint range of approximately 45° F to 95° F with the following features:

      1) Seven (7) day programming with 2 occupied/unoccupied periods per day

      2) Automatic heat/cool changeover

      3) Battery backup

      4) Setback controls to automatically restart and temporarily operate system during setback periods

      5) Digital display

      6) Temporary override of setpoints

      7) Two (2) configurable LEDs

      8) Where an economizer is used, the programmable thermostat shall be suitable for interfacing with the economizer control package

11. Temperature Control Panels

   a. Temperature control panels, denoted by the symbol “TCP” and an identifying number, shall be manufactured by Hoffman Engineering, Hubbell Wiegman, or Rittal Corporation. Temperature control panel enclosures shall be NEMA Type 12 unless otherwise indicated on the electrical Drawings with a special area designation. Where a panel is located in a room with a special area designation, the panel shall be constructed to meet the special area designation requirements. Panels shall be designed for wall mounting and shall be completely prewired and checked. All electrical accessory devices and internal wiring shall be furnished and installed.

b. Where required by the applicable codes and ordinances, panel assemblies, materials, and equipment shall be approved, identified, labeled, or listed by Underwriters' Laboratories or other testing agency acceptable to the governing authority.

c. All controllers, selector relays, switching relays, interlock relays, manual switches, timers, alarm, and other devices indicated to be panel mounted shall be mounted in or on the respective control panel. Accessories such as indicating lights, pushbuttons, alarm horns, and selector switches shall be mounted on the front hinged covers of the panels. The accessories and panels shall be identified with an identification plate as described in the Equipment Identification paragraph. The identification plates shall be fastened to the panel with corrosion-resistant pan head screws.

d. Each temperature control panel shall supply power to all associated control system field control components, including but not limited to, damper operators, thermostats, sensors, and smoke detectors. The controls shall include all necessary relays, interlocks, and control devices to enable the control panel to function as described in the sequence of operation on the Drawings.

e. All interconnecting wiring and wiring to terminals for exterior connection shall be stranded copper, insulated for not less than 600 volts, with a moisture resistant and flame-resistant covering rated for at least 90°C. Power distribution wiring on the line side of panel fuses shall be at least 12 AWG. Wiring for secondary power distribution and for control, annunciator, and indicating light circuits shall be at least 14 AWG. Wiring shall be color coded in accordance with the legend on the panel wiring diagrams.

f. Equipment operational control and run/off status shall be provided from terminal blocks within the respective motor starter. Refer to the electrical Drawings for additional information.

12. Selector Switches

a. Selector switches shall be Micro Switch "Type PT", Cutler-Hammer "10250T Series", or General Electric "CR". Selector switches shall be heavy-duty 30 mm oiltight type with gloved-hand or wing lever operators. Position legends shall be engraved on switch faceplate. Switches for electric circuits shall have silver butting or sliding contacts, rated 10 amperes continuous at 120 volts ac. Contact configuration shall be as indicated on the Drawings or as necessary for the application. Switches used in electronic signal circuits shall have contacts suitable for that duty.

13. Push Buttons

a. Push buttons shall be Micro Switch "Type PT", Cutler-Hammer "10250T Series", or General Electric "CR". Push buttons shall be heavy-duty, oiltight type, with legends engraved on the faceplate. Contacts shall be rated 10 amperes continuous at 120 volts ac.

14. Indicating Lights

    a. Indicating lights shall be Micro Switch “Type PT”, Cutler-Hammer “10250T Series”, or General Electric “CR”. Alarm, indicator, and running status lights shall be furnished with lamps. Indicating lights shall be heavy-duty, 30 mm, push-to-test, oiltight type with LED lamps. Legends shall be engraved on the lens or on a legend faceplate. Lamps shall be easily replaceable from the front of the device.

15. Alarm Horns

    a. Alarm horns shall be Federal Signal “Model 350”. Alarm horns shall have a sound output of 100 dB at 10 feet [3 m]. Horns shall be furnished with mounting hardware suitable for flush mounting.

16. Relays

    a. Relays shall be Eagle Signal “Series 22, 80”; Potter & Brumfield “Series KRP, CB”; or Struthers-Dunn “Series A3, A4”. Relays shall be of the plug-in socket base type, with dustproof plastic enclosures unless noted otherwise. Relays shall be UL recognized and shall have not less than double-pole, double-throw contacts. Control circuit relays shall have silver-cadmium oxide contacts rated 10 amperes at 120 volts ac. Electronic switching-duty relays shall have gold-plated or gold alloy contacts suitable for use with low level signals. Relays used for alarm input or indicating light service shall have contacts rated at least 3 amperes. Time-delay relays shall have dials or engraved switch settings marked in seconds and shall have timing repeatability of ±2 percent of setting. Latching and special purpose relays shall be as needed for the specific application.

17. Terminal Blocks and Panel Wiring

    a. Terminal blocks for external connections shall be suitable for 12 AWG wire and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated, shall be complete with marking strip, covers, and pressure connectors, and shall be labeled to agree with the identification on the temperature control manufacturer’s submittal drawings.

    b. A terminal shall be provided for each conductor of external circuits, plus one ground cable. At least 8 inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space. At least 25 percent spare terminals shall be provided.

    c. All wiring shall be grouped or cabled and firmly supported inside the panel. Wiring shall be bundled in groups and bound with nylon cable ties or shall be routed in Panduit or similar nonmetallic slotted ducts. Ducts shall be readily accessible within the panel, with removable covers, and shall have a space of at least 40 percent of the depth of the duct available for future use after the installation including all field wiring, has been completed. Sufficient space shall be provided between cable groups or ducts and terminal blocks for easy installation or removal of cables.

d. Where signal wiring must be routed to more than one panel or device, the requested circuit routing shall be as indicated on the electrical one-line diagrams.

18. Control Power Transformers

a. Where 24-volt ac control power is necessary for the temperature control components, 120/24-volt transformers shall be furnished and mounted in the respective temperature control panel. Control power transformers shall be sized by the manufacturer based on the equipment load of the panel, shall be copper wound, vacuum impregnated with solid polyester varnish, and shall be 100 percent tested in strict compliance with ANSI, CSA, and UL codes. Control power transformers shall have both primary leads fused, one secondary lead fused, and one secondary lead grounded. The control power transformers shall be sized by the manufacturer based on the equipment load of the panel.

19. Painting

a. Interior and exterior surfaces of all panels shall be thoroughly cleaned and painted with rust-inhibitive primer. The panel interior shall be painted white with the manufacturer's standard coating. All pits and blemishes in the exterior surfaces shall be filled before the surface is painted with one or more finish coats of the manufacturer's standard coating. Finish coats shall have a dry film thickness of at least 4 mils. One (1) quart of paint shall be furnished with the panels for future touchup painting.

20. Dial Thermometers

a. A dial thermometer shall be supplied and installed at each remote bulb sensor for calibration and calibration checks. Thermometers shall be bimetal type with at least a 4 1/2-inch dial. The dial shall have white background and black markings with units of measurement indicated on the dial face. The pointer travel shall not be less than 200 degrees nor more than 270 degrees of arc. Thermometers shall have a stainless-steel case, bezel, fittings, and stem and shall be hermetically sealed with external pointer recalibration adjustment and acrylic plastic or shatterproof glass window. The range of the dial thermometers shall be -40° F to 120° F. Duct mounted thermostats shall be furnished with duct mounting flange.

b. In ducted systems containing coils or electric duct heaters, a dial thermometer shall be furnished and installed on the downstream side of the coil or heater. Thermometers shall be complete with averaging type elements.

21. Smoke Detectors

a. Smoke detectors shall be as specified or as shown on the Drawings.

b. Smoke detectors, denoted by the symbol "SMD" and an identifying number, shall be System Sensor "D4120", Secutron "MRD-DH100ACDCP", or Totaline "P270-2000P".

c. Detectors shall be designed to detect combustion gases, fire, and smoke in air conditioning and ventilating duct systems in compliance with the NFPA 90A and shall contain a detector and air sampling chamber which serves as a reference point to help stabilize the detector against the effects of changes in temperature, humidity, and pressure.

d. Smoke detectors shall be duct mounted photoelectric type and shall be completely self-contained, including integral power supply, supervisory and control circuitry and isolated alarm contacts. The detector shall provide a single-pole, single-throw supervisory alarm contact and a single-pole, double-throw supervisory trouble contact rated 2 amperes at 30 volts dc. The detector shall also provide double-pole, double-throw auxiliary alarm contacts rated 10 amperes at 120 volts ac. A local tamper trouble signal shall be emitted by the detector in the event the cover is removed or missing. A remote key-operated test station with alarm light and power supply status light shall also be furnished and installed where indicated on the Drawings. Detectors shall be suitable for operation on a 120-volt, 60 Hz, single phase power supply or the power supply available from the temperature control system furnished.

e. Detectors shall be provided with sampling tubes extending the width of the air duct.

22. Pressure Differential Airflow Switches

a. Pressure differential airflow switches, denoted by the symbol “PDS” and an identifying number, shall be furnished and installed as indicated on the Drawings and the sequence of operation. Each pressure switch operating range shall be selected so that the setpoint is between 25 and 75 percent of the scale range. Switches used for proving airflow shall be selected with the lowest operating range such that the switch activates at 50 percent of the system airflow. Differential switches shall be UL listed.

b. Where indicated on the Drawings, pressure differential switches shall be provided with an explosion-proof housing suitable for a NEC Class 1, Division 2, Group D environment. Where differential pressure switches are located outdoors, a NEMA 4 rated weather enclosure shall be provided.

c. Pressure differential airflow switches shall be Dwyer Instruments, Inc. “Series 1800”. Explosion-proof pressure differential airflow switches shall be Dwyer Instruments, Inc. “Series 1950G”. Pressure differential switches for airflow service shall be diaphragm operated by differential air pressure between duct and atmosphere or across a filter. The switch shall be spdt, shall be rated 10 amperes at 120 volts ac and for a temperature range of 0° F to 125° F, and shall be provided with corrosion resistant mounting brackets. Unless otherwise indicated on the Drawings, initial setpoints of pressure differential switches located across filters shall be 0.75-inch water column to alarm high filter pressure loss and 0.1-inch water column when mounted in air systems to alarm ventilation failure.

23. Control Stations

a. Control stations for equipment shall consist of a selector switch or pushbutton station with two indicating lights for “On/Off” indication. Indicating lights, selector switches, and push button stations shall be heavy duty oiltight NEMA Type 13. The control station enclosure shall be NEMA Type 4.

24. Accessory Components

a. All additional control components, including, but not limited to, electric relays, temperature sensors and transmitters, humidity sensors and transmitters, controllers, and position switches, shall be furnished where necessary to ensure a complete, properly operating installation. All components shall be products of the temperature control manufacturer. Accessory components not mounted inside the temperature control panels shall be furnished with equipment enclosures. Relays shall be provided with 120-volt coils and at least 10 ampere contacts.

25. Electrical Wiring

a. Detailed wiring diagrams shall be submitted in accordance with the Submittals Procedures section. The wiring diagrams shall show the internal connections of the control panels and all field wiring to equipment remote from the control panels including wiring to Owner-furnished equipment. The wiring diagrams shall be complete, showing all connections necessary to place the temperature control systems in operation.

b. Control wiring shall be in accordance with the National Electric Code (NEC). Cable shall be multi-conductor, at least 18 AWG size, specifically designed for industrial systems and UL listed for indoor/outdoor installations.

c. Conduit for all HVAC control circuits in indoor locations shall be furnished and installed under this section. Conduit type shall be as specified in the Electrical Section.

2.05 ELECTRICAL

A. Electric motors and motor controls shall conform to the Basic Mechanical Building Systems Materials and Methods section. Motor starters and controls shall be furnished and installed under the Electrical section, except for equipment specified or furnished with prewired integral starters. Disconnects for equipment shall be furnished and installed under the Electrical section, except where specified with integral disconnects. All electrical controls shall have enclosures suitable for the environment and NEMA rating as indicated on the electrical Drawings. Equipment installed outdoors shall have NEMA Type 4 enclosures.

2.06 DRIVE UNITS

A. Electric motors, V-belt drives, and safety guards shall be in accordance with the requirements of the Basic Mechanical Building Systems Materials and Methods section.

2.07 MANUFACTURE AND FABRICATION

A. Manufacture and fabrication shall comply with the requirements of the Basic Mechanical Systems Materials and Methods section.

2.08 SHOP TESTING

A. The equipment furnished under this section shall be tested at the factory according to the standard practice of the manufacturer. Ratings shall be based on tests made in accordance with applicable AMCA, ASHRAE, AHRI, NBS, NFPA, and UL Standards.

2.09 BALANCE

A. All rotating parts shall be accurately machined and shall be in as nearly perfect rotational balance as practicable. Excessive vibration shall be sufficient course for rejection of the equipment. The mass of the unit and its distribution shall be such that the resonance at normal operating speeds is avoided. In any case, the maximum measured root-mean-square (rms) value as measured at any point on the equipment shall not exceed those listed in the latest ASHRAE Applications Handbook.

B. At any operating speed, the ratio of rotative speed to the critical speed of a unit or components thereof shall be less than 0.8 or more than 1.3.

PART 3 EXECUTION

3.01 INSPECTION

A. Equipment installed in facilities with limited access shall be suitable for being installed through available openings. Contractor shall field verify existing opening dimensions and other provisions for installation prior to submittal of bids.

B. Where penetrations through existing concrete slabs are made, the Contractor shall locate and avoid damage to all rebar, embedded conduit, etc. when making new openings.

3.02 PREPARATION

A. Field Measurement

1. Contractor shall be responsible for verifying all field dimensions, and for verifying location of all equipment relative to any existing equipment or structures.

B. Surface Preparation

1. All surfaces to be field painted shall be dry and free of dirt, dust, sand, grit, mud, oil, grease, rust, loose mill scale, or other objectionable substances, and shall meet the recommendations of the paint manufacturer for surface preparation. Cleaning and painting operations shall be performed in a manner which will protect freshly painted surfaces from dust or other contaminants. Oil and grease shall be

completely removed by use of solvents or detergents before mechanical cleaning is started. The gloss of previously painted surfaces shall be dulled if necessary for proper adhesion of topcoats.

2. Surface finish damaged during installation shall be repaired to the satisfaction of Engineer. Field painting shall be as specified in the Architectural Painting and Protective Coatings sections.

3.03 INSTALLATION

A. Equipment and materials furnished under this section shall be installed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

B. The space beneath baseplates shall be grouted as specified in the Grouting section.

C. Makeup Air Units

1. Flexible connections shall not be in tension when the fans are operating. Curb mounted units shall be firmly anchored to the equipment curbs with corrosion resistant fasteners.

2. The installation shall be checked by the manufacturer in accordance with the Installation Check paragraph.

D. Heaters

1. The bottom elevation of unit heaters shall be 8 feet above finished floor unless otherwise indicated.

2. Electric duct heaters shall be installed with a minimum distance of 4 feet from all ductwork transitions and obstructions on both sides of the heater.

3. The bottom elevation of wall heaters shall be 16 inches above finished floor unless otherwise indicated.

4. The electric infrared heaters shall be installed in the ceiling as per manufacturer’s recommended clearances and height.

E. Fans

1. Where indicated on the Drawings, flexible connections shall be installed between fan inlet and outlet sheet metal connections. Flexible connections shall not be in tension when the fans are operating. Where fan inlets and outlets are exposed, safety screens shall be installed over the opening. Scroll drains for equipment installed indoors shall be piped to the nearest floor drain.

2. Power roof ventilators shall be secured with corrosion resistant lag screws to the roof curb.

3. The installation shall be checked by the manufacturer in accordance with the Installation Check paragraph.

F. Roof Hoods

1. Roof hoods shall be secured with corrosion resistant lag screws to the roof curb.

G. Damper Operators

1. Damper operators shall be installed on a mounting bracket rigidly attached to the damper frame or duct. Where the bracket attaches to the duct, suitable stiffeners shall be installed on the duct to prevent noticeable deflection of the duct when the damper operates. Damper operators may be installed inside or outside the duct but consideration shall be given to the environment and duct dimensions in which the operators are installed. Where the damper installation inside the duct may or actually prevents the design airflow from being achieved, the damper operator shall be installed outside the duct. Damper operators shall be readily accessible and access doors shall be provided when the operator is installed inside the duct.

2. The damper operator shall be installed to prevent entry of moisture from contacting internal parts. Conduit shall enter the operator from below or horizontally and incorporate a drip leg to prevent water from following the conduit into the operator interior.

3. The number of operators furnished for each damper shall provide the torque necessary to operate the damper. Unless otherwise indicated, control dampers shall fail to the closed position.

H. Air Outlet and Inlet Devices

1. Air outlet and inlet devices shall be installed level and plumb and in accordance with the manufacturer's written instructions. **[**Diffusers with balance dampers installed in the flexible duct takeoffs shall not have an opposed blade damper mounted in the throat of the diffuser. For devices installed in lay-in ceilings panels, the units shall be located in the center of the panel. Ceiling mounted air devices or services weighing 20 pounds or more shall be supported directly from the structure.

I. Sheet Metal Ductwork

1. Ductwork, turning vanes, and other accessories shall be installed and supported in accordance with the latest SMACNA Duct Construction Standards unless otherwise indicated. The locations, arrangement, and sizes of ductwork shall be as indicated on the Drawings. The duct sizes indicated are clear dimensions inside the duct or duct lining. Sheet metal sizes are larger for ductwork with interior linings.

2. Ductwork shall be fabricated, reinforced, supported, and sealed for the operating pressures indicated in the schedules for the connected equipment. All ductwork shall have a pressure classification of at least 1 inch.

3. Sheet metal ductwork shall be sealed according to the classifications described in the SMACNA HVAC Duct Construction Standards in accordance with the following:

	Duct Type			
	Supply		Exhaust	Return
Duct Location	≤ 2 inches wc	> 2 inches wc		
Outdoors	A	A	A	A
Unconditioned Areas	B	A	B	B
Conditioned Spaces				
(concealed ductwork)	C	B	B	C
(exposed ductwork)	A	A	B	B

Sealing Levels
A - All transverse joints, longitudinal seams, and duct wall penetrations
B - All transverse joints and longitudinal seams
C - Transverse joints only

4. All joints, seams, connections, and penetrations in ductwork located outdoors shall be sealed watertight and weatherproof. Transverse joints shall be flanged and shall be provided with a continuous gasket and flange cap.

5. Ductwork shall be supported as required by SMACNA. Where ductwork is connected to equipment, it shall be independently supported with no weight bearing on the equipment and in such a manner that the equipment maybe removed for service without temporary support of the ductwork. Ductwork shall be supported within 24 inches of each elbow and within 48 inches of each branch intersection. Strap or wire hangers shall not be used where the hanger length exceeds 5 feet.

6. Ductwork shall be constructed and installed in accordance with the Drawings. When acceptable to Owner, modifications in the size and location of ductwork may be made where required to avoid interference with the building structure, piping systems, or electrical work. The installation shall be coordinated with other phases of work to establish space and clearance requirements. Unless otherwise indicated by a bottom of duct elevation, all ductwork shall be routed as high as possible, with a minimum height of 8 feet above the finished floor. Ductwork installed above suspended ceilings shall be installed with at least 8-inch lighting allowance between the ceiling and the bottom of the ductwork.

7. In vertical ducts with a closed bottom which terminate less than 24 inches above finished floor, the bottom of the ductwork shall be broken and sloped to a 1/2-inch drain hole in the bottom of the duct.

8. Turning vanes shall be installed in all elbows with 45 degree or greater angles. Vanes shall be double thickness or a minimum 4.5 inch radius type for vanes 30 inches and longer, where installed in ducts with velocity greater than 2000 fpm, or where installed in ducts with a pressure classification greater than 2 inches wc . Where 4.5 inch or double thickness type turning vanes are required, each vane shall be welded to the vane runner.

9. Sheet metal ductwork designed and indicated to operate at pressures greater than 3 inches wc shall be leaked tested according to SMACNA Duct Leakage Test Procedures. Representative sections of duct totaling not less than 25 percent of the total installed duct area for the designated pressure class shall be tested.

J. Flexible Duct and Takeoffs

1. The length of the flexible ductwork shall not exceed 8 feet. All support saddles for flexible duct shall be a minimum of 6 inches wide.

K. Access Doors

1. Airtight access doors shall be provided for inspection of all dampers, operators, filters, smoke detectors, duct-mounted coils, and at other locations indicated on the Drawings. The access doors shall be of a size suitable for the duct dimensions and at least 8 inches square for hand access, 18 inches for shoulder access, or as indicated on the Drawings. Each access door shall be installed to open against the pressure in the duct.

L. Temperature Controls

1. Automatic temperature controls shall be furnished and installed as indicated on the Drawings and as specified herein.

2. Contractor shall be responsible for determining that all equipment supplied is suitable for installation in the space indicated on the Drawings. Control equipment shall be installed with adequate space for operating and maintenance access.

3. The installation shall be checked by the manufacturer in accordance with the Installation Check paragraph.

4. Temperature Control Panels

a. The panels shall be mounted so that selector switches and indicating lights on the panel are located approximately 5 feet above the finished floor.

5. Thermostats

a. Wall-mounted thermostats shall be mounted above the finished floors as indicated in the Electrical section. Insulating spacers shall be provided for thermostats mounted on exterior building walls. The spacers shall be installed between the thermostat and its mounting surface, so that the thermostat will not be affected by surface temperatures.

b. Wall-mounted thermostats in non-air-conditioned areas shall be furnished and installed with a cast aluminum or wire guard.

3.04 FIELD QUALITY CONTROL

A. Installation Check

1. Where an installation check by the manufacturer is specified in the equipment installation paragraphs above, an experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation in accordance with the Startup Requirements section, and shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

2. The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

3. All costs for these services shall be included in the Contract Price.

B. Startup and Testing

1. After the equipment and systems have been installed, adjusted, and balanced, tests shall be conducted to demonstrate that each system is functioning as specified and to the satisfaction of Engineer. Tests shall be as indicated in the Startup Requirements section.

2. If inspection or tests indicate defects, the defective work or material shall be replaced, and inspection and tests repeated. All repairs to piping shall be made with new materials. Caulking of threaded joints or holes will not be acceptable.

3.05 CLEANING

A. At the completion of the testing, all equipment, pipes, ductwork, valves, and fittings shall be cleaned of grease, debris, metal cuttings, and sludge. Any stoppage, discoloration, or other damage to parts of the building, its finish, or furnishings shall be repaired by Contractor at no additional cost to Owner.

END OF SECTION

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SECTION 15650

REFRIGERATION SYSTEMS

PART 1 GENERAL

1.01 SCOPE

A. This section covers the furnishing and installation of refrigerant piping and accessories, condensing units, heat pumps, packaged air conditioning units, package heat pumps, mini split systems, dedicated outdoor air systems, and appurtenances associated with the heating, ventilating, and air conditioning (HVAC) systems.

B. Piping, pipe supports, valves, and accessories which are not an integral part of the equipment or are not specified herein are covered in other sections.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 GENERAL

A. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by Engineer.

1.04 MATERIAL COMPLIANCE WITH AIS

A. All parties are required to comply with the requirements of American Iron and Steel (AIS) and to ensure that all iron and steel products used in this project must be produced in the United States.

B. Coordination

1. Contractor shall verify that each component of the system is compatible with all other parts of the system; that all piping, ductwork, materials, fans, pumps, and motor sizes

are appropriate; and that all devices necessary for a properly functioning system have been provided.

2. Where two or more units of the same class of equipment are required, they shall be the product of a single manufacturer; however, all the component parts of the system need not be the products of one manufacturer.

3. Where individual equipment paragraphs specify the requirement for local service, each manufacturer shall have a local service center, or with written consent of Engineer, shall be able to provide service from other locations within 24 hours. The service center shall be equipped and staffed to service the system and shall maintain a local parts supply. Information on equipment manufacturers' representatives shall be included with the submittals.

4. Where several manufacturers' names have been listed in this section as possible suppliers, only the products of the first manufacturer listed have been checked for size, functions, and features.

5. General Equipment Stipulations

    a. The General Equipment Stipulations shall apply to all equipment and materials furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

C. Governing Standards

1. Except as modified or supplemented herein, all work covered by this section shall be performed in accordance with all applicable municipal codes and ordinances, laws, and regulations. In case of a conflict between this section and any state law or local ordinance, the latter shall govern.

2. All work shall comply with UL safety requirements.

3. The refrigerant systems shall be constructed in accordance with ASHRAE Standard 15. Refrigeration system equipment shall have a minimum efficiency of not less than specified in the latest edition of the Arkansas Energy Code.

4. Capacity ratings for condensing units, heat pumps, packaged air conditioning units, and packaged heat pumps with capacities less than 135,000 BTUH [39 kW] shall be in accordance with AHRI Standard 210/240. For condensing units, heat pumps, packaged air conditioning units and packaged heat pumps with capacities over 135,000 BTUH the capacity ratings shall be in accordance with AHRI Standard 340/360.

D. Power Supply

1. Power supply to equipment with motors shall be as indicated in the schedules on the Drawings. Power supply for controls shall be 120 volts, 60 Hz, single phase unless otherwise indicated or required for a properly operating system.

E. Metal Thickness

1. Metal thickness and gauges specified herein are minimum requirements. Gauges refer to US Standard gauge.

F. Mechanical Identification

1. Mechanical identification shall conform to the requirements of the Basic Mechanical Building Systems Materials and Methods section.

1.05 SUBMITTALS

A. Drawings and Data

1. Complete assembly and installation drawings, and wiring and schematic diagrams, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the Submittals Procedures section. Device tag numbers indicated on the Drawings shall be referenced on the wiring and schematic diagrams where applicable. The data and specifications for each unit shall include, but shall not be limited to, the following:

Packaged Air Conditioning Units/Packaged Heat Pumps

Name of manufacturer.
Type and model.
Construction materials, thickness, and finishes.
Locations and sizes of field connections.
Certified performance data and ratings.
Capacity at specified conditions.
Refrigerant type, charge, and safety data sheets.
Overall dimensions and required clearances.
Net weight and load distribution.
Multiline wiring diagrams clearly indicating field installed and factory installed wiring with all terminals identified.
Electrical requirements including voltage, number of phases, and amperage.
Where specified, information on equipment manufacturers' representatives.

Mini Split System Heat Pumps

Name of manufacturer.
Type and model.
Construction materials, thickness, and finishes.
Location and sizes of field connections.
Certified performance data and ratings.
Capacity at specified conditions.
Refrigerant type and charge.
Overall dimensions and required clearances.

Multiline wiring diagrams with field and factory wiring clearly identified and electrical requirements.
Net weight and load distribution.
Where specified, information on equipment manufacturers' representatives.

Dedicated Outdoor Air Unit System

Name of manufacturer.
Type and model.
Construction materials, thickness, and finishes.
Location and sizes of field connections.
Certified performance data and ratings.
Capacity and saturated suction temperature at specified conditions.
Equipment efficiency ratings.
Refrigerant type and charge.
Overall dimensions and required clearances.
Multiline wiring diagrams with field and factory wiring clearly identified and electrical requirements.
Net weight and load distribution.
Where specified, information on equipment manufacturer's representatives.

B. Operation and Maintenance Data and Manuals

1. Adequate operation and maintenance information shall be supplied as required in the Submittals Procedures section. Operation and maintenance manuals shall be submitted in accordance with the Submittals Procedures section. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

2. In addition to the requirements of the Submittals Procedures section, the operation and maintenance manuals shall include a listing of all filter locations, types, sizes, and quantities associated with each piece of equipment.

1.06 QUALITY ASSURANCE

A. Quality assurance shall comply with the requirements of the Basic Mechanical Building Systems Materials and Methods section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section.

1.08 EXTRA MATERIALS

A. Extra materials shall be furnished for the equipment as specified in the individual equipment paragraphs.

B. Extra materials shall be packaged in accordance with the Product Delivery Requirements section, with labels indicating the contents of each package. Each label shall indicate manufacturer's name, equipment name, equipment designation, part nomenclature, part number, address of nearest distributor, and current list price. Extra materials shall be delivered to Owner as directed.

C. Extra materials subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping.

PART 2 PRODUCTS

2.01 SERVICE CONDITIONS

A. All equipment shall be designed and selected to meet the specified conditions.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

A. Equipment and coil capacities shall be as indicated on the schedules. Where equipment is provided with special coatings, unit capacities shall be corrected to account for any efficiency losses from the selected special coating.

B. For equipment including fans, each fan's operating selection point on the fan curves shall be selected to the right of the peak pressure/efficiency point and below the lowest point along the fan curve, to the left of the peak pressure/efficiency point.

C. Dimensional Restrictions

1. Layout dimensions will vary between manufacturers and the layout area indicated on the Drawings is based on typical values of the first manufacturer listed. Contractor shall review the contract Drawings, the manufacturer's layout drawings, and installation requirements and shall make any modifications required for proper installation subject to acceptance by Engineer. At least 3 feet of clear access space shall be provided on all sides of the unit unless otherwise indicated.

D. Elevation

1. Equipment shall be designed to operate at the elevation indicated in the Meteorological and Seismic Design Criteria section. All equipment furnished for sites above 2000 feet above sea level shall be properly derated to operate and meet the specified capacities at the site conditions.

2.03 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers shall be as listed in the respective product description paragraphs.

2.04 MATERIALS

A. Refrigerant Piping and Accessories

1. Refrigerant piping shall conform to the Copper Tubing and Accessories section. Piping shall be supported as specified in the Pipe Supports section. Refrigerant filter dryers, expansion valves, solenoid valves, combination sight glass and moisture indicators, charging valves, relief valves, and other accessories shall be furnished and installed as needed for proper operation of the system.

2.05 EQUIPMENT

A. Packaged Air Conditioning /Heat Pump Units

1. Packaged air conditioning units, denoted by the symbol “PAC” and an identifying number, and packaged heat pumps denoted by the symbol “PHP” and an identifying number shall be furnished and installed where indicated on the Drawings. Each unit shall be designed for outdoor installation on a full perimeter curb as indicated on the Drawings. The packaged air conditioning unit/heat pump shall be manufactured by Trane, Carrier, Daikin, or York.

2. The manufacturer of the equipment provided shall have a local service center.

3. Extra Materials

Extra Materials	**Quantity**
Complete changes of lubricating oil	1
Sets of air filters	2

4. Performance and Design Requirements

a. The units shall be completely factory assembled and tested, piped, internally wired, fully charged with and compressor oil, and shipped in one piece. The unit shall be designed for direct expansion cooling and configured for heating type indicated. The unit shall be suitable for the power supply and shall have the capacities indicated on the Drawings. Cooling capacities listed in the schedule are gross cooling capacity.

b. The refrigeration system shall be capable of satisfactory cooling operation at the maximum and minimum outdoor ambient air temperatures indicated on the Drawings. In addition, heat pumps shall be capable of satisfactory heating operation at the outdoor ambient temperature indicated on the Drawings. Where units need to operate in the cooling mode at a lower temperature than the factory standard as indicated in the schedules on the Drawings, a low ambient kit shall be installed. The low ambient kit shall be designed for ambient temperature of 0° F consisting of a solid-state controller to vary the speed of the outdoor fan motor in response to refrigerant condensing temperature. The unit shall be provided with all necessary appurtenances required for a fully functional system as required for the proposed refrigerant and shall comply with all industry requirements and standards associated with the replacement refrigerant being used.

c. Where indicated in the schedules on the Drawings, all copper and other surfaces subject to corrosion from the atmosphere indicated shall be given a special coating.

5. Casing

a. The unit casing shall be of weatherproof design and shall be constructed of 20 gage or heavier zinc-coated steel. The casing shall be properly reinforced and braced for maximum rigidity. The casing shall be given a factory-applied coat of rust-inhibitive primer and shall be provided with the manufacturer's standard baked enamel finish. Interior surfaces of exterior casing members in contact with the airstream shall have 1 inch thick, 1 pound density, insulation coated on the air side. Aluminum foil-faced glass fiber insulation shall be used in gas fired heating sections. Hinged, insulated, neoprene gasketed access doors or removable panels shall be provided to permit easy inspection and maintenance. Surfaces in contact with the airstream shall comply with the requirements of ASHRAE 62.1. Removable insulated access panels shall have aluminum or steel covering on the interior to protect the insulation. The unit base shall be a one-piece, welded assembly with suitable roof curb sealing gasket and curb overhang for water runoff. Drains shall be provided to accommodate outdoor coil runoff.

6. Indoor Coil Section

a. The indoor coil shall be multirow of seamless copper tubing mechanically bonded to heavy-duty aluminum fins. The coil shall be factory leak tested underwater at 200 psig . The coil shall be provided with expansion device or valve, filter-dryer, and moisture indicator. The indoor coil section shall have fully insulated, sloped drain pan extending under the entire coil section and extending sufficiently past the coil to capture and collect any condensate carryover that may be produced when the unit is operating within the specified operating conditions. The drain pan construction shall comply with the requirements of ASHRAE 62.1.

7. Heating Sections

a. The unit shall have an electric heating coil.

b. Electric coils shall be completely factory assembled and wired integral within the unit. Coils shall be heavy-duty nickel chromium with an automatic reset device to de-energize all staging contactors on high temperature. The heating coils shall be electrically subdivided within the unit into balanced, individually fused stages as required by the National Electrical Code. The heating coil shall have the minimum number of stages indicated in the schedules on the Drawings.

8. Filters

a. Filters shall be mounted integral within the packaged air conditioning or heat pump unit and shall be 2 inches thick. Hinged access doors shall be provided. Filters shall conform to the requirements in the Heating, Ventilating, and Air Conditioning Systems section.

9. Fans and Motors

    a. The indoor supply fan shall be forward-curved, multiblade, centrifugal type and shall be statically and dynamically balanced by the fan manufacturer. The fan shall have die-formed, streamlined inlets and the scroll shall be constructed of steel with all seams sealed airtight. The fan shall have steel shafts operating in self-aligning, grease lubricated ball bearings.

    b. Units 5 tons and smaller shall have direct or belt driven fans. Where direct driven fans are used, the fan shall have multiple speeds to allow for airflow adjustment. Units greater than 5 tons shall have V-belt drive with adjustable sheaves and shall be designed for 50 percent overload. The supply fan motor shall conform to the requirements of the Electric Motors paragraph. Vibration isolators shall be provided for the fan assembly and motor assembly.

    c. Static pressure values indicated on the Drawings are external to the complete unit. Internal coil(s), dampers, filters, and fan housing losses are not included. A filter allowance of 0.35-inch water column shall be used for 2-inch pleated filter losses.

    d. The outdoor fans shall be direct drive, vertical discharge, propeller type with aluminum blades. Fan motors shall be weatherproof with permanently lubricated ball bearings and built-in thermal overload protection. A corrosion resistant wire guard shall be installed over the fan opening.

10. Compressors

    a. Compressors shall be of the reciprocating hermetic, semi-hermetic, or scroll type mounted on vibration isolators. The compressor motor shall have temperature and current sensitive overload protection devices. Each packaged air conditioning or heat pump unit shall have a minimum number of capacity reduction steps as indicated in the schedules on the Drawings.

    b. Reciprocating hermetic compressors shall be suction gas cooled with internal pressure relief for high pressure protection, high- and low-pressure cutout switches, temperature actuated crankcase heater, and automatic reset timer to prevent the compressor from rapid cycling.

    c. Reciprocating semi-hermetic compressors shall be suction gas cooled, internal pressure relief for high pressure protection, high- and low-pressure cutout switches, temperature actuated crankcase heater, oil level sight glass, and automatic reset timer to prevent the compressor from rapid cycling. Capacity reduction shall be provided by automatic suction valve unloaders. Each compressor shall start unloaded.

    d. Scroll compressors shall be suction gas cooled with high- and low-pressure cutout switches and automatic reset timer to prevent the compressor from rapid cycling. The compressor shall have radial and axial compliant scroll plates to allow the compressor to handle liquid slugging without damage to the compressor.

11. Refrigerant Circuit

    a. The factory sealed refrigerant system shall consist of compressors, outdoor coils, indoor coils, expansion device, refrigerant dryer, reversing valves for heat pump units, accumulators, refrigerant piping, and a full operating charge of refrigerant. Units with multiple stages shall have a separate refrigerant circuit for each stage where available as a manufacturer's standard option. Service gauge connections shall be furnished on the suction, discharge, and liquid lines. Units with multiple compressors shall have multiple circuits with separate expansion device, refrigerant dryer, reversing valves for heat pump units, accumulators, compressor, and refrigerant charge. All factory installed gauges, switches, and other devices connected to the refrigerant circuit shall have isolation valves.

12. Outdoor Coil

    a. The outdoor coil shall be of the air-cooled integral finned tube type. The coil shall be constructed of copper tubes with aluminum fins permanently and securely bonded to the tubes. The coil shall be factory leak and pressure tested. The coils shall be protected with hail guards.

13. Accessories

    a. Where indicated on the Drawings, the packaged unit shall be provided with an economizer to automatically utilize up to 100 percent of outside air for cooling. The economizer shall modulate return and outside air dampers to maintain proper discharge temperature into the conditioned space. The dampers shall be equipped with automatic lockout when the outside air conditions are not suitable for proper cooling, and shall have adjustable minimum position control. The damper motor shall be spring return and shall operate to close the outside damper during shutdown. 100 percent relief of the return air shall be provided. The economizer shall be factory installed unless not available as a factory option. Where not available as factory installed, a field installed economizer shall be furnished and installed including damper, hood, controls, and all appurtenances required for a complete installation.

    b. Where an economizer package is not specified, a manually set air damper shall be furnished to provide the indicated outside air volume.

    c. Where indicated on the Drawings, hot gas bypass shall be installed to provide reduced capacity control.

    d. Where indicated on the Drawings, modulating hot gas reheat coil shall be provided to provide humidity control.

    e. Packaged units shall be furnished with a roof mounting curb. The curb shall be constructed of at least 16-gauge zinc-coated steel with nominal 2 by 4-inch wood nailer strip and with supply and return air openings. The curb shall be a minimum of 16 inches high unless mentioned otherwise in the schedules on the Drawings. The curb shall be approved by the National Roofing Contractors Association.

14. Controls

    a. Each packaged unit shall be completely factory wired with a single point power connection and factory installed integral disconnect switch. Where a factory installed integral disconnect switch is not available as a standard option, a disconnect switch for field installation on the unit shall be provided. All wiring shall be installed in accordance with the National Electrical Code.

    b. The unit shall be provided with remote control and monitoring panel consisting of system operation switches and signal lights. The signal lights shall be provided for power and dirty filters.

    c. Packaged units shall be provided with a factory wired control panel containing full voltage magnetic starters for compressor, outdoor fan, and indoor fan motors, and internal control power transformer.

    d. Defrost controls, electronic timed initiated and temperature terminated with field adjustable timer shall be provided for all packaged heat pumps. When auxiliary electric heating is provided, a factory installed emergency heat package shall be provided. When heating is locked out, the auxiliary heat shall be activated as necessary.

    e. Units with multiple compressors shall have a built-in time delay to prevent both compressors from starting simultaneously.

    f. All internal panel wiring shall be neatly run in gutters or bundles to terminal strips for connection of external wiring. All wires and terminal strips shall be numbered, or color coded in accordance with the wiring diagram. All internal and external controls, gauges, lights, and switches shall be identified with nameplates. A complete wiring diagram showing the compressor and fan starting circuits and the control circuit shall be furnished.

    g. Terminal blocks shall be factory wired to provide terminal points for permissive start for each stage of cooling or cooling and heating from a remotely located control panel or thermostat; terminal points to energize remote dirty filter, heating mode, cooling mode, and service indicating lights; and terminal points to de-energize the unit upon detection of smoke.

    h. A thermostat for operation of the unit shall be furnished and installed as indicated and located where indicated on the Drawings. The thermostat shall be a programmable wall mounted type and shall be single or multistage as required by the controlled equipment, solid state programmable electronic type configurable for use with a conventional or heat pump system. The thermostats shall have a setpoint range of approximately 45° F to 95° F with the following features:

        1) Seven (7)-day programming with 2 occupied/unoccupied periods per day
        2) Automatic heat/cool changeover
        3) Battery backup
        4) Setback controls to automatically restart and temporarily operate system during setback periods

5) Digital display
6) Temporary override of setpoints
7) 2 configurable LEDs
8) Where an economizer is used, the programmable thermostat shall be suitable for interfacing with the economizer control package

B. Dedicated Outdoor Air Unit

1. Dedicated outdoor air units, denoted by the symbol “DOAU” and an identifying number shall be furnished and installed where indicated on the Drawings. Each unit shall be designed for outdoor installation on a full perimeter curb as indicated on the Drawings. Subject to compliance with specifications contained within this document, manufacturers offering products that may be incorporated into the work include, Greenheck, Trane, or AAON.

2. Unit shall be fully assembled at the factory and consist of an insulated metal cabinet, outdoor air intake, blower, evaporator coil, hot gas reheat coil, direct expansion cooling system, electric post-heating section, supply air filter, discharge damper, and an electrical control center. Weatherproof hood with aluminum bird screen shall be provided for outdoor air intake opening. All specified components and internal accessories shall be factory installed, tested, and prepared for single-point high voltage connection.

3. The manufacturer of the equipment provided shall have a local service center.

4. Extra Materials

Extra Materials	**Quantity**
Set of air filters	2

5. Performance and Design Requirement

a. The unit shall be completely factory assembled and tested, piped, internally wired, fully charged with R-454B (or manufacturer’s standard code-compliant replacement refrigerant for R410A) and compressor oil, and shipped in one piece. The unit shall be provided with all necessary appurtenances required for a fully functional system as required for the proposed refrigerant and shall comply with all industry requirement and standards associated with the refrigerant being used. The unit shall be designed for direct expansion type cooling and configured for heating type indicated. The unit shall have the capacities and be suitable for power supply as indicated in the schedules on the Drawings.

b. Where indicated in the schedules on the Drawings, all copper and other surfaces subject to corrosion from the atmosphere indicated shall be given a special coating.

6. Casing

a. The unit casing shall be of weatherproof design and shall be constructed of G60 galvanneal steel or heavier zinc coated steel. The casing shall be properly

reinforced and braced for maximum rigidity. The casing shall be provided with protective coating as follows, use two coats of corrosion resistant epoxy for all interior components. Use one coat corrosion resistant epoxy and one coat corrosion resistant polyurethane on exterior components. Uncoated galvanized steel exterior is not acceptable. controls panels, wiring connections and other sensitive electronics shall be provided with heresite, E-coat, microguard, or equal. Internal assemblies shall be constructed of 24 gauge, galvanized (G90) steel except for motor supports which shall be minimum 14 gauge galvanized (G90) steel. Cabinet insulation shall comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.

b. Hinged, insulated, neoprene gasketed access doors or removable panels shall be provided to permit easy inspection and maintenance. Surfaces in contact with the airstream shall comply with the requirements of ASHRAE 62.1. removable insulated access panels shall have aluminum or steel covering on the interior to protect the insulation.

c. Drain pan shall be an integral part of the unit whenever a cooling option is included. Pan shall be formed welded austenitic stainless steel sheet material and provided with a welded stainless steel drain connection at the front for the connection to a P trap. Drain pan shall be sloped in two directions to provide positive draining and drain connector shall be sealed at penetration through cabinet wall. The drain pan construction shall comply with ASHRAE 62.1 requirements.

7. Evaporator Coil Section

a. The evaporator coil shall be constructed of copper tubing, permanently bonded to aluminum fins and enclosed in a galvanized steel frame. If two compressors are used as components of the unit, then the evaporator coil shall be of “interlaced” configuration, permitting independent operation of either compressor without conflict with the other compressor. The evaporator, hot gas reheat, and condensing coils shall be coated with corrosion inhibiting special coating as specified in the schedules on the Drawings.

8. Heating Section

a. The unit shall have an electric post-heating coil section.

b. Electric coils shall be finned tube type, completely factory assembled, and wired integral within the unit. Electric heating coils shall have SCR control and shall include a temperature sensor with field adjustable set point, located in the supply air stream. Heat output of the post heater shall be infinitely variable to maintain the supply air temperature setpoint.

c. A reheat coil with factory installed modulating hot gas reheat valve shall be furnished to control space humidity when specified in the schedules on the Drawings.

9. Filters

    a. Filters shall be mounted integral within the dedicated outdoor air unit system and shall be 2 inches (50 mm) thick. Hinged access doors shall be provided. Filters shall conform to the requirements in the Heating, Ventilating, and Air Conditioning Systems section.

10. Fans and Motors

    a. The blower assembly shall consist of an electric motor and direct drive fan. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125-inch-thick neoprene vibration isolators. Blower motors shall be capable of delivering constant airflow and shall be provided with an AFD for initial balancing when specified in the schedules on the Drawings.

    b. Blower assemblies shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

    c. Blower motors greater than ½ horsepower shall be “NEMA Premium” unless otherwise indicated. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase, and enclosure.

    d. Motors shall be suitable for 60 cycles, 3 phase, 480 volts power supply.

    e. The outdoor condenser fans shall be direct-drive, vertical discharge, propeller type with aluminum blades. Fan motors shall be weatherproof with permanently lubricated ball bearing and built-in thermal overload protection. A corrosion resistant wire guard shall be installed over the fan opening.

11. Refrigeration System

    a. Units shall have an integral compressor(s) and evaporator coil located within the weather-tight unit housing. The evaporator, hot gas reheat coil and condensing coils shall be coated with corrosion inhibiting special coating where specified in the schedules on the Drawings. Condenser coils and appurtenant condenser fan assemblies shall be factory installed as integral subassemblies of the unit and mounted on the exterior of the unit. Lead condenser fan shall have EC motor to maintain condenser pressure at part load conditions. The lead refrigerant compressor(s) shall be inverter hermetic scroll type and shall be equipped with liquid line filter drier, thermostatic expansion valves (TXVs), manual reset high pressure and low-pressure cutouts and all appurtenant sensors, service ports and safety devices.

    b. Units with multiple compressors shall have a built-in time delay to prevent both compressors from starting simultaneously.

    c. Refrigeration system control and diagnostics: The refrigeration system shall be controlled by an onboard microprocessor-based controller that indicate both OWNER supplied settings and fault conditions that may occur. The controller shall be programmed to indicate the following faults:

1) Global alarm conditions (active when there is at least one alarm)
2) Supply air proving alarm
3) Dirty filter alarm
4) Compressor trip alarm
5) Compressor locked out alarm
6) Supply air temperature low limit alarm
7) Sensor #1 Out of range (supply air temperature sensor)
8) Sensor #2 Out of range (room thermostat)
9) Sensor #3 Out of range (room humidistat)

12. Accessories

a. Units shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply. Unit shall be equipped with a disconnect switch. Electric heater shall have single point power.

b. Unit shall have a factory-installed phase monitor to detect electric supply phase loss and voltage brown-out conditions. Upon detection of a fault, the monitor shall disconnect supply voltage to all motors.

c. Electrically operated two position discharge damper(s). Damper shall be of low-leakage type and factory installed. Damper operator shall conform to the requirements in the Heating, ventilating, and Air Conditioning Systems section.

d. Dedicated outdoor air units shall be furnished with a roof mounting curb. The curb shall be constructed of at least 16-gauge (1.52 mm) zinc-coated steel with nominal 2 by 4-inch wood nailer strip and with supply air openings. The curb shall be approved by the National Roofing Contractors Association.

e. LED service lights to be mounted in the unit and used during times of routine maintenance. Service lights to be factory wired and powered.

f. Unit shall be supplied with a Dirty Filter Sensor

g. Unit shall be supplied with an Airflow Proving Sensor in the supply air stream.

h. Unit shall be supplied with a space thermostat and humidistat measuring temperature and relative humidity. Thermostats shall have an LCD display and push buttons allowing for setpoint adjustments.

13. Controls

a. The unit shall be furnished with a complete control system consisting of fan starters and overload devices, cooling and heating system controls, an airflow proving switch, control circuit fuses, and a factory installed integral disconnect switch. Where a factory installed integral disconnect switch is not available as a standard option, a disconnect switch for field installation on the unit shall be provided. Controls shall be suitable for interfacing with and enacting the control sequence and concept indicated on the Drawings.

b. The controls shall include controls to lock out the heating section when the outside air temperature is above the outdoor air inlet sensor setpoint.

c. An equipment control panel, denoted by the symbol “ECP” and an identifying number, shall be furnished with the makeup air unit and located where indicated on the Drawings. The panel shall be NEMA Type 12 and shall allow for remote operation of the unit with a “On-Off-Auto” switch, a supply temperature setpoint adjustment, and indicating lights for fan on, heat, cooling, safety lockout, and dirty filters. Where indicated in the sequence of operations, a room override thermostat shall be mounted on the panel.

2.06 ELECTRICAL

A. Electric motors and motor controls shall conform to the Basic Mechanical Building Systems Materials and Methods section. Motor starters and controls shall be furnished and installed under the Electric Motors section, except for equipment specified or furnished with prewired integral starters. Disconnects for equipment shall be furnished and installed under the Division 16 - Electrical sections, except where specified with disconnects. All electrical controls shall have enclosures suitable for the environment and NEMA rating as indicated on the electrical Drawings. Equipment installed outdoors shall have NEMA Type 4X enclosures, minimum.

2.07 DRIVE UNITS

A. Electric motors, V-belt drives, and safety guards shall be in accordance with the requirements of the Basic Mechanical Building Systems Materials and Methods section.

2.08 MANUFACTURE AND FABRICATION

A. Manufacture and fabrication shall comply with the requirements of the Basic Mechanical Systems Materials and Methods section.

2.09 SHOP TESTING

A. The equipment furnished under this section shall be tested at the factory according to the standard practice of the manufacturer. Ratings shall be based on tests made in accordance with applicable AMCA, ASHRAE, AHRI, NBS, NFPA, and UL Standards.

2.10 BALANCE

A. All rotating parts shall be accurately machined and shall be in as nearly perfect rotational balance as practicable. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that the resonance at normal operating speeds is avoided. In any case, the maximum measured root-mean-square (rms) value as measured at any point on the equipment shall not exceed those listed in the latest ASHRAE Applications Handbook.

B. At any operating speed, the ratio of rotative speed to the critical speed of a unit or components thereof shall be less than 0.8 or more than 1.3.

PART 3 EXECUTION

3.01 INSPECTION

A. Equipment installed in facilities with limited access shall be suitable for being installed through available openings. Contractor shall field verify existing opening dimensions and other provisions for installation prior to submittal of bids.

3.02 PREPARATION

A. Field Measurement

1. Contractor shall be responsible for verifying all field dimensions, and for verifying location of all equipment relative to any existing equipment or structures.

B. Surface Preparation

1. All surfaces to be field painted shall be dry and free of dirt, dust, sand, grit, mud, oil, grease, rust, loose mill scale, or other objectionable substances, and shall meet the recommendations of the paint manufacturer for surface preparation. Cleaning and painting operations shall be performed in a manner which will protect freshly painted surfaces from dust or other contaminants. Oil and grease shall be completely removed by use of solvents or detergents before mechanical cleaning is started. The gloss of previously painted surfaces shall be dulled if necessary for proper adhesion of topcoats.

2. Surface finish damaged during installation shall be repaired to the satisfaction of Engineer. Field painting shall be as specified in the Finish Painting section.

3.03 INSTALLATION

A. Equipment and materials furnished under this section shall be installed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

B. The space beneath the baseplate shall be grouted as specified in the Grouting section.

C. Refrigerant Piping and Accessories

1. The refrigerant piping shall be sized and arranged in accordance with the manufacturer’s recommendations. Pipe routing and isolation shall be selected to minimize vibration and transmission of sound to the conditioned space. The refrigerant piping system shall be provided with the necessary traps and risers for uniform return of oil to the compressor. The suction gas line shall be sized to produce a minimum load gas velocity of 1,000 feet per minute in vertical risers with upward gas flow and 500 feet per minute in horizontal piping. The full load pressure drop should not exceed 3 psi or 2°F change in saturated refrigerant temperature. The maximum gas velocity shall not exceed 4,000 feet per minute. The liquid lines shall be sized to limit the pressure loss to the equivalent of 2°F of temperature change and a maximum liquid line velocity of 360 feet per minute. A piping schematic

indicating refrigerant piping sizes and corresponding velocities, accessories, accessory pressure losses, and piping pitch and direction shall be submitted in accordance with the Submittals section.

D. Packaged Air Conditioning Units/Packaged Heat Pumps

1. The packaged air conditioning units and packaged heat pumps shall be installed in accordance with the manufacturer's installation instructions. Each unit shall be leveled and installed to maintain the manufacturer's recommended clearances. The units shall be firmly anchored to the equipment curbs with corrosion resistant fasteners.

2. The installation shall be checked by the manufacturer in accordance with the Installation Check paragraph.

E. Dedicated Outdoor Air Unit System

1. Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance.

2. Examine roughing-in of plumbing, electrical and HVAC services to verify actual location and compliance with unit requirements.

3. Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices, and all applicable building codes.

4. The installation shall be checked by the manufacturer in accordance with the installation check paragraph.

3.04 FIELD QUALITY CONTROL

A. Installation Check

1. Where an installation check by the manufacturer is specified in the equipment installation paragraphs above, an experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation in accordance with the Startup Requirements section and shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

2. The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

3. All costs for these services shall be included in the Contract Price.

B. Startup and Testing

1. After the equipment and systems have been installed, adjusted, and balanced, tests shall be conducted to demonstrate that each system is functioning as specified and to the satisfaction of Engineer. Tests shall be as indicated in the Startup Requirements section.

2. If inspection or tests indicate defects, the defective work or material shall be replaced, and inspection and tests repeated. All repairs to piping shall be made with new materials. Caulking of threaded joints or holes will not be acceptable.

3.05 CLEANING

A. At the completion of the testing, all equipment, pipes, ductwork, valves, and fittings shall be cleaned of grease, debris, metal cuttings, and sludge. Any stoppage, discoloration, or other damage to parts of the building, its finish, or furnishings shall be repaired by Contractor at no additional cost to Owner.

END OF SECTION

SECTION 15990

TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.01 SCOPE

A. This section covers the cleaning, testing, adjusting, and balancing of the air system(s) associated with the heating, ventilating, and air conditioning (HVAC), and odor control system.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 GENERAL

A. Equipment and systems shall be cleaned, tested, adjusted, and balanced in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by Engineer. Contractor shall replace any belts and sheaves as needed to balance the airflows as indicated. An allowance shall be provided to cover belt and sheave replacement work, and shall be refunded to the Client if not used.

B. Coordination

1. Contractor shall verify that all components and devices necessary for a properly functioning system have been provided. Prior to cleaning, testing, adjusting, and balancing, Contractor shall verify that each system has been installed properly and is operating as specified. Equipment bearings shall be lubricated in accordance with the manufacturer’s recommendations.

2. Air systems shall be complete and operating, with dampers, filters, ductwork, air outlet and inlet devices, duct mounted equipment, and control components.

C. Governing Standards

1. Except as modified or supplemented herein, all work covered by this section shall be performed in accordance with all applicable municipal codes and ordinances, laws, and regulations. In case of a conflict between this section and any state law or local ordinance, the latter shall govern.

2. All work shall comply with the latest edition of AABC, NEBB, or SMACNA standard manuals for testing, adjusting, and balancing of air systems.

1.04 SUBMITTALS

A. Drawings and Data

1. Complete apparatus report sheets for all air systems shall be accurately and completely filled out in accordance with the Standard's manual. The testing and balancing results shall be submitted on the TAB report forms of the applicable standard. Copies of the final test readings and report sheets shall be submitted in accordance with the Submittals Procedures section. A description of the standard procedures used during testing, adjusting, and balancing shall be included in the submittal. The submittal shall include a reduced set of drawings, with the air outlet devices, air inlet devices, and equipment identified to correspond with the report sheets. Test dates shall be recorded on the individual TAB report forms indicating when the actual testing was performed.

2. The apparatus report sheets shall include the following information:

a. Title Page

1) Company name
2) Company address
3) Company telephone number
4) Project name
5) Project location
6) Project Engineer
7) Project Contractor
8) Project altitude
9) Date

b. Instrument List

1) Instrument
2) Manufacturer
3) Model
4) Serial number
5) Range
6) Calibration date

c. Air Moving Equipment

1) Unit number

2) Location
3) Manufacturer
4) Model and serial number
5) Airflow, design and actual
6) Total static pressure (total external), design and actual
7) Static pressure, inlet and discharge
8) Total pressure
9) Fan RPM, design and actual

d. Electric Motors

1) Manufacturer
2) Motor type and frame
3) HP/BHP
4) Phase, voltage, amperage, nameplate, actual, no load
5) RPM
6) Service factor
7) Starter size, rating, heater elements

e. VBelt Drive

1) Required driven RPM
2) Driven sheave make, diameter, and RPM
3) Belt make, size, and quantity
4) Motor sheave make, diameter, and RPM
5) Center to center distance, maximum, minimum, and actual

f. Return Air/Outside Air Data

1) Unit number
2) System airflow, design and actual
3) Return airflow, design and actual
4) Outside airflow, design and actual
5) Return air temperature
6) Outside air temperature
7) Mixed air temperature, design and actual
8) Outside/return air ratio, design and actual

g. Coil Data

1) Unit number
2) Location
3) Service
4) Manufacturer
5) Fin spacing and rows
6) Face area
7) Airflow, design and actual
8) Air velocity, design and actual
9) Entering air DB temperature, design and actual
10) Entering air WB temperature, design and actual
11) Leaving air DB temperature, design and actual

12) Leaving air WB temperature, design and actual
13) Water flow, design and actual
14) Water pressure drop, design and actual
15) Entering water temperature, design and actual
16) Leaving water temperature, design and actual
17) Air pressure drop, design and actual

h. Duct Traverse

1) System zone/branch
2) Duct size
3) Area
4) Velocity, design and actual
5) Airflow, design and actual
6) Duct static pressure
7) Air temperature
8) Air correction factor

i. Outlet and Inlet Devices

1) Air outlet and inlet device number
2) Room number/location
3) Air outlet and inlet device type
4) Air outlet and inlet device size
5) Area factor
6) Velocity, design, preliminary, and final
7) Air flow, design, preliminary, and final
8) Percent of design airflow

j. Sound Level Report

1) Location
2) Octave bands equipment off
3) Octave bands equipment on

k. Room/Space/System Pressurization Report

1) Location
2) Room Number
3) Pressurization, preliminary, and final
4) Description of steps taken to achieve correct pressurization

l. Package Air Conditioning/Heat Pump Unit

1) Unit number
2) Location
3) Manufacturer and model
4) Refrigerant type and capacity
5) Airflow, design and actual
6) Return airflow, design and actual
7) Outside airflow, design and actual

8) Dry bulb temperature, entering and leaving
9) Wet bulb temperature, entering and leaving
10) Outside air temperature, dry and wet bulb

m. Air Terminal Unit Data

1) Manufacturer
2) Type, constant, variable, single
3) Unit number
4) Location
5) Model
6) Size
7) Minimum static pressure
8) Minimum design airflow
9) Maximum design airflow
10) Maximum actual airflow
11) Inlet static pressure

n. Electric Duct Heater

1) Manufacturer
2) Unit number
3) Location
4) Model
5) Design kW
6) Number of stages
7) Phase, voltage, amperage
8) Test voltage (each phase)
9) Test amperage (each phase)
10) Airflow, design and actual
11) Temperature rise, design and actual
12) Face area

o. Air Cooled Condenser/Heat Pump

1) Unit number
2) Location
3) Manufacturer and model
4) Refrigerant type and capacity
5) Entering DB air temperature, design and actual
6) Leaving DB air temperature, design and actual
7) Number of compressors
8) Suction pressure and temperature
9) Condensing pressure and temperature

p. Odor Control Vessels

1) Unit number
2) Manufacturer and model
3) Air pressure drop across media bed(s), design and actual

q. Dedicated Outdoor Air Units

1) Unit number
2) Location
3) Manufacturer and model
4) Refrigerant type and capacity
5) Heating type and capacity
6) Airflow, design and actual
7) Dry bulb temperature, entering and leaving
8) Wet bulb temperature, entering and leaving
9) Number of compressors

3. Product data indicating cleaning materials and treatment, chemicals, and reports on the analysis of system water after cleaning and after treatment, shall be submitted in accordance with the Submittals Procedures section.

1.05 QUALITY ASSURANCE

A. Contractor shall provide the services of a licensed independent contractor, certified by AABC, NEBB, or TABB and with proven experience on at least three similar projects, to perform operational testing, adjusting, and balancing of the air. The work shall be performed in accordance with the latest edition of the procedural standards as published by the National Organization associated with the testing, adjusting, and balancing contractor.

PART 2 PRODUCTS

2.01 SERVICE CONDITIONS

A. All equipment shall be adjusted or balanced to meet the specified conditions and to operate at the elevation indicated in the equipment sections.

2.02 CONSTRUCTION

A. Painting

1. Surface finish damaged during cleaning, testing, adjusting, and balancing of equipment shall be repaired to the satisfaction of Engineer. Field painting shall be as specified in the Protective Coatings sections.

PART 3 EXECUTION

3.01 INSPECTION

A. Before testing and balancing the air system, doors and windows surrounding the area served by the system shall be closed. Fans shall be checked for correct rotation and rotative speed. Dampers shall be open and access doors and panels shall be closed during the testing and balancing period.

B. A resistance shall be placed at all filter locations to simulate dirty filter conditions. The resistance shall remain in place during all work, and shall be removed at the end of work. The filter resistance shall be as follows:

Filter Type	Simulated Loss
2 inch pleated	0.35 inch water column

C. Before starting the hydronic system testing and balancing, all valves and control components shall be opened or set to direct flow through the heat transfer element. The pumps shall be checked for correct rotation and rotative speed.

3.02 STARTUP REQUIREMENTS

A. System equipment shall be subject to preliminary field tests as indicated in Startup Requirements section.

3.03 FIELD PERFORMANCE TESTING

A. Field performance tests shall be conducted for each system to demonstrate each is functioning as specified and to the satisfaction of Engineer. All tests shall be conducted in a manner acceptable to Engineer and shall be repeated as many times as necessary to secure Engineer's acceptance of each system. If inspection or tests indicate defects, the defective item or material shall be replaced, and the inspection and tests shall be repeated. All repairs to piping shall be made with new materials. Caulking of threaded joints or holes will not be acceptable.

B. Air filters which are subject to a pressure loss exceeding the dirty filter values shall be removed and replaced. The spare air filters furnished with equipment shall not be used as the replacement filters. Dirty filter values shall be as follows:

Filter Type	Dirty Filter Conditions
2 inch pleated	1 inch water column

C. Refrigerant Piping

1. The refrigerant piping system shall be tested in accordance with ANSI/ASME B31.5.

2. After testing of the refrigerant piping system is completed, the system shall be charged with the proper refrigerant and placed in operation.

3. The completed refrigerant system shall be guaranteed to be sufficiently free from leaks for 1 year from the date of acceptance. The loss of refrigerant shall not exceed 5 percent over that period.

3.04 CLEANING

A. At the completion of the testing, all parts of the installation shall be thoroughly cleaned. All equipment, ductwork, pipes, valves, and fittings shall be cleaned of grease, debris, metal cuttings, and sludge. Any stoppage, discoloration, or other damage to parts of the

building, its finish, or furnishings shall be repaired by Contractor at no additional cost to Owner.

3.05 ADJUSTING & BALANCING

A. The air system shall be adjusted and balanced.

B. All instrumentation shall be calibrated in accordance with the governing standard manual and shall be checked for accuracy before testing, adjusting, and balancing the systems. The accuracy of the instrumentation shall be not less than specified by the testing, adjusting, and balancing standard manual or the instrument manufacturer.

C. All data, including system deficiencies encountered and corrective measures taken, shall be recorded. If a system cannot be adjusted to meet the design requirements, Contractor shall notify Engineer in writing as soon as practicable.

D. Following final acceptance of the certified balancing reports, the testing and balancing contractor shall permanently mark the settings of all adjustment devices, including valves and dampers, and shall lock the memory stops. If any locking devices are non-functional, Contractor shall replace or repair them.

E. All ceiling tiles, belt guards, panels, and doors removed during testing, adjusting, and balancing shall be reinstalled.

F. Air Systems

1. Air systems shall be adjusted to the design airflows indicated on the Drawings. Airflows shall be adjusted to maintain a net positive (supply airflow greater than exhaust airflow) or negative (exhaust airflow greater than supply airflow) pressure as indicated on the Drawings. Dampers located behind air outlet and inlet devices shall be used to adjust the airflow only to the extent that the adjustments do not create objectionable air movement or noise. Fans shall not be adjusted above the maximum safe speed as determined by the fan manufacturer.

2. Dampers with operators shall be checked for tight shutoff when in the closed position. Shutoff dampers shall not be used for balancing.

END OF SECTION

SECTION 16000

ELECTRICAL GENERAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall provide and install equipment, labor, and material as referenced in the Specifications and Drawings for two (2) proposed electrical services, in coordination with the Bentonville Electrical Utility Department. The Bentonville WRRF has three (3) existing electrical services that will remain in place during the treatment plant upgrade. Two (2) of the existing electrical services will be phased out and removed after the treatment plant upgrades are complete.

B. Existing service #1 is located at the Blower Building at the southern end of the WRRF. The service is fed from a power pole on the southeast corner of the site, travels west underground along the southern fence line, before turning north at the western property edge to the Blower Building 500kVA pad mount transformer. No changes are proposed for this service during the project.

C. Existing service #2 is located at the Operations Building in the center of the WRRF. The service is fed from the southeast corner power pole, underground to a junction box on the eastern property line. From the junction box, the service is fed underground to a 1000kVA pad mount transformer and 1600A main circuit breaker. The main feeds a 1600A switchboard inside the Operations Building. This switchboard is the service point for all plant equipment except the Blower Building and Anoxic Basin, and must be maintained until these loads are transferred to the proposed services. Once the loads have been transferred, existing service #2 will be demolished and the Operations Building will be re-fed with a single 480V three phase feed from proposed service #2.

D. Existing service #3 is located at the northern end of the WRRF. The service is fed underground, continuing from the junction box of existing service #2 along the eastern property edge, to a junction box and 300kVA pad mount transformer and outdoor motor control center. The existing service #3 junction box also connects to an underground primary line that routes to a secondary overhead/underground distribution circuit on the western side of the WRRF. Existing service #3 will remain in service until the existing Anoxic Basin loads have been transferred to proposed service #1 at the headworks area. Once the loads have been transferred, existing service #3 will be removed.

E. Proposed service #1 will be located at the northwest corner of the WRRF, with a 1500kVA pad mount transformer, 2500A service entrance automatic transfer switch (ATS), and motor control center. This service shall power the influent bar screen and grit removal equipment, air compressors for the anoxic basin, and eight (8) rotors for the aeration basins.

F. Proposed service #2 will be located near the Effluent Pump Station, with a 1000kVA pad mount transformer, 1600A service entrance ATS, and motor control center. The service will power clarifiers, RAS and WAS pumps, filtration, UV, post aeration, effluent pumping, and other miscellaneous building loads.

G. The Contractor shall install all Division 13 control and instrumentation equipment, and assist in the startup of all SCADA activities. The Contractor shall install all raceways for fiber optic communications across the treatment plant. The Contractor shall install site security equipment in coordination with Division 13.

H. All wiring and terminations for this project shall be provided under Division 16 unless otherwise specified.

I. The scope of the work consists of the furnishing and installing of complete electrical systems – exterior and interior – including miscellaneous systems. The Contractor shall provide all supervision, labor, materials, equipment, machinery, and any and all other items necessary to complete the systems. The Contractor shall note that all items of equipment are specified in the singular; however, the Contractor shall provide and install the number of items of equipment as indicated on the drawings and as required for complete systems.

J. The Contractor shall provide all conduit, wire, and field connections for all control panels, control stations, motors, and other miscellaneous equipment furnished under other Divisions of the project.

K. The Contractor shall provide all conduit, wire, and field connections for all instrumentation and data networks furnished under Division 13 of the project as shown on the Drawings.

L. The Contractor shall provide all conduit, wire, and field connections for all HVAC equipment provided under Division 15 of the project.

M. It is the intention of the Specifications and Drawings to call for finished work, tested, and ready for operation.

N. Any apparatus, appliance, material or work not shown on drawings but mentioned in the specifications, or vice versa, or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation, even if not particularly specified, shall be furnished, delivered and installed by the Contractor without additional expense to the Owner.

O. Minor details not usually shown or specified, but necessary for proper installation and operation, shall be included in the Contractor’s estimate, the same as if herein specified or shown.

P. With submission of bid, the Contractor shall give written notice to the Engineer of any materials or apparatus believed inadequate or unsuitable, in violation of laws, ordinances, rules; any necessary items or work omitted. In the absence of such written notice, it is mutually agreed the Contractor has included the cost of all required items in his proposal, and that he will be responsible for the approved satisfactory functioning of the entire system without extra compensation.

Q. Provide all temporary power for construction. Coordinate requirements with other trades.

R. Provide all electrical demolition work associated with abandonment or relocation of existing facilities, including disconnecting and removal of all conduit and cable to equipment being removed.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Excavation and backfilling responsibility shall be coordinated with Division 2 and conform to the requirements in Part 3 of this Specification.

B. Concrete work, including equipment pads, concrete electrical duct banks, lighting bases, and other miscellaneous work shall be coordinated with Division 3 and conform with Division 3 Specifications.

1.04 SUBMITTALS

A. Submit in accordance with Section 01300, Submittals. Refer to individual specification sections for detailed submittal requirements.

B. No material shall be ordered or shipped to the project without approved submittals.

C. Submit one (1) copy of as-built project drawings, showing actual conduit locations and field changes.

1.05 GENERAL CONDITIONS

A. The General and Special Conditions for the construction of this project shall be a part of the Electrical Specifications. The Contractor shall examine the general and special conditions before submitting his or her proposal.

B. The Contractor shall be responsible for all work included in this section and the delegation of work to a subcontractor shall not relieve him of this responsibility.

C. Where items of the General Conditions or of the Special Conditions are repeated in this section of the specifications, it is intended to call particular attention to or qualify them; it is not intended that any other parts of the General Conditions or Special Conditions shall be assumed to be omitted if not repeated herein.

D. The naming of a certain brand or make or manufacturer in the specifications is to establish a quality standard for the article desired. The Contractor is not restricted to the use of the specific brand of the manufacturer named unless so indicated in the Specifications or Drawings. However, where a substitution is requested, a substitution will be permitted only with the written approval of the Engineer. All proposed substitutions shall be submitted to the Engineer no later than seven working days prior to bid closing. The Contractor shall be responsible for installing the specified equipment unless approval by the Engineer is granted prior to bid closing. No substitute material or equipment shall be ordered, fabricated, shipped or processed in any manner prior to the approval of the Engineer. The Contractor shall assume all responsibility for additional expenses as required in any way to meet changes from the original material or equipment specified.

E. The Contractor shall examine drawings relating to work of all trades and become fully informed as to extent and character of work required and its relation to all other work in the project.

F. Before submitting bid, Contractor shall visit the site and examine all adjoining existing buildings, equipment and space conditions on which his work is in any way dependent for the best workmanship and operation according to the intent of specifications and drawings. He shall report to the Engineer any condition which might prevent him from installing his equipment in the manner intended.

G. No consideration or allowance will be granted for failure to visit site, or for any alleged misunderstanding of materials to be furnished or work to be done.

H. The Contractor shall be responsible for all arrangements and costs for providing temporary electrical metering, main switches and distribution panels at the site as required for construction purposes. The distribution panels shall be located at a central point designated by the Engineer.

1.06 CODES AND STANDARDS

A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards, and utility company requirements.

B. In case of difference between the building codes, specifications, state laws, local ordinances, industry standards, utility company regulations, and the contract documents, the most stringent shall govern. The Contractor shall promptly notify the Engineer in writing of any such difference.

C. Noncompliance: Should the Contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards, and utility company regulations, he shall bear the cost arising in correcting any such deficiency.

D. Applicable codes and all standards shall include all state laws, local ordinances, utility company regulations and the applicable requirements of the following nationally accepted codes and standards, latest edition:

1. ASME – American Society of Mechanical Engineers
2. ASTM – American Society for Testing and Materials
3. EIA – Electronic Industries Association
4. IEEE – Institute of Electrical and Electronic Engineers
5. IPCEA – Insulated Power Cable Engineers' Association
6. NEC – National Electrical Code (NFPA No. 70)
7. NBS – National Bureau of Standards
8. NEMA – National Electrical Manufacturers' Assoc.
9. NFPA – National Fire Protection Association
10. UL – Underwriters' Laboratories

1.07 FEES, PERMITS, AND INSPECTIONS

A. Obtain any and all required permits in connection with this work under the Contract and pay any and all fees in connection therewith. Arrange with the serving utility companies for the connections to all utilities and pay all charges for same including inspection fees and meters if required.

B. Under this section of work the Contractor shall, upon completion of the work, furnish a certificate of final inspection to the Engineer from the inspection department having jurisdiction.

1.08 DRAWINGS

A. The Electrical Drawings and Specifications under this division shall be made a part of the contract documents.

B. Failure to examine all documents shall not relieve the bidder of any responsibility nor shall it be used as a basis for additional compensations due to omission of details of other divisions from the electrical documents.

C. The Drawings are diagrammatic and indicate generally the locations of material and equipment. These Drawings shall be followed as closely as possible. The Contractor shall coordinate the work under this section with the architectural, structural, plumbing, heating and air conditioning, and the drawings of other trades for exact dimensions, clearances and roughing-in locations: This Contractor shall cooperate with all other trades in order to make minor field adjustments to accommodate the work of others.

D. The Drawings and Specifications are complementary, each to the other, and the work required by either shall be included in the Contract as if called for by both. Should the Drawings and Specifications be contradictory, the Drawings shall take precedence.

E. If directed by the Engineer, the Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades of for proper execution of the work.

F. Electrical symbols used on this project are shown in a Symbol List on the accompanying working drawings. This list shows standard symbols, and all may not appear on the project drawings; however, wherever the symbol on project drawings occurs, the item shall be provided and installed.

G. The Contractor shall keep a complete set of prints in good condition and on these shall indicate all field changes made. These prints shall be turned over to the Engineer at completion of the project.

1.09 WARRANTY

A. The Contractor shall provide a written certificate guaranteeing all labor, equipment, and materials furnished for the project to be free of defects for a period of one year after the date of final test and acceptance. The Contractor shall remedy any defects within this period free of charge.

1.10 ARC FLASH/COORDINATION STUDY

A. The Contractor, in coordination with the Engineer, shall perform an Arc Flash and Short Circuit Coordination study, in accordance with IEEE-584 and NFPA 70E. Responsibilities of the parties shall be as follows:

1. The Contractor shall supply complete electrical system data collection from equipment submittals, including transformers, panelboards, and all electrical motor and pump nameplate data. The data shall include all circuit breaker and fuse model numbers and ratings. The data collection shall include all 480V branch circuits and shall include the main circuit breaker data for 120/240V panelboards, but shall exclude the branch circuits of the 120/240V panelboards.

2. The Engineer shall use the data above to perform the Arc Flash and Short Circuit Coordination study using SKM Power Tools software and produce a study report of the required coordination settings of all protective devices. The Engineer shall identify any deficient protective devices during the preliminary study to be corrected prior to submittal approval.

3. The Contractor shall verify and set all protective devices settings according to the Engineer report.

4. The Contractor shall provide and install all Arc Flash Hazard labeling on equipment as directed by the Engineer to meet NFPA 70E.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. All materials and equipment used on this project shall be new and of equal or greater quality than specified in the Drawings and Specifications.

B. All materials must conform to the standards set out in 1.05 D.

PART 3 EXECUTION

3.01 COOPERATION WITH OTHER TRADES

A. The Contractor shall cooperate with all other trades to ensure the general progress of the work. Allow other trades access for the installation of their work and storage of materials.

B. The Contractor shall schedule his work according to the master schedule and follow the general building construction closely.

C. The Contractor shall set all pipe and conduit sleeves, or install conduits and raceways where necessary, prior to the placement of masonry or the pouring of concrete.

D. The Contractor shall work with other trades on the placement of his equipment, such as conduits, fixtures, and outlets, to prevent interference with the installation of other work.

E. The Contractor shall not delay the work of other trades by failure to meet schedules as set by the Engineer.

3.02 CONSTRUCTION REQUIREMENTS

A. The locations and elevations of equipment shown on the Drawings are approximate and subject to slight revisions, if necessary, at the time the work is installed. Final locations should be confirmed with the Engineer in advance of construction. Minor changes in location shall be made at no cost by the Contractor.

B. The wiring for all electrical equipment shall be furnished and/or installed by the Contractor, unless otherwise noted, for equipment being furnished under another section of these Specifications. Request from the Engineer a shop drawing showing the required locations of facilities and connections.

C. No additional compensation will be provided for failure to examine the responsibility of other trades.

D. Holes for raceway penetration into sheet metal cabinets and boxes shall be made accurately with a hole punch. Cutting openings with a torch or other device will not be acceptable.

E. Raceway entry into equipment shall be carefully planned. Cutting of the enclosure framework to accommodate poorly planned raceways will not be acceptable.

F. Cabling inside equipment shall be carefully planned, routed, and laced. Cables shall be placed such that they do not cause obstruction.

G. Equipment shall be set level and plumb. Equipment shall be braced and secured for a rigid fit.

3.03 EQUIPMENT PROTECTION

A. Provide suitable protection for all equipment, work, and property against damage during construction.

B. The Contractor shall assume all responsibility for material and equipment stored at the site.

C. Conduit openings shall be closed with caps or plugs during construction. All outlet boxes will be kept free of concrete, plaster, and debris.

D. Equipment shall be covered and tightly sealed against the entrance of dust, dirt, and moisture.

E. Interiors of all electrical equipment shall be kept clean and dry prior to placing into service.

3.04 EXCAVATION AND BACKFILLING

A. The Contractor shall perform all excavation and backfilling necessary for the installation of the electrical system. The work shall include shoring and pumping in ditches to keep them dry until the work has been installed. All shoring required to protect the excavation and safeguard employees shall be properly performed according to code.

B. All excavations shall be made to the proper depth with allowances made for floor slabs, forms, beams, finished grades, etc. Ground under conduits shall be compacted prior to raceway installation.

C. All backfill shall be made with selected soil, free of rocks and debris. The backfill shall be mechanically tamped in 6-inch layers to secure a ninety percent (90%) density ratio.

D. All excavated material not suitable and not used in the backfill shall be removed to a disposal area as directed by the Engineer.

E. Field check and verify all locations of underground utilities prior to any excavating. In the event existing utilities are broken, they are to be repaired to the original condition.

F. Where the excavation requires the opening of existing walks, drives, or other existing equipment, these facilities shall be cut as required to facilitate the new construction. The sizes of the cut shall be kept to a minimum. After installation is complete, repair the existing walks, drives, or other pavement to original condition or to match the new installation.

3.05 CUTTING AND PATCHING

A. Cutting and patching required under this section shall be done in a workmanlike manner. Cutting lines shall be uniform and smooth.

B. Use concrete saws for large cuts in concrete and use core drills for small round cuts in concrete.

C. Where openings are cut through masonry walls, provide lintel or other structural supports to protect the existing masonry. Adequate support shall be provided during the cutting operation to prevent damage to the masonry.

D. Patch concrete openings that are to be filled with nonmetallic, non-shrinking grout. Finished concrete patching shall be smooth and shall be uniform with surrounding surfaces.

3.06 FLASHING

A. Provide waterproof flashing for each penetration of exterior walls and roofs.

B. Flashing for conduit penetrations through built-up roofs shall be made with patch panel filled full with pitch.

3.07 CLEAN-UP AND TEST

A. Remove all temporary labels, dirt, paint, grease, and stains from all exposed equipment. Upon completion of work, clean equipment and the installation such as to produce a first-class job suitable for occupancy. No loose or scraps of equipment shall be left at the site.

B. Repair any scars to paint with kits supplied by the manufacturer.

C. Clean interiors of each item of electrical equipment.

D. Test each service entrance cable, each feeder cable, and each branch circuit wire. The Contractor shall use a megohmeter, 1000V DC scale for the test. The tests shall be made in the presence of the Engineer. The insulation value should be 500,000 ohms minimum to ground when tested with the megohmeter. Should the value be less, the faulty conductor shall be replaced and retested for compliance.

END OF SECTION

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SECTION 16110

RACEWAYS AND BOXES

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Provide complete raceways systems, boxes, and fittings for all required electrical systems. The raceway systems shall be installed in environments that are wet and corrosive.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 16000 – Electrical General Provisions

B. Section 16115 – Hangers and Support

C. Section 16140 – Wiring Devices

D. Section 16195 – Electrical Identification

1.04 SUBMITTALS

A. Submit in accordance with 01300, Submittals for all products.

1.05 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. Sealtite Liquidtight Flexible Metallic Conduit (LFMC)

a. UL Standard UL-360
b. NEMA Standard RV 3

2. Non-Metallic Conduit (PVC)

a. UL Standard UL-651
b. NEMA Standard TC-2

3. PVC Coated Rigid Conduit (CGRS)

a. NEMA Standard RN 1
b. UL Standard UL-6

4. Rigid Aluminum Conduit (RAC)

a. ANSI C80.5
b. UL Standard UL-6A

PART 2 PRODUCTS

2.01 RACEWAY TYPES

A. PVC Coated Galvanized Rigid Steel Conduit (CRSC) shall conform to NEMA RN 1.

1. Acceptable manufacturers shall be Perma-Cote or Robroy.

2. CRSC and fittings shall meet all of the performance standards specified herein and such performance standards shall require verification by a nationally recognized testing agency including American Society for Testing and Materials (ASTM) and Underwriter Laboratories (UL).

3. CRSC shall be UL Listed. The PVC coating shall have been investigated by UL as providing the primary corrosion protection for the rigid metal conduit. Ferrous fittings for general service locations shall be UL Listed with PVC as the primary corrosion protection. Hazardous location fittings, prior to plastic coating shall be UL Listed. All conduits and fittings must be new, unused material. Applicable UL standards shall include UL 6 Standard for Safety, Rigid Metal Conduit, UL514B Standard for Safety, Fittings for Conduit and Outlet Boxes.

4. CRSC shall be Electrical Testing Laboratory (ETL) verified to the Inertek ETL SEMKO High Temperature H2O PVC Coating Adhesion Test Procedure for 200 hours. CRSC shall be the ETL Verified PVC-001 label to signify compliance to the adhesion performance standard.

5. CRSC shall be hot dip galvanized inside and out with hot galvanized threads.

6. A PVC sleeve extending one (1) pipe diameter or 2 inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit.

7. The PVC coating on the outside of the conduit couplings shall have a series of longitudinal ribs 40 mils in thickness to protect the coating form tool damage during installation.

8. Form 8 condolets, 1/2-inch through 2-inch diameters, shall have a v-seal tongue-in-groove gasket to effectively seal against the elements. The design shall be equipped with a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 inches of mercury (vacuum) for 72 hours shall be available. Form 8 condolets shall be supplied with plastic encapsulated stainless steel cover screws.

9. A urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings. The internal coating shall be nominal 2 mil thickness. Conduit or fittings having areas with thin, or no coating shall be unacceptable.

10. The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above 30F.

11. All male threads on conduit, elbows, and nipples shall be protected by application of a urethane coating.

12. All female threads on fittings or conduit couplings shall be protected by application of a urethane coating.

13. Independent certified test results shall be available to confirm coating adhesion under the following conditions:

    a. Conduit and condolet exposure to 150F and 95 percent (95%) relative humidity with a minimum mean time to failure of 30 days (ASTM D1151).

    b. The interior coating bond shall be confirmed using the Standard Method of Adhesion by Tape Test (ASTM D3359).

    c. No trace of the internal coating shall be visible on a white cloth following six (6) wipes over the coating which has been wetted with acetone (ASTM) D1308).

    d. The exterior coating bond shall be confirmed using the methods described in Section 3.8, NEMA RN1. After these tests the physical properties of the exterior coating shall exceed the minum requirements specified in Table 3.1, NEMA RN1.

14. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameter of the coated conduit. All U bolts will be supplied with plastic encapsulated nuts that cover the exposed portions of the threads.

B. Sealtitie Liquidtight Flexible Steel Conduit (LFMC)

1. Conduit shall be equal to Anaconda SEALTITE® Type UA or approved equal. Conduit shall provide a flexible liquid-tight raceway for wiring and shall be constructed of continuously interlocked hot dipped zinc galvanized steel core with an integral bonding wire in sizes 3/8-inch thru 1¼-inch. Conduit shall have a sunlight resistant and flame retardant PVC jacket in electrical trade sizes 3/8-inch thru 4-inch. Conduit shall be UL listed, CSA certified, and IP 66/67 rated when installed with approved end fittings.

2. Maximum length: 6 feet

C. Non-Metallic Raceway (PVC)

1. Composed of polyvinyl chloride suitable for 90 degrees C.

2. Raceway, fittings, and cement must be produced by the same manufacturer who must have had a minimum of ten (10) years' experience in manufacturing the products.

3. Materials must have a tensile strength of 7,000-7,200 psi at 73.4 degrees F., flexural strength of 12,000 psi and compressive strength of 9,000 psi.

4. All joints shall be solvent cemented in accordance with the recommendations of the manufacturer.

D. Aluminum Conduit

1. 6063 alloy, T-1 temper
2. Color coded thread protectors

2.02 LOCKNUTS AND BUSHINGS

A. Locknuts shall be aluminum.

B. All bushings shall be insulated. Use nylon insulated metallic bushings for sizes 1-inch and larger. Plastic bushings may be used in 1/2-inch and 3/4-inch sizes.

2.03 CONDUIT BOXES, OUTLET BOXES, CONDUIT FITTINGS

A. Cast Type Conduit Boxes, Outlet Bodies and Fittings

1. Provide surface mounted outlet and junction boxes, in indoor locations, where exposed to moisture and in outdoor locations.

2. Use cast aluminum FS or FD boxes.

3. Use cast aluminum conduit bodies and fittings.

4. All covers shall be aluminum.

5. Exterior devices shall be PVC coated.

B. PVC Conduit Boxes, Outlet Bodies and Fittings

1. Provide surface mounted PVC outlet and junction boxes, in indoor locations, where indicated on the Drawings for exposure to corrosive chemicals.

PART 3 EXECUTION

3.01 APPLICATION OF RACEWAYS

A. The following applications must be adhered to except as otherwise required by Code. Raceways not conforming to this listing must be removed by this Contractor and replaced with the specified material at this Contractor's expense.

1. CRSC – Application: Used for exterior and interior installations where noted, elbows and bends below grade, and vertical risers from below grade to above grade. CRSC shall be utilized within 5-foot under a change in surface material. The Contractor must utilize special dies specifically manufactured for CRSC when cutting and threading CRSC conduit. Dies used for standard RSC are not acceptable.

2. LFMC – Applications: Use in areas at connections to all motors and control devices, and all raised floor areas.

3. PVC – Applications: Schedule 40 – Where specifically indicated on the drawings and for raceways in slab or below grade. Schedule 80 – Where specifically indicated on the drawings and for above grade installations in chemical use locations.

4. RAC – Application: Use in all above grade indoor installations and outdoor installations except where explicitly noted.

3.02 CRSC INSTALLATION

A. All clamping, cutting, threading, bending, and assembly instructions listed in the manufacturer installation guide shall be vigorously followed.

B. Installation of CRSC shall be performed in accordance with the manufacturer installation manual. To assure correct installation, the installer shall be certified by the manufacturer to install coated conduit.

C. Installer certification is required to be provided to the Engineer prior to construction.

D. Clamps, bolts, angles, pipe straps, struts, rods, nuts, and other supporting products for CRSC shall be PVC coated or stainless steel.

E. The Contractor shall use equipment specifically designed for CRSC when cutting, clamping, reaming, threading, bending, assembling, or performing other installation procedures. PVC coating shall be protected at all times.

F. Touch-up compound for CRSC shall not be allowed. All conduits with damaged coatings shall be removed and replaced at no cost to the Owner.

3.03 RACEWAY SYSTEMS IN GENERAL

A. Provide raceways for all wiring systems, including security, data transmission, paging, and low voltage.

B. Install capped bushings on raceways as soon as installed and remove only when wires are pulled. Securely tie embedded raceway in place prior to embedment. Lay out the work in advance to avoid excessive concentrations of multiple raceway runs.

C. Locate raceways so that the strength of structural members is unaffected, and they do not conflict with the services of other trades. Install 1-inch or larger raceways, in or through structural members (beams, slabs, etc.) only when and in the manner accepted by the Engineer. Draw up couplings and fittings full and tight.

D. Above-grade raceways to comply with the following:

1. Install raceways concealed except at surface cabinets and for motor equipment connection in electrical and mechanical rooms. Install a minimum of 6 inches from flues, steam pipes, or other heated lines. Provide flashing and counterflashing for waterproofing of raceways, outlets, fittings, etc., which penetrate the roof. Route exposed raceways parallel or perpendicular to building lines with right-angle turns and symmetrical bends. Run concealed raceways in a direct line and, where possible, with long sweep bends and offsets. Provide sleeves in forms for new concrete walls, floor slabs, and partitions for passage of raceways. Waterproof sleeved raceways where required.

2. Raceways shall not be run on roofs or exposed on the outside of the buildings unless specifically noted as exposed on the drawings or approved by the Engineer.

3. Provide raceway expansion joints for exposed and concealed raceways with necessary bonding conductor at building expansion joints and between buildings or structures and where required to compensate for raceway or building thermal expansion and contraction.

4. Provide raceway installation (with appropriate seal-offs, explosion-proof fittings, etc.) in special occupancy area, as required. Provide conduit seal-offs where portions of an interior raceway system pass through walls, ceiling, or floors that separate adjacent rooms having substantially different maintained temperatures, as in refrigeration or cold storage rooms.

5. Provide pull string in spare or empty raceways. Allow 5 feet of slack at each end, and in each pull box. Tie each end of the string to a washer or equivalent that does not fit into the conduit. Tag both ends of string denoting opposite end termination location.

E. No raceway may be installed in a concrete slab or members except with the permission of the Structural Engineer and with the written consent of the Owner.

1. Conduits embedded in structural concrete slabs shall have an outside diameter less than one third of the thickness of the concrete slab and shall be installed entirely within the center one third of the concrete slab.

2. Raceways embedded in concrete slabs shall be spaced not less than 8 inches on centers and as widely spaced as possible where they converge at panels or junction boxes.

3. In no case will installation of raceways be permitted to interfere with the proper placement of principal reinforcement.

4. Raceways running parallel to slab supports, such as beams, columns, and structural walls, shall be installed not less than 12 inches from such supporting elements.

5. To prevent displacement during concrete pour of lift slab, saddle supports for conduit, outlet boxes, junction boxes, inserts, etc., shall be secured with suitable adhesives.

F. Non-metallic raceway installation shall conform to the following:

1. All joints are to be made by the solvent cementing method using the material recommended by the raceway manufacturer. To ensure good joints, components shall be cleaned prior to assembly.

2. Raceway cut-offs shall be square and made by handsaw or other approved means which does not deform the conduit. Raceway shall be reamed prior to solvent cementing to couplings, adapters, or fittings.

3. Electrical devices that are served by PVC raceways shall be grounded by means of a ground wire pulled in the raceway.

4. Bends shall be made by methods that do not deform or damage the conduit. The radii of field bends shall not be less than those established by the N.E.C.

5. Raceway expansion fittings shall be provided where necessary. The position of the expansion fitting shall be adjusted proportional to the temperature at installation.

6. Raceway supports shall be installed, in such a manner, to allow the PVC conduit to slide through the supports as the temperature changes.

G. Raceways in hung ceiling shall be run on and secured to slab or primary structural members of ceiling, not to lathing channels or T-bars, Z-bars, or other elements which are the direct supports of the ceiling panels. Secure conduit firmly to steel by clips and fittings designed for that purpose. Install as high as possible, but not less than 1-foot 0-inch above hung ceilings.

H. Exposed raceways shall be run parallel or at right angles with building lines. Secure raceway clamps or supports to masonry materials by toggle bolts, expansion bolts, or steel inserts. Install raceway on steel construction with approved clamps that do not depend on friction or set screw pressure alone.

I. Clear raceway of all obstructions and dirt prior to pulling in wires or cables. This shall be done with ball mandrel (diameter approximately 85 percent (85%) of conduit inside diameter) followed by close fitting wire brush and wad of felt, or similar material. This assembly may be pulled in together with, but ahead of, the cable being installed. All empty raceways shall be similarly cleaned. Clear any raceway, which rejects ball mandrel.

J. Support raceways at intervals no greater than 10 feet and with one (1) support within 3 feet of each coupling, box, fitting, or outlet box. Provide one (1) support within 3 feet of each elbow or bend.

3.04 CONDUIT BOXES, OUTLET BOXES, CONDUIT FITTINGS

A. Provide boxes and fittings as indicated on the drawing and required for the complete installation of the various electrical systems, and to facilitate proper pulling of wires and cables. J-boxes and pull boxes shall be sized per electrical code minimum. Boxes on empty conduit systems shall be sized as if containing conductors of #4 AWG.

B. Install boxes and covers for wiring devices so that the wiring devices will be installed with a vertical orientation unless otherwise noted on the drawings.

C. The exact location of outlets and equipment is governed by structural conditions and obstructions or other equipment items. When necessary, relocate outlets so that when fixtures or equipment are installed, they will be symmetrically located according to the room layout and will not interfere with other work or equipment. Verify final location of outlets, panels equipment, etc. with Engineer.

D. Back-to-back outlets in the same wall or “thru-wall” type boxes not permitted. Provide 12-inch (minimum) spacing for outlets shown on opposite sides of a common wall to minimize sound transmission. Provide 24-inch (minimum) horizontal spacing for outlets shown on opposite sides of a fire rated wall to maintain fire rating.

END OF SECTION

SECTION 16111

ELECTRICAL HANDHOLES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide and install electrical handholes as indicated in the Specifications and Drawings.

B. Where embedded in earth, provide concrete collars as shown on the Drawings to prevent settling and damage to raceways.

C. PVC Coated Rigid Steel conduit (CRSC) shall be utilized for all conduits entering electrical handholes, 10 foot minimum.

D. Driven ground rods and grounding bushings for CRSC conduits shall be installed at each handhole.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 16000 – Electrical General Provisions

B. Section 16110 – Raceways and Boxes

1.04 SUBMITTALS

A. Submit in accordance with 01300 for all products.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Electrical handholes shall be Quazite as manufactured by Strongwell or equal.

2.02 PROPERTIES

A. Boxes and covers shall be concrete gray and sustain a minimum vertical test load of 7,500#.

B. All covers will have a minimum coefficient of friction of .50.

C. Boxes will be constructed of polymer concrete. Plastic and fiberglass boxes will not be accepted.

D. Boxes shall be stackable for extra depth.

E. Enclosures, boxes, and covers are required to conform to all test provisions of ANSI/SCTE 77 for Tier 5 applications.

F. The electrical handholes shall be UL Listed.

G. The electrical handholes shall meet the requirements of section 314.30 of NEC 70 – 2005.

PART 3 EXECUTION

3.01 GENERAL

A. Handholes will be installed approximately where shown on the Drawings with the sizes shown. The exact location of each handhole shall be determined after careful consideration has been given to location of other utilities. The cover plate shall be engraved “Electric”.

B. Handholes shall have reinforced concrete collar which shall be poured around the box extensions as shown on the Drawings. Cable inside the box shall be installed with at least two feet of slack within the box. No cable or wire splices will be allowed in the handholes.

C. Conduit entrances into the electrical handhole shall utilize a coupling and box adapter for electrical enclosures.

END OF SECTION

SECTION 16113

CABLE TRAY

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, tests and services to install complete cable tray systems as shown on the Drawings.

B. Cable tray systems are defined to include, but are not limited to straight sections of ladder type cable trays, bends, tees, elbows, drop-outs, supports and accessories.

1.02 REFERENCES

A. ANSI/NFPA 70 – National Electrical Code

B. NEMA VE 1-1998 – Metallic Cable Tray Systems

C. NEMA VE 2-2000 – Cable Tray Installation Guidelines

1.03 SUBMITTALS

A. Submit in accordance with 01300.

B. Submittal Drawings: Submit drawings of cable tray and accessories including clamps, brackets, hanger rods, splice plate connectors, expansion joint assemblies, and fittings, showing accurately scaled components.

C. Product Data: Submit manufacturer's data on cable tray including, but not limited to, types, materials, finishes, rung spacings, inside depths and fitting radii. For side rails and rungs, submit cross sectional properties including Section Modulus (Sx) and Moment of Inertia (Ix).

1.04 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of cable trays and fittings of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. NEMA Compliance: Comply with NEMA Standards Publication Number VE1, "Cable Tray Systems".

C. NEC Compliance: Comply with NEC, as applicable to construction and installation of cable tray and cable channel systems.

D. UL Compliance: Provide products that are UL-classified and labeled.

E. NFPA Compliance: Comply with NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance" pertaining to installation of cable tray systems

1.05 DELIVERY AND STORAGE

A. Deliver cable tray systems and components carefully to avoid breakage, denting and scoring finishes. Do not install damaged equipment.

B. Store cable trays and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials should be unpacked and dried before storage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cooper B-Line or equal.

2.02 CABLE TRAY SECTIONS AND COMPONENTS

A. Except as otherwise indicated, provide metal cable trays, of types, classes and sizes indicated; with splice plates, bolts, nuts and washers for connecting units. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.

B. Aluminum straight section and fitting side rails and rungs shall be extruded from Aluminum Association Alloy 6063. All fabricated parts shall be made from Aluminum Association Alloy 5052.

2.03 CABLE TRAY TYPES

A. Ladder type trays shall consist of two longitudinal members (side rails) with transverse members (rungs) welded to the side rails. Spacing in shall be 9 inches. Rungs shall have a minimum cable-bearing surface of 7/8 inch with radiused edges. No portion of the rungs shall protrude below the bottom plane of the side rails. Each rung must be capable of supporting the maximum cable load, with a safety factor of 1.5 and a 200 pound concentrated load when tested in accordance with NEMA VE-1, section 5.4.

B. Tray sizes shall have 3 inch minimum usable load depth.

C. Straight tray sections shall have side rails fabricated as I-Beams. All straight sections shall be supplied in standard lengths, except where shorter lengths are permitted to facilitate tray assembly lengths as shown on Drawings.

D. Tray widths shall be as shown on Drawings.

E. All fittings must have a minimum radius of 12 inches.

F. Splice plates shall be the bolted type made as indicated below for each tray type. The resistance of fixed splice connections between adjacent sections of tray shall not exceed .00033 ohms. Splice plate construction shall be such that a splice may be located anywhere within the support span without diminishing rated loading capacity of the cable tray.

G. Cable Tray Supports: Shall be placed so that the support spans do not exceed maximum span indicated on drawings. Supports shall be constructed from 12 gauge steel formed shape channel members 1-5/8 inch by 1-5/8 inch with necessary hardware such as Trapeze Support Kits (9G-55XX-22SH) as manufactured by Cooper B-Line, Inc.

H. Trapeze hangers and center-hung supports shall be supported by 1/2 inch (minimum) diameter rods.

I. Accessories - special accessories shall be furnished as required to protect, support, and install a cable tray system. Accessories shall consist of but are not limited to; section splice plates, expansion plates, blind-end plates, specially designed ladder dropouts, barriers, fire wall sleeves, etc.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install cable trays as indicated: Installation shall be in accordance with equipment manufacturer's instructions, and with recognized industry practices to ensure that cable tray equipment comply with requirements of NEC and applicable portions of NFPA 70B. Reference NEMA-VE2 for general cable tray installation guidelines.

B. Coordinate cable tray with other electrical work as necessary to properly integrate installation of cable tray work with other work.

C. Provide sufficient space encompassing cable trays to permit access for installing and maintaining cables.

D. Cable tray fitting supports shall be located such that they meet the strength requirements of straight sections. Install fitting supports per NEMA VE-2 guidelines, or in accordance with manufacturer's instructions.

3.02 TESTING

A. Test cable trays to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. See NFPA 70B, Chapter 18, for testing and test methods.

END OF SECTION

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SECTION 16115

HANGERS AND SUPPORT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Continuous slot, bolted metal framing channels and all associated fittings and hardware.

B. Trapeze type supports for cable tray, conduit, pipe and other similar systems.

C. Electrical equipment racks shall be constructed with Unistrut channel and fittings as shown on the Drawings.

D. Use of bolted metal framing as a surface metal raceway.

E. All materials on the project shall be stainless steel for corrosion resistance.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 REFERENCES STANDARDS

A. ASTM A123 Standard Specification for Zinc (Hot-Galvanized) Coatings on Iron and Steel Products

B. ASTM A653 Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

C. ASTM A907 Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot-Rolled, Structural Quality (WITHDRAWN) (REPLACED BY A1018)

D. ASTM A1018 Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

E. ASTM A1011 Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

F. ASTM B633 Specification for Electrodeposited Coatings of Zinc on Iron and Steel

G. ASTM F1136 Standard Specification for Chromium/Zinc Corrosion Protective Coatings for Fasteners

H. MFMA Metal Framing Manufacturers' Association

I. ANSI/NFPA 70 National Fire Protection Association (National Electrical Code)

1.04 SUBMITTALS

A. Submit in accordance with Specification Section 01300, Submittals.

B. Submit drawings of strut and accessories including clamps, brackets, hanger rods, and fittings.

C. Submit manufacturer's product data on strut channels including, but not limited to, types, materials, finishes, gauge thickness, and hole patterns. For each different strut cross-section, submit cross sectional properties including Section Modulus (Sx) and Moment of Inertia (Ix).

1.05 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of bolted metal framing of the types required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. NEC Compliance: Comply with the latest revision NFPA 70 – Article 352 "Surface Metal Raceways and Surface Nonmetallic Raceway".

C. UL Compliance: Comply with UL "Standard for Surface Metal Raceway and Fittings", UL 5.

D. Bolted framing channels and fittings shall have the manufacturer's name, part number, and material heat code identification number stamped in the part itself for identification. Material certification sheets and test reports must be made available by the manufacturer upon request.

E. Bolted framing channels and fittings shall have the manufacturer's name, part number, and material heat code identification number stamped in the part itself for identification. Material certification sheets and test reports must be made available by the manufacturer upon request.

1.06 DELIVERY AND STORAGE

A. Deliver strut systems and components carefully to avoid breakage, denting, and scoring finishes. Do not install damaged equipment.

B. Store strut systems and components in original cartons and in clean dry space; protect from weather and construction traffic.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cooper B-Line or equal.

2.02 STRUT CHANNELS AND COMPONENTS

A. Strut shall be 1 5/8 inches wide in varying heights and welded combinations as required to meet load capacities and designs indicated on the Drawings.

B. Materials and Finish: Material and finish specifications for each strut type are as follows:

1. Stainless Steel: All strut, fittings and hardware shall be made of AISI Type 304 stainless steel as indicated.

PART 3 EXECUTION

3.01 INSTALLATION

A. Use stainless steel strut for all installations.

B. Install strut in accordance with MFMA-102 ‘Guidelines for the Use of Metal Framing’; in accordance with equipment manufacturer's recommendations, and with recognized industry practices.

C. All nuts and bolts shall be tightened to the following values:

Bolt Size	Torque (ft-lbs)
1/4 - 20	6
5/16 - 18	11
3/8 - 16	19
1/2 - 13	50

END OF SECTION

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SECTION 16120

WIRE AND CABLE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall provide under this section of the Specifications all materials, labor, equipment, tools, and supplies for the installation of wire and cable for a complete installation.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 16110 – Raceways and Boxes

1.04 SUBMITTALS

A. Submit in accordance with 01300, Submittals, including the following minimum information:

1. Manufacturer product data

PART 2 PRODUCTS

2.01 GENERAL

A. Wire and cable shall meet all standards and specifications applicable and shall be in conformance with the latest edition of the NEC. Insulated wire and cable shall have size, type of insulation, voltage and manufacturer’s name permanently marked on outer covering at regular intervals not exceeding four feet. Wire and cable shall be delivered in complete coils or reels with identifying tags, stating size, type of insulation, etc.

B. Wire and cable shall be suitably protected from weather and other damage during storage and handling and shall be in first-class condition after installation.

C. Wire sizes shall be No. 12 AWG minimum, except as specified for control and instrumentation circuits.

D. Conductors shall be 98 percent (98%) conductivity soft drawn copper, ASTM B8 for stranded conductors.

E. Wire and cable shall be factory color-coded with a separate color for each phase and neutral used consistently throughout the system. The color code below shall be used unless otherwise specified:

Phase	480Y/277V	240/120V	24VDC
A	Brown	Black	Blue (Positive)
B	Orange	Red	Blue with White Stripe (Negative)
C	Yellow		
N	Gray	White	
G	Green	Green	

F. Control conductors shall be colored red for 120V circuits with white for neutral. Control conductors shall be colored blue for low voltage DC circuits, 24 volts and below. Yellow conductors shall be used for separately powered control circuits entering a control enclosure.

G. All conductors shall be rated 600 volts, unless otherwise specified or shown on the drawings, or for electronic or communication use.

2.02 BUILDING WIRE

A. NEC type THHN/THWN shall be used for lighting, receptacles, and all circuits not exceeding 600 volts to ground.

B. THHN/THWN conductors sizes #1/0 and larger shall be rated for cable tray installation.

2.03 VFD SHIELDED POWER CABLE

A. VFD shielded power cable shall be utilized for all motors with long leads to the equipment and dV/dt output filters on the VFDs.

B. The power conductors shall be soft annealed flexible stranded tinned copper per IEEE 1580 Table 11.

B. The insulation shall be rated 2kV, cross-linked flame retardant polyolefin, meeting the requirements of Type X110 of UL 1309.

C. The cable shall have three ground conductors sized per UL 1277 and shall be green.

D. The cable shall have an overall tinned copper braid shield plus aluminum/polyester tape providing 100% coverage.

E. The jacket shall be black, artic grade, flame retardant, oil, abrasion, chemical, and sunlight resistant thermosetting compound meeting UL 1309.

F. The cable shall be 110 C temperature rated.

G. The cables shall be sized as shown on the Drawings, using the 75 C rating ampacity tables.

2.04 TRAY CABLE

A. Multiconductor power and control cable shall be UL Listed as TC-ER per UL Standard 1277 and used in accordance with NEC for 3 or more conductors. The cable shall be approved for use in Class 1 or 2, Division 2 industrial hazardous locations per NEC.

B. The tray cable shall be rated 600V, 90 degrees C wet or dry to meet UL 1883 for THHN/THWN-2, and meet cold bend test at -25 degrees C.

C. The tray cable shall meet UL 62, UL 66, UL 83, and UL 1277 standards.

D. The tray cable shall meet UL 1685 and IEEE 383 70,000 BTU vertical flame test.

E. The jacket shall be flame and sunlight resistant, with ripcord provided on all jackets less than 60 mils.

F. The ground conductor shall be soft bare annealed copper per ASTM B-3, Class B stranding.

2.05 CONTROL WIRE

A. Control wire contained within a single building shall be NEC type THHN/THWN, stranded No. 14 or No. 16 AWG.

B. Control wire within control panels shall be NEC type MTW stranded No. 16 AWG.

2.06 SHIELDED CABLE

A. Shielded cable shall be No. 18 AWG stranded conductors, 600-volt PVC insulation, 105C rating, with 100% mylar tape and drain wire shielding. Shielded cable shall be 2 conductor, 3 conductor, or multiple pairs as shown on the Drawings.

2.07 CONNECTORS

A. Joints on branch circuits shall occur only where such circuits divide as indicated on plans and shall consist of one through circuit to which shall be spliced the branch from the circuit. No splices shall be made in conductor except at outlet boxes, junction boxes, or splice boxes.

B. All joints or splices for #10 AWG or smaller shall be made with UL approved wire nuts or compression type connectors.

C. All joints or splices for #8 AWG Building Wire or larger shall be made with a Polaris Black IT or IPL insulated connector or approved equal. All joints or splices at electric motor junction box connections shall be made with a Polaris Gray ITG insulated connector for finely stranded wire or approved equal. The connector shall be UL approved.

PART 3 EXECUTION

3.01 INSTALLATION

A. All wire and cable shall be continuous from origin to panel or equipment termination without splices unless otherwise specified. No splices shall be allowed in handholes below grade.

B. No more than two conductors shall be installed under terminals for control and instrumentation.

3.02 TESTING

A. Test all 480-volt circuits with a megohm meter after installation. Submit a written report to the Engineer. Tests shall be performed at 1000 volts.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install wiring devices as shown on the Drawings and specified herein in compliance with the NEC. Furnish and install wiring devices suitable for the temperature, conditions, and location where installed.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 QUALITY ASSURANCE

A. Wiring devices shall be of specification grade as manufactured by Arrow-Hart, Crouse-Hinds, Hubbell, General Electric, or approved equal, and shall be UL listed.

PART 2 PRODUCTS

2.01 WALL SWITCHES

A. Wall switches shall be general duty, totally enclosed with bodies of phenolic compound, butt compact, with an integral mounting strap with provisions for side wiring with captively held binding screws. The following switches shall be used. Where installed in treatment process areas, the switches shall be installed with weatherproof covers for operating toggle switches, similar or equal to Cantex 5133330 into the cast aluminum FD or FS boxes. Switches with weatherproof covers are designated with an M on the project drawings.

Single Pole Switch	Hubbell 1221 or equal
Double Pole Switch	Hubbell 1222 or equal
Three-Way Switch	Hubbell 1223 or equal
Four-Way Switch	Hubbell 1224 or equal

2.02 RECEPTACLES

A. General duty receptacles shall be two pole, three wire grounding, 20 amp, 125 volts. NEMA configuration 5-20R shall be used unless otherwise specified. The following receptacles shall be used. Where installed in treatment process areas, the receptacles shall be provided with weatherproof while-in-use covers, similar or equal to Pass & Seymour WIUC series or T&B Red Dot. All receptacle boxes shall be cast aluminum FD or FS.

Duplex Receptacle	Hubbell 5362 or equal
Duplex Receptacle-GFI	Hubbell GF5362 or equal
Single Receptacle	Hubbell 5361 or equal

B. Special receptacles are as shown and detailed on the Drawings.

PART 3 EXECUTION

3.01 GENERAL

A. Coordinate switch and receptacle mounting location with detail and heights as noted on the Drawings.

B. Provide ivory switches, unless specifically noted otherwise.

C. Furnish device plates to match the wiring device used. Device plates shall be on piece type, single or multiple gang switch and duplex outlet wall plates for wiring devices.

D. Test all wiring devices to ensure electrical continuity of ground connections.

END OF SECTION

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide and install electrical identification materials to allow ease of future troubleshooting and maintenance.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

PART 2 PRODUCTS

2.01 WIRE LABELS

A. All wires shall be marked with durable, non-fading, sleeve type, heat shrink wire markers or laser printer wraparound labels with clear wrap protecting the printed section.

B. The Contractor shall use the unique wire label numbers supplied by the OEM process equipment to label each end of the wiring connection the control panel to field mounted equipment. No interim numbers shall be allowed.

C. All building power circuit wires will be labeled. Home runs to panelboards will be labeled as to the circuit number at the panelboard, such as PP3-1.

D. The Contractor will submit a list of all proposed wire numbers for review and approval.

E. The Contractor shall utilize control terminal designations as the wire label number. Where source and end terminals do not match, the wire label shall include the equipment and terminal numbers for source and destination terminations.

2.02 EQUIPMENT NAMEPLATES

A. Provide an engraved phenolic nameplate (white background with black letters) with 1/8-inch engraved letters for each panelboard, MCC, VFD, starter bucket, disconnect switch, control station, junction box, actuators, field instruments, motors, and all other equipment not mentioned specifically.

B. Provide an engraved phenolic nameplate with 1/16-inch engraved letters for each receptacle or lighting outlet indicating the panelboard circuit serving the device.

C. The Contractor will submit a list of all proposed nameplates for review and approval.

PART 3 EXECUTION

3.01 GENERAL

A. Attach all nameplates with self-tapping corrosion resistant screws.

B. Wire labels should be attached in a common direction in all equipment.

END OF SECTION

SECTION 16200

ELECTRIC UTILITY SERVICE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Electrical services at shall be coordinated with the Bentonville Electrical Utility Department (BEUD). The services shall be pad mounted transformers. Bentonville Electric shall provide and install current transformer metering inside the secondary compartment of the pad mount transformer and shall install the meter base on the exterior frame of the transformer.

B. The Contractor shall provide all trenching, raceway, and cable between the pad mount transformer and the service entrance equipment.

C. The Contractor shall construct the pad mount transformer and pad mounted switch concrete foundations according to Bentonville Electric standards.

D. The Contractor shall provide all trenching and raceway between the pad mount transformer and the power pole or junction box locations. Bentonville Electric will provide the down conduit for the power pole and pull in distribution voltage conductors. The Contractor shall close the trench.

E. The Contractor shall install the service in accordance with all local codes and Bentonville Electric standards.

F. Contact BEUD at 479.271.3135 before performing any grading within 5’ of existing or proposed power poles.

G. BEUD design layout drawing takes precedence over any electric information shown on the utility plan.

H. Electric facilities shall be installed in accordance with the latest revision of the electric specifications found on the website. Contractor is responsible for compliance with this document.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 16110 – Raceways and Boxes

B. Section 16120 – Wire and Cable

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall furnish and install all electric service entrance and related distribution equipment as indicated on the floor plan, diagrams, schedules, and notes. All equipment shall be new, and UL listed.

3.02 ELECTRIC SERVICE

A. The Contractor shall be responsible for any temporary electrical service charges. The Owner shall be responsible for any charges associated with the new electrical service.

B. The Contractor shall properly ground the electrical system as required by the NEC.

C. Conductors for the service entrance shall be copper Type THHN or THHW rated at 90 degrees C (90°C) unless otherwise noted.

D. Secondary service will be 480/277 volts, 3 phase, 4 wire, 60-hertz, unless otherwise noted on the Drawings.

END OF SECTION

SECTION 16210

EMERGENCY STANDBY GENERATOR SET

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide and install a 1250kW emergency standby generator at the Influent Electrical Building and a 750kW emergency standby generator at the Effluent Electrical Building as detailed in these Specifications and on the Drawings.

B. The generator set must be fully fueled by the Contractor upon completion of acceptance testing.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. SECTION 16215 – Automatic Transfer Switch

1.04 REGULATORY REQUIREMENTS

A. The generator set shall be UL 2200 listed as a stationary engine generator assembly.

B. The packaged set shall conform to NFPA 70 and NFPA 110.

1.05 SUBMITTALS

A. Submit in accordance with 01300.

1.06 WARRANTY

A. The entire emergency standby generator set, including engine, alternator, controls, and accessories, shall be covered by a five (5) year extended warranty. The warranty shall include all parts, material, labor, and travel charges.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Caterpillar, Kohler, and Cummins are approved generator suppliers.

2.02 RATINGS

A. The Influent standby generator engine set shall be rated to power loads at emergency standby 277/480 volts, 3 phase, 4 wire, .8 power factor, 1250 kW, 1562 kVA, 2200 amps at 1000 feet altitude, 100 degrees Fahrenheit (100°F) ambient.

B. The Treatment standby generator engine set shall be rated to power loads at emergency standby 277/480 volts, 3 phase, 4 wire, .8 power factor, 750 kW, 937 kVA, 1127 amps at 1000 feet altitude, 100 degrees Fahrenheit (100°F) ambient

2.03 GENERATOR SET ENGINE

A. The standby generator engine shall supply prime mover capability to power the ratings specified in 2.02.

B. The engine shall meet current EPA regulations for TIER emission standards for emergency standby generators.

C. The engine is to be cooled with a unit mounted radiator, fan, water pump, and closed coolant recovery system providing visual diagnostic means to determine if the system is operating with a normal engine coolant level. The radiator shall be designed for operation in 110 degrees Fahrenheit (110°F), 43 degrees Celsius (43°C) ambient temperature.

D. The intake air filter with replaceable element must be mounted on the unit.

E. Full pressure lubrication shall be supplied by a positive displacement lube oil pump. The engine shall have a replaceable oil filter with internal bypass and replaceable element.

F. The engine shall have a battery charging DC alternator with a voltage regulator. Remote 2-wire starting shall be by a solenoid shift, electric starter.

G. Engine speed shall be controlled by isochronous governor to maintain alternator frequency within 0.5 percent (0.5%) from no load to full load alternator output. Steady state regulation is to be 0.25 percent (0.25%).

H. The engine fuel system shall be designed for operation on No. 2 diesel fuel. A primary fuel filter, water separator, manual fuel priming pump, fuel shutoff solenoid and all fuel lines must be installed at the point of manufacture.

I. The primary diesel fuel filter shall be capable of removing contaminants of 10 microns. Element shall be replaceable paper type.

J. The engine shall have a unit mounted, thermostatically controlled water jacket heater to aid in quick starting. The wattage shall be as recommended by the manufacturer. The Contractor shall provide proper branch circuit from normal utility power source.

K. Sensing elements to be located on the engine for low oil pressure shutdown, high coolant temperature shutdown, low coolant level shutdown, overspeed shutdown and overcrank shutdown.

L. The manufacturer shall supply a stainless steel, flexible connector to couple the engine exhaust manifold to the exhaust system.

M. The fuel system shall include a double wall base mounted fuel tank. It shall have a stub-up area convenient for electrical conduit entry. It shall have the structural integrity to support the engine-generator set and carry the UL 142 mark. Minimum features shall include all welded construction, a lockable fuel filler cap, fuel gauge, low fuel level alarm, fuel line check valve, vent and fittings for fuel supply, return, fill and emergency vent. This tank must be supplied by the engine-generator set manufacturer and be installed before shipment. The size of the fuel tank shall allow for 24 hour continuous operation at generator set full load.

N. Vibration isolators shall be provided between the engine-generator and welded steel base or between the base and the fuel tank.

2.04 GENERATOR SET ALTERNATOR

A. The alternator shall be a 4 pole revolving field type, 12 lead, wired for 277/480V, 3 phase, 60 hz, with a permanent magnet driven exciter. The stator shall be direct connected to the engine to insure permanent alignment. The generator shall meet temperature rise standards for Class "H" insulation, operate within Class "F" standards for extended life. The alternator shall be protected by internal thermal overload protection.

B. One step load acceptance shall be 100 percent (100%) of engine-generator set nameplate rating and meet the requirements of NFPA 110 paragraph 5-13.2.6. The generator set and regulator must sustain at least 90 percent (90%) of rated voltage for 10 seconds with 250 percent (250%) of rated load at near zero power factor connected to its terminals when equipped with direct or brushless excitation.

C. A solid state voltage regulator must be used to control output voltage by varying the exciter magnetic field to provide + or - 0.25 percent (+/- 0.25%) regulation during stable load conditions.

D. The generator shall be equipped with a permanent magnet generator exciter system. Both the PMG and rotating brushless exciter shall be mounted outboard of the bearing. The system shall supply a minimum short circuit support current of 300 percent (300%) of the rating (250% for 50Hz operation) for 10 seconds. The rotating exciter shall use a three phase full wave rectifier assembly with hermetically sealed silicon diodes protected against abnormal transient conditions by a multi-plate selenium surge protector.

E. A main line circuit breaker carrying the UL mark shall be factory installed. The breaker shall be rated per the manufacturer's recommendations unless specified below and factory mounted for accessibility. The line side connections are to be made at the factory. Output lugs shall be provided for load side connections. The circuit breaker shall contain 2 sets of auxiliary contacts to annunciate breaker open or breaker closed. The contact configuration shall be form C (SPDT).

F. An alternator strip heater shall be installed to prevent moisture condensation from forming on the alternator windings.

2.05 GENERATOR SET CONTROLS

A. All engine alternator controls and instrumentation shall be designed, built, wired, tested and shock mounted in a NEMA 1 enclosure to the engine-generator set by the manufacturer. It shall contain panel lighting, a fused DC circuit to protect the controls and a + or – 5 percent (+/-5%) voltage adjusting control. This panel must be able to be rotated 90 degrees in either direction for correct installation.

B. The engine-generator set shall contain a complete 2 wire automatic engine start-stop control which starts the engine on closing contacts and stop the engine on opening contacts. A programmable cyclic cranking limiter shall be provided to open the starting circuit after eight attempts if the engine has not started within that time.

C. The panel shall include a digital display to monitor KVA, KW, KVAR, Power Factor, AC voltage, AC current and AC frequency, a Manual/Off/Auto switch, an emergency stop switch, an audible alarm, battery charger fuse, and a programmable engine control and monitoring module.

D. The generator controller shall have a minimum of two (2) dry Form C contacts for Generator Running and Generator Faulted condition.

2.06 GENERATOR SET ACCESSORIES

A. The engine-generator set shall be factory enclosed in a heavy gauge steel or aluminum weather proof enclosure. The roof shall aid in the runoff of water and include a drip edge. The enclosure shall be coated with electrostatically applied power paint, baked and finished to manufacturer specifications. The enclosure is to have large, hinged doors to allow access to the engine, alternator and control panel. The doors must lift off without the use of tools. Each door will have lockable hardware with identical keys. The enclosure shall be weatherproof and Level 1 sound attenuated.

B. A heavy duty, lead acid 12/24vdc battery set rated for cold weather shall be installed by the generator set manufacturer. Provide all intercell and connecting battery cables as required.

C. Provide an automatic dual rate battery charger manufactured by the engine-generator set supplier. The automatic equalizer system shall monitor and limit the charge current to 10 amps. The output voltage is to be determined by the charge current rate. The charger must be protected against a reverse polarity connection. The battery charger is to be factory installed on the generator set.

D. Provide two (2) thermostatically controlled blanket type battery heaters each rated at 160 watts to increase engine battery capacity for cold weather starting. The blankets shall operate from the 120vac utility circuit.

E. The exhaust silence shall be provided of the size as recommended by the manufacturer and shall be of critical grade. The silencer shall be mounted within the sound attenuated enclosure for reduced exhaust noise and provide a clean, smooth exterior design. It shall be connected to the engine with a flexible, seamless, stainless steel exhaust connection. A rain cap will terminate the exhaust pipe. All components must be properly sized to assure operation without excessive back pressure when installed.

PART 3 EXECUTION

3.01 FACTORY TESTING

A. Before shipment of the equipment, the engine-generator set shall be tested under rated load for performance and proper functioning of control and interfacing circuits. Tests shall include:

1. Verifying all safety shutdowns are functioning properly.

2. Verify single step load pick-up per NFPA 110-1996, Paragraph 5-13.2.6.

3. Verify transient and voltage dip responses and steady state voltage and speed (frequency) checks

4. Three (3) sets of owner’s manuals specific to the product supplied must accompany delivery of the equipment. General operating instruction, preventive maintenance, wiring diagrams, schematics and parts exploded views specific to this model must be included.

5. Contractor shall install the complete electrical generating system including all fuel connections in accordance with the manufacturer’s recommendations as reviewed by the Engineer.

6. Supplier of the electric plant and associated items shall have permanent service facilities in this trade area. These facilities shall comprise a permanent force of factory trained service personnel on 24-hour call, experienced in servicing this type of equipment, providing warranty and routine maintenance service to afford the owner maximum protection. Delegation of this service responsibility for any of the equipment listed herein will not be considered fulfillment of these specifications. Service contracts shall also be available.

7. The supplier of the electric generating plant and associated items covered herein shall provide factory trained technicians to check out the completed installation and to perform an initial startup inspection to include:

B. Ensuring the engine starts (both hot and cold) within the specified time.

C. Verification of engine parameters within specification.

D. Verify no load frequency and voltage, adjusting if required.

E. Test all automatic shutdowns of the engine-generator.

F. Perform a load test of the generator, ensuring full load frequency and voltage are within specification by using building load.

3.02 ON-SITE TESTING

A. Perform a power outage test, coordinated with the Engineer. Verify that the plant loads operate properly.

END OF SECTION

SECTION 16215

AUTOMATIC TRANSFER SWITCH

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide and install a 2500A NEMA 1 indoor service entrance rated automatic transfer switch (ATS) as detailed in these Specifications and on the Drawings for the Influent area at the WRRF. The ATS dimensions and clearances are shown on the Drawings. Working clearances have been provided on both sides and the front of the ATS for access to cable and mechanical lug connections. The allotted dimensions for the ATS are 90" H x 44" W x 60" D, not including anchor plates and lifting plates/eyes.

B. Provide and install a 1600A NEMA 1 indoor service entrance rated automatic transfer switch (ATS) as detailed in these Specifications and on the Drawings for the Treatment area at the WRRF. The ATS dimensions and clearances are shown on the Drawings. Working clearances have been provided on both sides and the front of the ATS for access to cable and mechanical lug connections. The allotted dimensions for the ATS are 90" H x 44" W x 60" D, not including anchor plates and lifting plates/eyes.

C. Provide and install a 400A NEMA 4 protected service entrance rated automatic transfer switch (ATS) as detailed in these Specifications and on the Drawings for the Maintenance Building.

D. The plant electrical service is 277/480V, 3 phase, 4 wire. Service grounding and bonding of neutral are required in the ATS.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 REGULATORY REQUIREMENTS

A. The automatic transfer switches and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of UL and NEMA as follows:

1. UL 1008 – Transfer Switches
2. UL 991 – Tests for Safety-Related Controls Employing Solid-State Devices
3. NFPA 70 – National Electrical Code
4. NFPA 99 – Essential Electrical Systems of Health Care Facilities
5. PA 110 – Emergency and Standby Power Systems
6. NEMA ICS 10 – AC Transfer Switch Equipment
7. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems

1.04 SUBMITTALS

A. Submit drawings and technical data for compliance review with this specification.

1.05 WARRANTY

A. The ATS shall be warranted to be free from defects in materials and workmanship for a period of one (1) year from the date of completion and acceptance by the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The free-standing transfer switches shall be similar or equal to the Thomson TS 880 or Eaton Magnum ATVIMGF automatic transfer switch with stored energy draw-out switching devices.

B. The wall mount transfer switches shall be similar or equal to the Asco 300 series service entrance.

2.02 AUTOMATIC TRANSFER SWITCH

A. The automatic transfer switch shall be listed by Underwriter's Laboratory, Standard 1008. Wiring must comply with NEC table 373-6(b). The manufacturer shall furnish schematic and wiring diagrams for the particular automatic transfer switch and a typical wiring diagram for the entire system.

B. The automatic transfer switch shall be a 3 pole design rated as shown on the Drawings for continuous operation in ambient temperatures of -20 degrees Fahrenheit (-30 degrees Celsius) to +140 degrees Fahrenheit (+60 degrees Celsius). Main power switch contacts shall be rated for 600 V AC minimum. The transfer switch supplied shall have a minimum withstand and closing rating with circuit breakers of 42,000 amperes RMS. The RMS symmetrical fault current ratings shall be the rating listed in the UL listing or component recognition procedures for the transfer switch.

C. Each transfer switch shall be positively interlocked both mechanically and electrically to prevent simultaneous closing of both sources under either automatic or manual operation. Main contacts shall be mechanically locked in position in both normal and emergency positions. A neutral position shall not be possible under normal electrical operation unless a delayed transition accessory is required for switching highly inductive loads.

D. Transfer switches shall be capable of being operated manually under full rated load conditions. Manual operation shall be accomplished by a permanently attached manual operator, or by integrally mounted pushbuttons. Removable manual operating handles and handles that may move in the event of an electrical operation during the manual operation, are not acceptable. Manual operators requiring source or load disconnection prior to manual operation are not acceptable.

E. Where shown on the Drawings, transfer switches applied as service entrance switches shall be provided with overcurrent trip units and a service entrance label. An external key-operated selector switch shall be provided to disconnect the power supplies. Indicators shall be provided to show the availability of each source as well as breakers in a tripped or disconnected position. Provide a neutral disconnect link for three-pole solid neutral switches, and a neutral-to-ground main bonding jumper for all switches to meet UL service entrance requirements. Ground fault protection shall be provided for all switches rated 1000 amperes or more applied on 480Y/277V AC systems in accordance with NEC Article 230.

F. Switching devices for 800 through 5000 Amp Floor Mount transfer switches shall be draw-out mounted power case switches or circuit breakers. Frame ratings shall be 2000, 2500, 3000, or 4000 amperes. All breakers shall be UL listed for application in their intended enclosures for 100 percent (100%) of their continuous ampere rating. Breakers shall be electrically operated. All breakers shall include LSI electronic trip units and LSIG electronic trip units where required by code.

G. All breakers shall be provided with a true, two-step stored energy mechanism providing a maximum of three-cycle closing. All the energy required for closing the breakers shall be completely stored and held in readiness pending a release to close action. The power case switch or breaker shall have high-endurance characteristics being capable of no-load and full-load interruptions at rated current equal to or exceeding the UL endurance ratings for power circuit breakers without maintenance.

H. The transfer switch shall be controlled by a microprocessor-based controller. The controller shall be hardened against potential problems from transients and surges. Operation of the transfer switch and monitoring of both sources shall be managed by the controller.

I. The microprocessor-based controller shall be door mounted and shall provide the operator with an overview of the transfer switch status, parameters, and diagnostic data. The controller shall have a voltage range of 0-790 volts and an accuracy of +/- two percent (2%) of nominal input voltage. The controller shall be listed under UL1008.

J. The controller shall include an LED display for the following:

1. Voltage, line to line, both sources,
2. Frequency, both sources,
3. Timer countdowns,
4. Real time clock,
5. Parameter setpoints.

K. The controller shall include individual LEDs or other indication device for the following:

1. Normal source available,
2. Normal source connected,
3. Emergency source available,
4. Emergency source connected,
5. Normal source preferred,
6. Emergency source preferred,
7. Load energized,
8. Automatic mode,
9. Test mode,
10. Program mode.

L. The controller shall store all setpoints and parameters in non-volatile memory.

M. The controller shall contain a program/run selector switch.

N. The controller shall provide an undervoltage dropout adjustable from 50 to 97 percent (50 to 97%) and a pickup adjustable from dropout setting +/- two to 99 percent (2% to 99%) of nominal.

O. The controller shall provide an overvoltage dropout adjustable from 105 to 120 percent (105 to 120%) of nominal and pickup adjustable from dropout setting + two to 103 percent (2% to 103%) nominal.

P. The controller shall provide an underfrequency dropout adjustable from 90 to 97 percent (90 to 97%) of nominal and pickup adjustable from dropout setting +1 Hz to 99 percent (99%) of nominal.

Q. The controller shall provide an over frequency dropout adjustable from 100 to 120 percent (100 to 120%) of nominal and pickup adjustable from dropout setting +1 Hz to 101 percent (101%) of nominal.

R. The controller shall provide the following time delay functions:

1. A time delay shall be provided to override a momentary power outage or voltage fluctuation, adjustable from 0 to 120 seconds.

2. A time delay shall be provided on transfer to Emergency source, adjustable from 0 to 1800 seconds.

3. A time delay shall be provided on retransfer from Emergency to Normal source, adjustable from 0 to 1800 seconds. The time delay shall be bypassed if Emergency source fails, and Normal source is available.

4. A time delay shall be provided after retransfer that allows the generator to run unloaded prior to shutdown, adjustable from 0 to 1800 seconds.

5. A time delay shall be provided for the neutral position, adjustable from 0 to 120 seconds.

6. A time delay shall be provided for engine failure to start, adjustable from 0 to 6 seconds.

7. All delays shall be field adjustable via the Program/Run selector switch.

S. The controller shall contain a plant exerciser, selectable, 0 to 600 minutes, load or no load.

T. The controller shall include a test mode selectable for disabled, load, or no load.

U. The controller shall include two SPST contacts for generator start, 5A rated.

V. The controller shall include SPST contacts for Normal Source Energized and Emergency Source Energized.

W. The controller shall include SPST contacts for Engine Fail to Start, Normal Source Trip, and Emergency Source Trip.

PART 3 EXECUTION

3.01 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.

1. Insulation check to ensure the integrity of insulation and continuity of the entire system.

2. Visual inspection to ensure that the switch matches the specification requirements and to verify that the fit and finish meet quality standards.

3. Mechanical tests to verify that the switch's power sections are free of mechanical hindrances.

4. Electrical tests to verify the complete electrical operation of the switch and to set up time delays and voltage sensing settings of the logic.

B. The manufacturer shall provide three (3) certified copies of factory test reports.

END OF SECTION

SECTION 16250

GROUNDING AND BONDING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install grounding systems in compliance with NEC Article 250.

B. Supplemental grounding shall be installed as shown on the Drawings for grounding of equipment.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 16200 – Electric Utility Service

1.04 SUBMITTALS

A. Submit in accordance with Specification Section 01300, Submittals for all equipment and materials specified herein.

PART 2 PRODUCTS

2.01 ELECTROLYTIC GROUNDING ELECTRODE SYSTEM

A. The primary grounding electrode shall be a chemical ground rod using electrolytically enhanced grounding where shown on the Drawings.

B. The ground rod shall operate by hygroscopically extracting moisture from the air to activate the electrolytic process.

C. The ground rod system shall be UL Listed.

D. The ground rod system shall be 100 percent (100%) self-activating and sealed. No additions of chemical or water solutions shall be required.

E. The electrolytic grounding system shall be similar and equal to the system manufactured by Erico ECRH102G4U.

F. All copper ground rod shall consist of a 2-inch nominal diameter hollow copper tube with a wall thickness of not less than .083-inch. The tube shall be permanently capped on the top and bottom. Air breather holes shall be provided in the top of the tube and drainage holes shall be provided in the bottom of the tube for electrolyte drainage into the surrounding soil.

G. The ground rod shall be L shaped, 10 feet long, for horizontal installation.

H. A stranded 2/0 AWG copper pigtail connection shall be exothermically welded to the side of rod for ground wire termination and for use as test point.

I. Provide a precast concrete box with slots for conduit entrances, approximately 10 inches in diameter by 12 inches high. Provide a cast iron grate flush cover with “Breather” slots.

J. Provide natural volcanic, non-corrosive form of bentonite clay grout backfill material free of polymer sealants.

K. The backfill material shall absorb approximately 14-gallons of water per 50-pound bag for optimal 30 percent (30%) solids density.

L. The backfill shall have a pH value of 8-10 with a maximum resistivity of 3 ohms/meter at 30 percent (30%) solids density.

2.02 CONCRETE ENCASED ELECTRODE

A. Concrete encased electrodes shall be provided where shown for supplemental equipment grounding.

B. The grounding electrode conductor for the concrete encased electrode shall be #1/0 bare copper. The conductor shall be installed in a 1-inch PVC SCH 40 conduit for protection during construction and slab pour. Exothermic weld the conductor to the building footing rebar.

2.03 DRIVEN GROUND RODS

A. All driven ground rods, where shown on the Drawings, shall be 5/8" x 6' or 10' copper clad.

2.04 WATER PIPE

A. Provide all necessary conductors and bonding lugs for grounding of all metallic water piping as required.

2.05 GROUND CONNECTIONS AND BONDING

A. All conductor to conductor, conductor to ground rod and conductor to structure connections of #6 AWG and larger sized conductors shall be permanent exothermic welded connections. All grounding connections to equipment shall use bolted lugs.

B. All connections of #8 AWG and smaller and all connections to conduit, equipment or other items where the ground conductor must be removable shall be made using mechanical connections.

C. All mechanical ground connectors shall be UL listed.

D. All separately derived voltages shall be bonded to the service ground.

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall provide a permanent and continuous grounding path for all circuits and equipment of all system neutrals at the service disconnect. The path must be of sufficient capacity to safely transmit available fault current.

B. The main grounding electrodes shall be the electrolytic ground rod kit. Install per manufacturer's recommendations.

C. Equipment grounding conductors shall be included for all circuits and mechanically bonded.

D. Where shown on the Drawings, connect to ductile iron pipe, building steel, and reinforcing steel as supplementary grounding electrodes.

E. Where buildings are fed from separate structures, the neutral conductor shall not be bonded to the local ground bus.

F. Certified measurements shall be taken and submitted prior to connection of the main service utility to ground. The ground grid resistance shall not exceed 10 ohms. The testing shall utilize an earth resistance meter and be conducted in accordance with the IEEE Standard 3-point fall of potential method or stakeless method monitoring ground current.

END OF SECTION

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SECTION 16425

ACTIVE HARMONIC FILTER

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide and install an active harmonic filter in the Effluent Electrical Building as shown on the Drawings, rated at 300A, 249.4 kVAR @ 480V, similar or equal to Square D Accusine PCS+ PCSP300D5N2. Provide and install three (3) Accusine current transformers rated at 1600:5A ratio, split round core, to install inside switchboard SWBD-EFF.

B. Provide and install an active harmonic filter in the Influent Electrical Building as shown on the Drawings, rated at 300A, 149.4 kVAR @ 480V, similar or equal to Square D Accusine PCS+ PCSP300D5N2. Provide and install three (3) Accusine current transformers rated at 2500:5A ratio, split round core, to install inside switchboard SWBD-INF.

C. This specification defines the electrical and mechanical characteristics and requirements for power correction systems in order to meet five percent (5%) total demand distortion (TDD), at selected points within the electrical system.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 16475 – Switchboards

1.04 SUBMITTALS

A. Submit in accordance with 01300, Submittals.

B. The following information shall be submitted to the Engineer:

1. Master drawing index
2. Front view and plan view of the assembly
3. Three-line diagram
4. Schematic diagram
5. Nameplate schedule
6. Component list
7. Conduit space locations within the assembly
8. Assembly ratings including:

    a. SHORT-CIRCUIT RATING
    b. VOLTAGE
    c. CONTINUOUS CURRENT RATING

9. Major component ratings including:

    a. VOLTAGE
    b. CONTINUOUS CURRENT RATING
    c. INTERRUPTING RATINGS

10. Cable terminal sizes,
11. Product data sheets.

1.05 REFERENCES

A. The power correction systems shall be designed in accordance with the applicable sections of the following documents. Where a conflict arises between these documents and statements made herein, the statements made in this specification shall govern.

1. ANSI IEEE std C62.41-1991 [Surge Withstand Capacity],
2. CSA 22.2, No. 14 & 66 [CSA requirements for power electronics],
3. ANSI IEEE std 519 [Harmonic limits].

B. The products shall include third party approvals by UL or CSA.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer’s instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.07 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Square D Accusine, or approved equal.

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.02 ENCLOSURE

A. Each power correction unit shall be provided in a NEMA 1 or 2 rated enclosure with forced fan ventilation as required.

B. Units rated 100 Amperes and under for total output current shall be designed for wall mounting with cable entry through the bottom. Units rated greater than 100 Amperes for total output current shall be freestanding for floor mounting and top cable entry.

C. Freestanding units shall include a door-interlocked disconnect that provides power interruption when the door is opened. Disconnect shall be lockable in the power-off position. Wall mount units shall be disconnected from the power source by a disconnect device or circuit breaker contained in the power distribution center as defined by local and national codes for branch circuit protection.

D. Freestanding units shall include lifting provisions by forklift truck and lifting lugs. Wall mount units weighing more than 80 pounds shall have lifting lugs.

E. All units shall include 200,000 AIC rated fuses with Class T actuation.

F. All units shall be provided with a grounding lug. Grounding by the contractor is to be performed according to local and national standards.

G. The paint shall be the manufacturer’s standard type and color.

2.03 CONTROL

A. All units shall include a digital interface model (DIM) that includes an alphanumeric display consisting of 2-lines with 20 characters per line. All information shall be in English. Display shall be easily viewed under all lighting conditions, including sunlight, as found inside buildings.

B. The display shall provide operating data while functioning. Standard operating parameters available for display are AC line voltage, total rms load current, harmonic current of load, reactive current of load, output harmonic and reactive current of power correction system.

C. When the output of the power correction unit is at full rated capacity, the display shall indicate at-maximum capacity and actuate an at-maximum capacity relay.

D. All fault conditions shall be displayed as they occur. Diagnostic information shall be provided in English and clearly indicate the nature of the fault.

E. The run pushbutton shall include a green LED. LED shall be lighted when unit is operating.

F. Contacts shall be provided for operator information for power-on, run, fault and at-maximum capacity. Each contact shall be rated for 1 Ampere at 120/240 volts. One form C contact shall be provided for each relay.

2.04 BUS

A. All power correction units shall be defined as a power electronic device consisting of power semiconductors that switch into the AC lines to modulate its output to cancel detrimental harmonic and/or reactive currents. A DC bus shall store power for power semiconductor switching. A microprocessor shall control the operation of the power converter.

B. Each unit shall be designed with a current limiting function to protect the semiconductors. When this level is attained, a message shall be displayed indicating the output capacity is at-maximum capacity and actuate the at-maximum capacity relay. Operation shall continue indefinitely at this level without trip off or destruction of the power correction unit.

C. Each unit shall incorporate an over-temperature output roll back that reduces the total output current in order to maintain maximum current correction within the electrical system.

D. Two distinct levels of faults shall be employed. Non-critical level faults will provide automatic restart and a return to normal operation upon automatic fault clearance. Critical level faults stop the function of the unit and await operator action.

1. Faults such as AC line over voltage, AC line under-voltage, AC line power loss, and AC line phase imbalance shall be automatically restarted. Upon removal of these fault conditions, the power correction system shall restart without user action. Automatic restart will not occur if five (5) faults have occurred in less than five (5) minutes. During the fault condition, except line loss, the display shall state the type of fault and indicate that automatic restart will occur. The run relay and run LED shall be disabled. The fault relay shall not be enabled unless time out occurs. Upon AC line loss, the power-on relay shall be disabled, and no display shall be provided.

2. All other types of faults shall be considered critical and stop the power correction system. The display shall indicate the fault condition and “stop.” The run LED and relay shall be disabled, and the fault relay enabled. User shall be required to initiate a power reset (turn power off and on) to restart the power correction system.

E. The logic of the power correction system shall monitor the load current by utilizing two (2) current transformers (CTs) mounted on phases A and B to direct the function of the power electronic converter. The ratio of the CTs must be entered into the logic via the

digital keypad/display to calibrate the operation of the power correction system. The output of the current transformers shall be 5 Amperes.

2.05 RATINGS

A. Voltage: 480 Volts, 60 Hz, 3 phase, 4 wire plus ground.

B. Field Installable Capacity Upgrade: Additional power correction capacity shall be added by installing additional units in parallel to previously installed power correction systems. A maximum of five (5) units shall be installed in parallel per set of current transformers.

C. Current Transformers:

1. Split core type current transformers shall be installed as defined herein.

2. Two current transformers per power correction system location are required and mounted on phases A & B. C phase CT required when line-to-neutral loads present.

3. Current ratings of the current transformers shall be according to full load current of the circuit on which installed, 500, 1000, 3000, or 5000A to 5A secondary acceptable.

4. Current transformers rated for 400 hertz shall be used.

2.06 OPERATION

A. The power correction system shall be designed to electronically inject harmonic current to cancel the load produced harmonic current such that the upstream power harmonic current and voltage are reduced to below five percent (5%) TDD and five percent (5%) THD(V). TDD as used herein refers to the total load demand of the applied circuit. The applied circuit may be a single nonlinear load, an entire distribution-bus load, or the facility load at the point-of-common coupling (PCC) with the power source. Reactive current compensation (aka displacement power factor correction) shall be activated via a digital keypad/display mounted on the door of the enclosure. When reactive current compensation is activated, the power correction system shall first perform harmonic current correction and then use the remaining capacity to inject reactive current compensation to attain the specified level herein defined.

PART 3 EXECUTION

3.01 FACTORY TESTING

A. The active harmonic filter shall be completely assembled, wired, adjusted and tested at the factory.

B. A certified test report of all standard production tests shall be shipped with each assembly.

3.02 FIELD QUALITY CONTROL

A. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this section, to occur simultaneously with the startup of the switchgear. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

B. The Contractor shall provide three (3) copies of the manufacturer's field startup report.

3.03 MANUFACTURER'S CERTIFICATION

A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

B. The Contractor shall provide three (3) copies of the manufacturer's representative's certification before final payment.

3.04 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.

B. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

C. The equipment shall be installed and checked in accordance with the manufacturer's recommendations. This shall include but not limited to:

1. Checking to ensure that the pad location is level to within 0.125-inch per 3 foot of distance in any direction,

2. Checking to ensure that all bus bars are torqued to the manufacturer's recommendations,

3. Assembling all shipping sections, removing all shipping braces and connecting all shipping split mechanical and electrical connections,

4. Securing assemblies to foundation or floor channels.

END OF SECTION

SECTION 16430

SAFETY SWITCHES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install heavy duty non-fusible switches at locations as shown on the Drawings and as specified herein.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 REFERENCE STANDARDS

A. Switches shall be manufactured in according with the following standards:

1. UL 98 Enclosed and Dead Front Switches
2. NEMA KS 1 Enclosed Switches
3. NEMA 250 Enclosures for Electrical Equipment

1.04 SUBMITTALS

A. Submit in accordance with Specification Section 01300, Submittals for all equipment specified herein.

1.05 O & M MANUALS

A. Provide O&M Manuals in accordance with Section 01782, Operation and Maintenance Data.

B. O & M Manuals must include all information from Section 01782, Operation and Maintenance Data, paragraph 1.03.B and the additional information:

1. Maintenance Procedures
2. Spare Parts Requirements

1.06 PACKING/SHIPPING

A. Inspect and report concealed damage to carrier within their required time period.

B. Handle carefully to avoid damage to internal components, enclosure, and finish.

1.07 STORAGE

A. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

1.08 WARRANTY

A. The equipment shall be warranted to be free from defects in materials and workmanship for a period of one (1) year from the date of completion and acceptance by the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Switches shall be as manufactured by Cutler-Hammer, Square D, Siemens, General Electric or approved equal.

2.02 SWITCH TYPES

A. This specification covers fusible and non-fusible heavy duty metallic safety switches.

2.03 METALLIC SWITCH INTERIOR

A. All switches shall have switch blades which are visible when the switch is OFF and the cover is open.

B. Lugs shall be front removable and UL Listed.

C. Switches required for NEMA 4X stainless steel applications shall have all copper current carrying parts.

D. All current carrying parts shall be plated to resist corrosion.

E. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.

F. Switches shall have provisions for a field installable electrical interlock.

G. Switches shall have a field installed UL Listed ground terminal.

2.04 METALLIC SWITCH MECHANISM

A. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.

B. The operating handle shall be an integral part of the box, not the cover.

C. Provisions for padlocking the switch in the OFF position with at least three (3) padlocks shall be provided.

D. The handle position shall travel at least 90 degrees between OFF and ON positions to clearly distinguish and indicate handle position.

E. All switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism.

2.05 METALLIC SWITCH ENCLOSURES

A. Switch covers shall be attached with welded pin type hinges.

B. Switches for outdoor applications shall be NEMA 4X stainless steel.

C. Switches for indoor applications shall be NEMA 12/3R gray baked enamel paint or as noted on the Drawings. The switches shall not have knockouts.

D. The enclosure shall have ON and OFF markings stamped into the cover.

E. The operating handle shall be provided with a dual colored, red/black position indication.

2.06 METALLIC SWITCH RATINGS

A. Switches shall be UL horsepower rated for ac and/or ac/dc as on the plans.

2.07 SAFETY SWITCH ACCESSORIES

A. All safety switches used for VFD driven electrical motors shall be provided with a Normally Open auxiliary contact switch that is closed when the switch is closed.

PART 3 EXECUTION

3.01 GENERAL

A. Install switches as shown on the Drawings.

B. Switches shall be attached with corrosion resistant hardware.

END OF SECTION

SECTION 16460

TRANSFORMERS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide general purpose transformers as shown on the Drawings and as specified herein.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 REFERENCE SPECIFICATIONS

A. NFPA 70 – National Electrical Code

B. NEMA ST20

C. Underwriters Laboratories (UL) 1561

1.04 SUBMITTALS

A. Submit in accordance with Section 01330, Submittals.

1.05 STANDARDS

A. Transformers 1000 kVA and smaller shall be listed by UL.

B. Conform to the requirements of ANSI/NFPA 70.

C. Transformers are to be manufactured and tested in accordance with NEMA ST20.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Transformers shall be as manufactured by Square D, Acme, Hammond, or equal.

2.02 RATINGS INFORMATION

A. All insulating materials are to exceed NEMA ST20 standards and be rated for 220 degrees C UL component recognized insulation system.

B. The maximum temperature of the top of the enclosure shall not exceed 50 degree C rise above a 40 degree C ambient.

C. The transformer(s) shall be rated as indicated in the following schedule:

1. Identification Number(s)
2. kVA Rating
3. Voltages
4. Phase
5. Frequency

2.03 CONSTRUCTION

A. Transformer coils shall be of the continuous wound construction and shall be impregnated with nonhygroscopic, thermosetting varnish.

B. All cores to be constructed with low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point to prevent core overheating. Cores for transformers greater than 500 kVA shall be clamped utilizing insulated bolts through the core laminations to provide proper pressure throughout the length of the core. The completed core and coil shall be bolted to the base of the enclosure but isolated by means of rubber vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure except for a flexible safety ground strap. Sound isolation systems requiring the complete removal of all fastening devices will not be acceptable.

C. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance wit applicable UL and NEC standards.

D. The transformer enclosures shall be ventilated and be fabricated of heavy gauge, sheet steel construction. The entire enclosure shall be finished utilizing a continuous process consisting of degreasing, cleaning and phosphatizing, followed by electrostatic deposition of polymer polyester powder coating and baking cycle to provide uniform coating of all edges and surfaces. The coating shall be UL recognized for outdoor use. The coating color shall be ANSI 49.

2.04 SOUND LEVELS

A. Sound levels shall be warranted by the manufacturer not to exceed the following: 15 to 50 kVA – 45 dB; 51 to 150 kVA – 50 dB; 151 to 300 kVA – 55 dB; 301 to 500 kVA – 60 dB; 501 to 700 kVA – 62 dB; 701 to 1000 kVA – 64 dB; 1001 to 1500 kVA – 65 dB; 1501 to 2000 kVA – 66 dB.

PART 3 EXECUTION

3.01 GENERAL

A. Install general-purpose single-phase transformers directly below the served lighting and appliance panelboard.

B. Ground all separately derived systems according to NEC.

END OF SECTION

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SECTION 16470

PANELBOARDS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install 480V three phase, four wire power distribution panelboards and 120/208-240V single phase three wire or three phase four wire lighting and appliance panelboards as shown on the Drawings.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 REFERENCE SPECIFICATIONS

A. The panelboards and circuit breakers referenced herein are designed and manufactured according to the latest revision of the following specifications.

1. NEMA PB 1 – Panelboards

2. NEMA PB 1.1 – Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less

3. NEMA AB 1 – Molded Case Circuit Breakers

4. NEMA KS 1 – Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

5. UL 50 – Enclosures for Electrical Equipment

6. UL 67 – Panelboards

7. UL 98 -- Enclosed and Dead-front Switches

8. UL 489 – Molded Case Circuit Breakers and Circuit Breaker Enclosures
9. CSA Standard C22.2 No. 29-M1989 – Panelboards and Enclosed Panelboards
10. CSA Standard C22.2 No. 5-M91 – Molded Case Circuit Breakers
11. Federal Specification W-P-115C – Type I Class I
12. Federal Specification W-P-115C – Type II Class I
13. Federal Specification W-C-375B/Gen. – Circuit Breakers, Molded Case, Branch Circuit and Service
14. Federal Specification W-C-865C – Fusible Switches
15. NFPA 70 – National Electrical Code (NEC)
16. ASTM – American Society of Testing Materials

1.04 SUBMITTAL AND RECORD DOCUMENTATION

A. Approval documents shall include drawings. Drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one-line diagrams with applicable voltage systems.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inspect and report concealed damage to carrier within their required time period.

B. Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.

C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

1.06 WARRANTY

A. Manufacturer shall warrant specified equipment free from defects in materials and workmanship for the lesser of one (1) year from the date of installation or eight (18) months from the date of purchase.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable manufacturers shall be Square D, Siemens, Cutler-Hammer, General Electric, or approved equal.

2.02 POWER DISTRIBUTION PANELBOARDS

A. Interior

1. Shall be rated 600 VAC or 250 VDC maximum. Continuous main current ratings as indicated on Drawings, not to exceed 1200 amperes maximum. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67.

2. Provide UL Listed short circuit current ratings (SCCR) as indicated on the associated Drawings not to exceed the lowest interrupting capacity rating of any circuit breaker installed with a maximum of 200,000 rms symmetrical amperes. Main lug and main breaker panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and –G.

3. The bussing shall be fully rated with sequentially phased branch distribution. Panelboard bussing rated 100 through 600 amperes shall be plated copper. Bussing rated 800 amperes and above shall be plated copper. The entire interleaved assembly shall be contained between two (2) U-shaped steel channels, permanently secured to a galvanized steel-mounting pan by fasteners employing the use of a tamper-resistant warning label.

4. Interior trim shall be of dead-front construction to shield user from all energized parts. Main circuit breakers through 800 amperes shall be vertically mounted. Main circuit breaker and main lug interiors shall be bottom incoming feed.

5. Equipment ground bar shall be bonded. Ground bar shall be copper. Solid neutral shall be equipped with a full capacity-grounding strap for service entrance applications. UL Listed panelboards with 200% rated solid neutrals shall have plated copper neutral bus for non-linear load applications. Gutter-mounted neutral will not be acceptable.

6. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label, and Short Circuit Current Rating shall be provided. Leveling provisions shall be provided for flush mounted applications.

B. Molded Case Circuit Breakers – Mains and Branches

1. Circuit breakers shall be constructed in accordance with the following standards.

UL 489	Federal Specification W-C-375B/GEN
NEMA AB1	CSA 22.2, No. 5-M91
IEC 157-1	BS 4752

2. Circuit breakers shall be constructed using glass reinforced polyester insulating material providing superior dielectric strength. Current-carrying components shall be completely isolated from the handle and the accessory mounting area.

3. Circuit breakers shall have an overcenter, trip-free, toggle operating mechanism which will provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.

4. Circuit breakers shall have a push-to-trip button for maintenance and testing purposes.

5. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position.

6. Breaker faceplate shall indicate rated ampacity. Breaker faceplate shall indicate UL and IEC certification standards with applicable voltage systems and corresponding AIR ratings.

7. Circuit breakers shall be factory sealed and shall have a date code on the face of the circuit breaker. Poles shall be labeled with respective phase designations.

8. Standard construction circuit breakers shall be UL Listed for reverse connection without restrictive line or load markings. Circuit breakers shall be suitable for mounting and operating in any position.

9. Circuit breakers equipped with line terminal jaws shall meet the following requirements. In the event of a short circuit condition, the increased magnetic flux shall cause the jaws to grip the supply bus more firmly. Circuit breaker jaws shall be protected by an impact resistant molded shroud.

10. Circuit breakers equipped with line terminal jaws shall not require any additional external mounting hardware. Circuit breakers shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Each individual circuit breaker shall be capable of being mounted independently. Circuit breakers of different frame sizes shall be capable of being mounted across from each other.

11. Manufacturer shall provide time/current characteristic trip curves (Ip and I2T let-through curves for true current limiting circuit breakers only) for each type of circuit breaker.

12. Lugs shall be UL Listed to accept solid or stranded copper conductors only. Lugs shall be suitable for 90 degree C rated wire, sized according to the 75 degree C temperature rating per NEC Table 310-16. Lug body shall be bolted in place; snap-in designs are not acceptable.

13. Circuit breakers shall be UL Listed for use with the following accessories: Shunt Trip, Under Voltage Trip, Auxiliary Switch, Alarm Switch, Ground Fault Shunt Trip, Electrical Operators, Cylinder Locks, Mechanical Lugs Kits, Compression Lugs Kits, and Handle Accessories.

C. Equipment Ground Fault Protection

1. Where required, ground fault protection shall be true rms sensing type.

2. Provide a separate neutral current transformer for three-phase, four-wire systems.

3. The ground fault sensing system shall be residual type.

4. Provide a means of testing the ground fault system to meet the on-site testing requirements of NEC Article 230-95(c).

5. Provide local visual trip indication for overload, short circuit, and ground fault trip occurrences.

D. Enclosures

1. Boxes shall be galvanized steel construction in accordance with UL requirements. Zinc-coated galvannealed steel and will not be acceptable.

2. Boxes shall have removable blank endwalls and interior mounting studs. Interior support bracket shall be provided for ease of interior installation.

3. The enclosure shall be NEMA Type 1 construction, dimensions as shown on the Drawings.

2.03 LIGHTING AND RECEPTACLE PANELBOARD TYPE

A. Interior

1. Shall be type NQOD panelboard rated for 240 VAC/48 VDC maximum. Continuous main current ratings, as indicated on associated schedules, not to exceed 600 amperes maximum.

2. Minimum short circuit current rating: 10,000 in rms symmetrical amperes at 240 VAC.

3. Provide one (1) continuous bus bar shall have sequentially phased branch circuit connectors suitable for plug-on or bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67. Bussing rated 100-400 amperes shall be copper.

4. All current-carrying parts shall be insulated from ground and phase-to-phase by Noryl high dielectric strength thermoplastic or equivalent.

5. Split solid neutral shall be plated and located in the mains compartment up to 225 amperes so all incoming neutral cable may be of the same length.

6. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trim shall have pre-formed twistouts covering unused mounting space.

7. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label and short circuit current rating shall be displayed on the interior or in a booklet format.

8. Interiors shall be field convertible for top or bottom incoming feed. Main and sub-feed circuit breakers shall be vertically mounted. Main lug interiors up to 400 amperes shall be field convertible to main breaker. Interior leveling provisions shall be provided for flush mounted applications.

B. Main Circuit Breaker

1. Main circuit breakers shall have an overcenter, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be true rms sensing and be factory calibrated to operate in a 40-degree C ambient environment. Thermal elements shall be ambient compensating above 40-degree C.

2. Two- and three-pole circuit breakers shall have common tripping of all poles. Circuit breakers frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker, which allows the user to simultaneously select the desired trip level of all poles. Circuit breakers shall have a push-to-trip button for maintenance and testing purposes.

3. Breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL Listed for reverse connection without restrictive line or load markings.

4. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position.

5. Lugs shall be UL Listed to accept stranded copper conductors only. Lugs shall be suitable for 90 degree C wire, sized according to the 75 degree C temperature rating per NEC Table 310-16. Lug body shall be bolted in place; snap-in designs are not acceptable.

6. The circuit breakers shall be UL Listed for use with the following accessories: Shunt Trip, Under Voltage rip, Ground Fault Shunt Trip, Auxiliary Switch, Alarm Switch, Mechanical Lug Kits, and Compression Lug Kits.

C. Branch Circuit Breakers

1. Circuit breakers shall be UL Listed with amperage ratings, interrupting ratings, and number of poles as indicated on the panelboard schedules.

2. Molded case branch circuit breakers shall have bolt-on type bus connectors.

3. Circuit breakers shall have an overcenter toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.

4. There shall be two forms of visible trip indication. The breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red VISI-TRIP indicator appearing in the clear window of the circuit breaker housing.

5. The exposed faceplates of all branch circuit breakers shall be flush with one another.

6. Lugs shall be UL Listed to accept stranded copper conductors only. Lugs shall be suitable for 90 degree C rated wire, sized according to the 75 degree C temperature rating per NEC Table 310-16.

7. Breakers shall be UL Listed for use with the following factory installed accessories: Shunt Trip, Auxiliary Switch, Alarm Switch.

D. Enclosures

1. Type 1 Boxes

2. Boxes shall be galvanized steel constructed in accordance with UL 50 requirements.

3. Boxes shall have removable endwalls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.

4. Box width shall be 20 inches wide.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and NEC standards.

B. Anchor panelboards to structure and make branch circuit connections.

C. Coordinate the panelboard bus ratings and circuit breaker coordination rating with the available fault current.

3.02 FIELD QUALITY CONTROL

A. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.

B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20% of each other. Maintain proper phasing for multi-wire branch circuits.

C. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

END OF SECTION

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SECTION 16475

SWITCHBOARDS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. At the proposed Influent Electrical Building, in the Electrical Room, the Contractor shall supply and install Switchboard SWBD-INF, a 3000A Main Lug/Bus, free-standing NEMA 1 power distribution panelboard, with branch breakers as shown on the Drawings.

B. At the proposed Effluent Electrical Building, in the Electrical Room, the Contractor shall supply and install Switchboard SWBD-INF, a 2000A Main Lug/Bus, free-standing NEMA 1 power distribution panelboard, with branch breakers as shown on the Drawings

1.02 REFERENCE STANDARDS

A.	NEMA PB 1	Panelboards
B.	NEMA PB 1.1	Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
C.	NEMA AB 1	Molded Case Circuit Breakers
D.	NEMA KS 1	Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
E.	UL 50	Enclosures for Electrical Equipment
F.	UL 67	Panelboards
G.	UL 98	Enclosed and Dead-front Switches
H.	UL 489	Molded Case Circuit Breakers and Circuit Breaker Enclosures
I.	CSA Standard C22.2 No. 29-M1989	Panelboards and Enclosed Panelboards
J.	CSA Standard C22.2 No. 5-M91	Molded Case Circuit Breakers
K.	Federal Specification W-P-115C	Type I Class I
L.	Federal Specification W-P-115C	Type II Class I
M.	Federal Specification W-C-375B/Gen.	Circuit Breakers, Molded Case, Branch Circuit and Service
N.	Federal Specification W-C-865C	Fusible Switches
O.	National Electrical Code (NEC)	NFPA 70

P. ASTM International (ASTM), latest edition.

1.03 SUBMITTAL AND RECORD DOCUMENTATION

A. Approval documents shall include drawings. Drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one-line diagrams with applicable voltage systems.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Inspect and report concealed damage to carrier within their required time period.

B. Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.

C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

1.05 WARRANTY

A. Manufacturer shall warrant specified equipment free from defects in materials and workmanship for the lesser of one (1) year from the date of installation or 18 months from the date of purchase.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Switchboards shall be as manufactured by Square D type QED-2 with I-Line type double row interiors or equal.

2.02 POWER DISTRIBUTION SWITCHBOARDS

A. Main circuit breakers for switchboards shall be fixed or draw-out mounted power case units as shown on the Drawings. All breakers shall be UL listed for application in their intended enclosures for 100 percent (100%) of their continuous ampere rating. Breakers shall be electrically operated. All breakers shall include LSI electronic trip units and LSIG electronic trip units where required by code.

B. All main circuit breakers shall be provided with a true, two-step stored energy mechanism providing a maximum of three-cycle closing. All the energy required for closing the breakers shall be completely stored and held in readiness pending a release to close action. The power case breaker shall have high-endurance characteristics being capable of no-load and full-load interruptions at rated current equal to or exceeding the UL endurance ratings for power circuit breakers without maintenance.

C. Distribution Section

1. Shall be rated 600 VAC or 250 VDC maximum. Continuous main current ratings as indicated on associated schedules not to exceed 3000 amperes maximum. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67.

2. Provide UL Listed short circuit current ratings (SCCR) as indicated on the associated Drawings not to exceed the lowest interrupting capacity rating of any circuit breaker installed with a maximum of 200,000 rms symmetrical amperes. Main lug and main breaker panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and –G.

3. The bussing shall be fully rated with sequentially phased branch distribution. Panelboard bussing rated 100 through 600 amperes shall be plated copper. The entire interleaved assembly shall be contained between two (2) U-shaped steel channels, permanently secured to a galvanized steel-mounting pan by fasteners employing the use of a tamper-resistant warning label.

4. Interior trim shall be of dead-front construction to shield user from all energized parts. Main circuit breaker and main lug interiors shall be field convertible for top or bottom incoming feed.

5. Equipment ground bar shall be bonded. Ground bar shall be copper. Solid neutral shall be equipped with a full capacity-grounding strap for service entrance applications. UL Listed panelboards with 200 percent (200%) rated solid neutrals shall have plated copper neutral bus for non-linear load applications. Gutter-mounted neutral will not be acceptable.

6. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label, and Short Circuit Current Rating shall be provided. Leveling provisions shall be provided for flush mounted applications.

D. Molded Case Circuit Breakers –Branches

1. Branch circuit breakers 600A and above shall be provided with electronic LSI trip modules with ammeter.

2. Circuit breakers shall be constructed in accordance with the following standards.

UL 489	Federal Specification W-C-375B/GEN
NEMA AB1	CSA 22.2, No. 5-M91
IEC 157-1	BS 4752

3. Circuit breakers shall be constructed using glass reinforced polyester insulating material providing superior dielectric strength. Current-carrying components shall be completely isolated from the handle and the accessory mounting area.

4. Circuit breakers shall have an overcenter, trip-free, toggle operating mechanism which will provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.

5. Circuit breakers shall have a push-to-trip button for maintenance and testing purposes.

6. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position.

7. Breaker faceplate shall indicate rated ampacity. Breaker faceplate shall indicate UL and IEC certification standards with applicable voltage systems and corresponding AIR ratings.

8. Circuit breakers shall be factory sealed and shall have a date code on the face of the circuit breaker. Poles shall be labeled with respective phase designations.

9. Standard construction circuit breakers shall be UL Listed for reverse connection without restrictive line or load markings. Circuit breakers shall be suitable for mounting and operating in any position.

10. Circuit breakers equipped with line terminal jaws shall not require any additional external mounting hardware. Circuit breakers shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Each individual circuit breaker shall be capable of being mounted independently. Circuit breakers of different frame sizes shall be capable of being mounted across from each other.

11. Manufacturer shall provide time/current characteristic trip curves (Ip and I2T let-through curves for true current limiting circuit breakers only) for each type of circuit breaker.

12. Lugs shall be UL Listed to accept solid or stranded copper conductors only. Lugs shall be suitable for 90 degree C rated wire, sized according to the 75 degree C temperature rating per NEC Table 310-16. Lug body shall be bolted in place; snap-in designs are not acceptable.

E. Enclosures

1. Boxes shall be constructed to NEMA 1 for interior installation and NEMA 3R/12 for exterior installations.

2.03 TRANSIENT VOLTAGE SURGE SUPPRESSOR (TVSS)

A. The switchboard shall be provided with an integral TVSS in the branch breaker distribution section. The manufacturer of the TVSS shall be the same as the manufacturer of the MCC.

B. The TVSS shall be listed and recognized in accordance with UL 1449.

C. The TVSS must be supplied with a UL recognized circuit breaker disconnect.

D. The TVSS shall provide surge current protection for all modes of protection: Line to Line, Line to Neutral, and Line to Ground.

E. The TVSS shall have a peak surge current rating of 240 kA per phase.

F. The TVSS shall be rated for 480Y/277 VAC, 3 Phase, 4 Wire system voltage.

G. The TVSS shall have UL suppression voltage rating of 800V Line-Neutral, 800V Line-Ground, and 1600V Line-Line. The TVSS shall have a maximum continuous operating voltage of 320V.

2.04 POWER CIRCUIT MONITOR

A. The power monitor will communicate to the local PLC via a built in Ethernet port and Ethernet IP communication protocol.

B. A local power monitor display shall be supplied.

C. The power monitor setup parameters will be stored in nonvolatile memory and retained in the event of a power interruption.

D. The power monitor will be applied in 480/277V, 3 phase, four (4) wire systems.

E. The power monitor will provide real time RMS values of the following parameters:

F. Current (Per phase, Neutral, Ground, 3 Phase Average)

G. Voltage (Line to Line per Phase, Line to Line 3 Phase Average, Line to Neutral per Phase)

H. Real Power (3 Phase Total)

I. Reactive Power (3 Phase Total)

J. Apparent Power (3 Phase Total)

K. Power Factor (3 Phase Total)

L. Frequency

M. Total Harmonic Distortion (THD), Current and Voltage

N. The power monitor shall have a form C contact which will close and alarm the local PLC when a power fault or power loss has occurred.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install switchboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and NEC standards.

B. Anchor switchboards to structure and make branch circuit connections.

C. Coordinate the switchboard bus ratings and circuit breaker coordination rating with the available fault current.

3.02 FIELD QUALITY CONTROL

A. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.

B. Measure steady state load currents at each switchboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20 percent (20%) of each other. Maintain proper phasing for multi-wire branch circuits.

C. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

END OF SECTION

SECTION 16480

MOTOR CONTROL CENTERS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide and install motor control centers (MCC) as shown on the Drawings and as specified herein. Unless otherwise specified, all MCCs shall be 480/277V, 3-Phase, 4-Wire, 60 Hz unless otherwise indicated.

B. The Contractor shall provide MCC-INF in the Influent Electrical Building, MCC-EFF in the Effluent Electrical Building, and MCC-WAS in the existing WAS/Scum Pump Building.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 01782 – Operation and Maintenance Data

1.04 REGULATORY REQUIREMENTS

A. NFPA 70 National Electric Code

B. UL 845 UL Standard for Safety for Motor Control Centers

C. UL 508 UL Standard for Safety for Industrial Control Equipment

D. UL 508C UL Standard for Safety for Power Conversion Equipment

E. NEMA ICS 3 Motor Control Centers Not Rated More Than 600 VAC

F. UL 50 UL Standard for Safety for Enclosures for Electrical Equipment

G. UL 1283 Electromagnetic Interference Filters

H. UL 1449 Transient Voltage Surge Suppressors 2nd Edition

1.05 SUBMITTALS

A. Submittals are required for the following:

1. MCC One - Line Diagram
2. MCC Elevation
3. MCC Conduit Entry and Clearance, Top and Bottom
4. MCC Control and Wiring Diagrams
5. VFD Catalog and Rating Information
6. Power Monitor Information and Wiring Details

1.06 O&M MANUALS

A. Provide MCC O&M Manuals in accordance with Section 01782, Operation and Maintenance Data.

B. O & M Manuals must include all information from 1.03.B and the additional information:

1. MCC Maintenance Procedures
2. MCC Spare Parts Requirements
3. VFD User Manuals
4. Power Monitor User Manuals
5. TVSS User Manuals

1.07 PACKING/SHIPPING

A. The MCC shall be separated into shipping blocks no more than three (3) vertical sections each. Shipping blocks shall be shipped on their sides to permit easier handling at the jobsite. Each shipping block shall include a removable lifting angle, which will allow an easy means of attaching an overhead crane or other suitable lifting equipment.

1.08 STORAGE

A. The MCC must be stored in a clean and dry environment after shipment to the jobsite, free from temperature extremes.

1.09 WARRANTY

A. The MCC shall be warranted to be free from defects in materials and workmanship for a period of one (1) year from the date of completion and acceptance by the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The MCC shall be manufactured by Square D Company Model 6 or Allen-Bradley Company Intellicenter, utilizing device communication networks with Ethernet IP protocol.

2.02 MATERIALS

A. Steel material shall comply with UL 845 and CSA requirements.

B. Each MCC shall consist of one or more vertical sections of heavy gauge steel bolted together to form a rigid, free-standing assembly. A removable 7-gauge structural steel lifting angle shall be mounted full width of the MCC lineup at the top. Removable 7-gauge bottom channel shall be mounted underneath front and rear of the vertical sections extending the full width of the lineup. Vertical sections shall be made of welded side-frame assembly formed from a minimum of 12-gauge steel. Internal reinforcement structural parts shall be of 11-gauge steel to provide a strong, rigid assembly. The entire assembly shall be constructed and packaged to withstand all stresses included in transit and during installation.

2.03 MCC FINISH

A. All steel parts shall be provided with UL and CSA listed acrylic/alkyd baked enamel paint finish, except plated parts used for ground connections.

2.04 STRUCTURES

A. Structures shall be totally enclosed, dead-front, free-standing assemblies. Structures shall be capable of being bolted together to form a single assembly.

B. The overall height of the MCC shall not exceed 90 inches. The total width of one (1) standard section shall be 20 inches. Specialty sections shall have maximum width as detailed on the Drawings.

C. Structures shall be NEMA/EEMAC 1 general purpose.

D. Each 20-inch wide standard section shall have all necessary hardware and bussing for modular plug-in units to be added and moved around. All unused space shall be covered by hinged blank doors and equipped to accept future units. Vertical bus openings shall be covered by manual bus shutters.

E. Each section shall include a top plate. The plate will be removable for ease in cutting conduit entry openings.

F. Vertical sections are made of a welded side-frame assembly formed from a minimum of 12-gauge steel. Internal reinforcement structural parts of 12 gauge and 14 gauge steel to provide a strong, rigid assembly. Steel material complies with UL 845 and CSA requirements. Bottom channels are not removable.

2.05 WIREWAYS

A. Structures shall contain a minimum of 12 inches high horizontal wireway at the top of each section and a minimum of 6 inches high horizontal wireway at the bottom of each section. These wireways shall run the full length of the MCC to allow room for power and control cable to connect between units in different sections.

B. A full-depth vertical wireway shall be provided in each MCC section that accepts modular plug-in units. The vertical wireway shall connect with both the top and bottom horizontal wireway and shall be isolated from unit interiors by a full height barrier. The vertical wireway shall be 4 inches wide minimum with a separate hinged door. Access to the wireways shall not require opening control unit doors.

2.06 BARRIERS

A. All power bussing and splice connections shall be isolated from the unit compartments and the wireways. The horizontal bus shall be mounted onto a glass filled polyester support assembly that braces the bus against the forces generated during a short circuit. The horizontal bus shall be isolated from the top horizontal wireway by a two (2) piece grounded steel barrier. The barrier shall be removable to allow access to the bus and connections for maintenance.

B. The vertical bus shall be housed in a molded glass filled polyester support that provides bus insulation and braces the bus against the forces generated during a short circuit. These supports shall have openings every 3 inches for unit stab-on connections. Each opening shall be provided with a manual shutter to close off the stab opening. These shutters shall be attached to the structure so that when they are removed, they are retained in the structure and are readily accessible for use should a plug-in unit be removed from the MCC.

C. Barriers shall be provided in the vertical structure and unit designs to prevent the contact of any energized bus or terminal by a fishtape inserted through the conduit or wireway areas.

2.07 BUSSING

A. All bussing and connectors shall be tin-plated or silver-plated copper.

B. The main horizontal bus shall be rated 600A, 800A, 1200A, 1600A, or 2000A continuous and shall extend the full length of the MCC. Bus ratings shall be based on 65C maximum temperature rise in a 40C ambient environment. Provisions shall be provided for splicing additional sections onto either end of the MCC.

C. The horizontal bus is isolated from the top horizontal wireway by a two-piece rigid non-conductive barrier. The barrier design allows qualified personnel to slide the barriers both left and right, to allow access to the bus and connections for maintenance without using tools or having to remove the barrier. Barrier sliding is via an upper and lower track system.

D. Each section that accepts plug-in units shall be provided with a vertical bus for distributing power from the main bus to the individual plug-in starter units. This bus shall be of the same material as the main bus. The vertical bus shall be connected directly to the horizontal bus stack without the use of risers or intervening connectors. It shall be possible to maintain the vertical to horizontal bus connection with a single tool. Nut and bolt bus connections to the power bus shall not be permitted.

E. A tin-plated copper ground bus shall be provided that runs the entire width of the MCC. A compression lug shall be provided in the MCC for a #8 -250 kcmil ground cable. The ground bus shall be provided with six (6) 0.38-inch holes for each vertical section to accept customer supplied ground lugs for any loads requiring a ground conductor.

F. Each vertical section shall have a copper vertical ground bus that is connected to the horizontal ground bus. This vertical ground bus shall be installed so that the plug-in units engage the ground bus prior to engagement of the power stabs and shall disengage only after the power stabs are disconnected upon removal of the plug-in unit.

G. The power bus system shall be braced for a short circuit capacity of 42,000 rms amperes minimum as standard. Bus bracing rated at 65,000, 85,000, and 100,000 rms amperes shall be available.

2.08 UNIT CONSTRUCTION

A. Units with circuit breaker disconnect through 400A frame, and fusible switch disconnects through 400A, shall connect to the vertical bus through a spring reinforced stab-on connector. Units with large disconnects shall be connected directly to the main horizontal bus with appropriately sized cable or riser bus. Stabs on all plug-in units shall be solidly bussed to the unit disconnect.

B. All conducting parts on the line side of the unit disconnect shall be shrouded by a suitable insulating material to prevent accidental contact.

C. Unit mounting shelves shall include hanger brackets to support the unit weight during installation and removal.

D. A cast metal handle operator must be provided for each disconnect. With the unit stabs engaged into the vertical phase bus and the unit door closed, the handle mechanism shall allow complete ON/OFF control of the unit disconnect with clear indication of the disconnect status. All circuit breaker operators shall include a separate TRIPPED position to clearly indicate the circuit breaker tripped condition. It shall be possible to reset a tripped circuit breaker without opening the control unit door.

E. A mechanical interlock shall prevent the operator from opening the unit door when the disconnect is in the ON position. Another mechanical interlock shall prevent the operator from placing the disconnect in the ON position while the unit door is open. It shall be possible for authorized personnel to defeat these interlocks.

F. A non-defeatable interlock shall be provided between the handle operator and the cam lever to prevent installing or removing a plug-in unit unless the disconnect is in the OFF position.

G. The plug-in unit shall have a grounded stab-on connector which engages the vertical ground bus prior to, and releases after, the power bus stab-on connectors.

H. Provisions shall be provided for locking all disconnects in the OFF position with up to three (3) padlocks.

I. Unit construction shall combine with vertical wireway isolation barrier to provide a fully compartmentalized design.

2.09 COMBINATION LIGHTING AND HVAC CONTACTORS

A. All combination contactors shall use a unit disconnect as previously specified. All contactors shall utilize NEMA rated contactors.

B. Auxiliary control circuit interlocks shall be provided where indicated. A minimum of two (2) normally open contacts shall be provided with each contactor.

C. Each unit will wire directly to terminal blocks for motor and control wiring. Terminal blocks shall all be rated at 600 volts and at the ampacity required for the loads.

D. When provided, control power transformers shall include two (2) primary and one (1) secondary fuse. The transformer shall be sized to power the contactor and all connected loads.

E. Controls for the contactors shall be as indicated on the Drawings.

F. All combination contactors shall be provided with HAND-OFF-AUTO switches.

G. All combination contactors shall be provided with green POWER ON indication pilot lights.

2.10 COMBINATION MOTOR STARTERS

A. All combination starters shall use a unit disconnect as previously specified. All starters shall utilize NEMA rated contactors for motors. Starters shall be provided with a solid state three pole, external manual reset, overload relay. The overload relays shall provide integral isolated normally closed and normally opened contacts.

B. Auxiliary control circuit interlocks shall be provided where indicated. A minimum of two (2) normally open contacts shall be provided with each contactor.

C. Each unit will wire directly to terminal blocks for motor and control wiring. Terminal blocks shall all be rated at 600 volts and at the ampacity required for the loads.

D. When provided, control power transformers shall include two (2) primary and one (1) secondary fuse. The transformer shall be sized to power the contactor and all connected loads.

E. Controls for the motor starters shall be as indicated on the Drawings.

F. All combination starters shall include elapsed time meters (ETM).

G. All combination starters shall be provided with HAND-OFF-AUTO switches.

H. All combination starters shall be provided with green RUN indication pilot lights.

2.11 VARIABLE FREQUENCY DRIVES (VFD)

A. All VFD shall use a unit disconnect as previously specified.

B. The VFD shall be supplied and installed by the MCC manufacturer. Empty MCC sections with field installed VFDs will not be allowed.

C. The VFD will be pulse with modulation (PWM) technology.

D. The VFD shall be rated as shown on the Drawings. The VFD rating is based on continuous required output current. Do not rate the VFD to motor horsepower shown on the Drawings.

E. The VFD shall be capable of 60 second operation at 110 percent (110%) output current rating.

F. The VFDs shall operate variable torque loads unless otherwise indicated.

G. The VFD shall be installed in an MCC section and shall incorporate a self-contained air based cooling system for operation in a NEMA 1 assembly.

H. The VFD must operate in an ambient temperature from 0 to 40 C with 65 C maximum temperature rise.

I. The VFD must operate in humidity conditions up to 95 percent (95%) non-condensing.

J. The VFD must operate at an input voltage of 380VAC - 15 percent (15%) and 480 VAC + ten percent (10%) without fault.

K. The VFD must operate from an input frequency range of 57 to 63 Hz.

L. The VFD efficiency shall be 97 percent (97%) minimum.

M. The output carrier frequency shall be adjustable from 1 to 8 kHz or 16kHz.

N. The VFD shall be capable of open loop torque control with sensorless flux vector algorithms. The VFD default setting shall be vector control.

O. All VFD feeder equipment shall be sized based on VFD input current rating.

P. The VFD shall have short circuit coordination with the MCC.

Q. The VFD shall have protection functions for output phase short circuits, ground faults, logic and analog output faults, over temperature, and internal power supply faults.

R. The VFD shall have solid state overload protection that is UL 508C listed for Class 10 overload protection. The overload protection shall be adjustable to the driven motor full load nameplate value.

S. The VFD shall be setup to automatically reset on all faults other than ground fault, short circuit, or internal fault.

T. The VFD shall be setup to ride through a power loss or fluctuation.

U. The VFD shall have a programmable skip frequency.

V. The VFD shall be setup to reduce frequency when an overload condition is detected.

W. The VFD shall have programmable form C contacts for VFD Fault and VFD Run.

X. The VFD shall have a minimum of two analog speed reference inputs, one for a potentiometer in the HAND mode of operation, and one for a 4-20mA input for AUTO mode of operation.

Y. The VFD shall be supplied with a keypad, mounted on the MCC door. The keypad shall provide the ability to adjust all programming parameters. The keypad shall include at least two lines of forty-character text, with the capability of monitoring volts, amps, frequency, speed reference, and other VFD monitor functions.

Z. The VFD shall have adjustable acceleration and deceleration parameters with linear/S curve switchable patterns.

AA. The VFD start/stop and speed reference will be controlled via terminal inputs on the VFD.

BB. Three percent (3%) line reactors shall be supplied with each VFD if shown on the Drawings. dV/dt filters shall be supplied for each VFD with long cable leads as shown on the Drawings.

CC. Where shown on the Drawings, the VFD shall include fully rated isolation and bypass contactors (three contactor design) complete with Class 20 thermal overload relay protection for emergency full speed capability. Bypass and isolation contactor shall be mechanically and electrically interlocked. Emergency full speed bypass shall be FVNR (Full Voltage Non-Reversing). Bypass and isolation contactors shall be in Integrated construction.

DD. The operator shall have full operational control of the bypass starter using a door mounted VFD/BYPASS selector switch. BYPASS shall only function when the mode of operation is HAND.

EE. The VFD Input Contactor must remove power to the VFD when the drive is not running. The control scheme must maintain input power to the VFD while the load is being decelerated to a STOP. Once stopped, the VFD input contactor will open and shall not report a FAULT to the SCADA system.

FF. Industrial rated 22mm type control operators and pilot devices shall be door mounted and used independently of the keypad display to select operator control modes of HAND-OFF-AUTO.

GG. In HAND mode, the VFD will operate independently from the SCADA system and speed reference shall be from the door operated potentiometer.

HH. OFF - The Off position of the control operator shall stop the AC drive and prevent it from restarting while in the Off position. This position shall also reset the AC Drive after a fault condition has occurred.

II. In AUTO mode, the VFD will operate when by the SCADA system dry contact in the AUTO circuit as shown on the Drawings. Speed reference shall be from the SCADA RTU 4-20mA signal.

JJ. The VFD shall include door-mounted “Power On”, “VFD Run”, “VFD Fault”, and “Bypass” pilot lights. All pilot lights except “Power On” shall be Push-to-Test configurations.

2.12 SOLID STATE SOFT START/SOFT STOP UNITS (SSS)

A. All SSS shall use a unit disconnect.

B. The SSS shall be supplied and installed by the MCC manufacturer. Empty MCC sections with field installed SSS will not be allowed.

C. The SSS shall be rated as shown on the Drawings. The SSS rating is based on continuous required output current. Do not rate the SS to motor horsepower shown on the Drawings.

D. The SSS shall be installed in an MCC section and shall incorporate a self-contained air based cooling system for operation in a NEMA 1 assembly.

E. The SSS must operate in an ambient temperature from 0 to 40 C.

F. The SS must operate in humidity conditions up to 95 percent (95%) at 40 C, non-condensing.

G. The SSS must operate at an input voltage of 480 VAC +/- 10 percent (10%) without fault.

H. All SSS feeder equipment shall be sized based on SSS input current rating.

I. The SSS shall have short circuit coordination with the MCC.

J. The SSS shall have protection functions for output phase short circuits, ground faults, logic and analog output faults, over temperature, and internal power supply faults.

K. The SSS shall have solid state overload protection that is UL 508C listed for Class 10 overload protection. The overload protection shall be adjustable to the driven motor full load nameplate value.

L. The SSS shall have output form A contacts for Fault and Run.

M. The SSS shall be supplied with a keypad, mounted on the MCC door. The keypad shall provide the ability to adjust all programming parameters.

N. The SSS start/stop commands will be controlled via terminal inputs on the SSS.

O. The SSS shall include fully integrated and automated management of the bypass contactor function at the end of starting while preserving electronic protection functions.

P. Industrial rated 22mm type control operators and pilot devices shall be door mounted and used independently of the keypad display to select operator control modes of HAND-OFF-AUTO.

Q. In HAND mode, the SSS will operate independently from the SCADA system.

R. OFF - The Off position of the control operator shall stop the SSS and prevent it from restarting while in the Off position. This position shall also reset the SSS after a fault condition has occurred.

S. In AUTO mode, the SS will operate when by the SCADA system dry contact in the AUTO circuit as shown on the Drawings.

T. The SSS shall include door-mounted “Power On”, “SSS Run”, and “SSS Fault” pilot lights. All pilot lights shall be Push-to-Test configurations.

2.13 BRANCH CIRCUIT BREAKERS

A. Branch circuit breakers for 480V loads shall be installed in 6-inch motor control center through 250A frame sizes as standard design. Circuit breakers above 150A may be installed in larger bucket sizes as required.

2.14 TRANSIENT VOLTAGE SURGE SUPPRESSOR (TVSS)

A. The MCC shall be provided with an integral TVSS. The manufacturer of the TVSS shall be the same as the manufacturer of the MCC.

B. The TVSS shall be listed and recognized in accordance with UL 1449.

C. The TVSS must be supplied with a UL recognized bladed disconnect switch with internal fusing.

D. The TVSS shall provide surge current protection for all modes of protection: Line to Line, Line to Neutral, and Line to Ground.

E. The TVSS shall have a peak surge current rating of 240 kA per phase.

F. The TVSS shall be rated for 480Y/277 VAC, 3 Phase, 4 Wire system voltage.

G. The TVSS shall have UL suppression voltage rating of 800V Line-Neutral, 800V Line-Ground, and 1600V Line-Line. The TVSS shall have a maximum continuous operating voltage of 320V.

H. The TVSS shall be supplied with an optional surge counter with reset button.

I. The TVSS shall be provided a form C contact which shall indicate a failure of a phase or the entire unit.

2.15 POWER CIRCUIT MONITOR

A. Where shown on the Drawings, the MCC will be provided with a power monitor on the incoming main. The power monitor will communicate to the local PLC via a built-in Ethernet port.

B. A local power monitor display shall be supplied.

C. The power monitor setup parameters will be stored in nonvolatile memory and retained in the event of a power interruption.

D. The power monitor will be applied in 480/277V, 3 phase, four (4) wire systems.

E. The power monitor will provide real-time RMS values of the following parameters:

F. Current (Per phase, Neutral, Ground, 3 Phase Average)

G. Voltage (Line to Line per Phase, Line to Line 3 Phase Average, Line to Neutral per Phase)

H. Real Power (3 Phase Total)

I. Reactive Power (3 Phase Total)

J. Apparent Power (3 Phase Total)

K. Power Factor (3 Phase Total)

L. Frequency

M. Total Harmonic Distortion (THD), Current and Voltage

N. The power monitor shall have a form C contact which will close and alarm the local PLC when a power fault or power loss has occurred.

2.16 TRANSFORMERS

A. All insulating materials are to exceed NEMA ST20 standards and be rated for 220 degrees C UL component recognized insulation system.

B. Transformers 15 kVA and larger shall be 150 degrees C temperature rise above 40 degrees C ambient. The transformer shall have a minimum of 4 – 2.5% full capacity primary taps.

C. The maximum temperature at the top of the MCC bucket shall not exceed 50 degrees C rise above 40 degrees C ambient.

D. The transformer shall be rated and identified with model number, kVA rating, Voltages, Phase, and Frequency.

E. Transformer coils shall be of continuous wound construction and shall be impregnated with non-hygroscopic thermosetting varnish.

F. All cores shall be constructed with low hysteresis and eddy current losses.

G. The core of the transformer shall be visibly grounded.

H. The transformer section shall be adequately ventilated to prevent overheating.

2.17 PANELBOARDS

A. Interior

1. Lighting and Appliance (LP) panelboards shall be rated for 120/240 VAC single-phase, three-wire, or 120/208 VAC three-phase four-wire ampacity as shown on the Drawings.

2. The minimum short circuit current rating shall be 10,000 rms symmetrical amperes at 240 VAC for lighting and appliance panelboards.

3. Provide one (1) continuous bus bar per phase. Each bus bar shall have sequentially phased branch connectors suitable for bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat-rise tests in accordance with UL 67.

4. All current carrying parts shall be insulated from ground and phase to phase by high dielectric strength thermoplastic or equivalent.

5. Interior trim shall be of dead front construction to shield the user from live parts.

6. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label, and short circuit current rating shall be displayed on the interior.

B. Main Circuit Breaker

1. Main circuit breaker shall have an overcenter, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be tru rms sensing and be factory calibrated to operate in a 40 degree C environment.

2. Two-pole and three-pole breakers shall have common tripping of all poles.

3. Breaker handle and faceplate shall indicate rated ampacity.

4. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings.

C. Branch Circuit Breakers

1. Circuit breakers shall be UL Listed with amperage ratings, interrupting ratings, and number of poles as indicated on the panelboard schedules.

2. Molded case branch circuit breakers shall have bolt-on type bus connectors.

D. Circuit breakers shall have an overcenter toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two-pole circuit breakers shall have common tripping of all poles.

E. There shall be two (2) forms of visible trip indication. The breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red indicator appearing in the clear window of a circuit breaker housing.

F. The panelboard will be installed in an MCC section as shown on the Drawings.

PART 3 EXECUTION

3.01 GENERAL

A. The MCCs shall be located as shown on the Drawings.

B. Factory startup in included in the Owner’s procurement package.

C. The MCC shall be installed on existing and new equipment pads in the buildings. Route circuits as shown on the Drawings.

END OF SECTION

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SECTION 16490

PROCESS VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install two (2) wall-mount process variable frequency drives (VFD) as shown on the Drawings and as specified at the lower level of the Influent Building for the Grit Pumps.

B. The VFDs shall be rated at the continuous output current shown on the One-Line Diagrams, variable torque, Type 1 gasketed enclosure. The VFDs shall include input short circuit protection, input contactor to de-energize the VFD when not in operation, three percent (3%) line reactor and all accessories specified herein.

C. The VFDs shall be top cable entry and exit.

1.02 MATERIALS COMPLIANCE WITH AIS

A. Section 746 of Title VII of the Consolidated Appropriations Act of 2017 (Division A - Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2017) and subsequent statutes mandating domestic preference applies an American Iron and Steel (AIS) requirement to this project.

B. All parties are required to comply with these requirements and to ensure that all iron and steel products used in this project must be produced in the United States. See also C-800, Supplementary Conditions for additional details.

1.03 RELATED SECTIONS

A. Section C-800 – Supplementary Conditions

B. Section 01300 – Submittals

C. Section 01782 – Operation and Maintenance Data

1.04 REFERENCE STANDARDS, latest edition:

A. NFPA 70 National Electric Code

B. UL 508A UL Standard for Safety for Industrial Control Panels

C. UL 508C UL Standard for Safety for Power Conversion Equipment

D. NEMA ICS7 Industrial Control and Systems: Adjustable Speed Drives

E. NEMA ICS7.1 Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems

F. NEMA 250 Enclosures for Electrical Equipment (1000V maximum)

G. IEEE 519 Recommended Practice and Requirements for Harmonic Control in Electric Power Systems

1.05 SUBMITTALS

A. Submit in accordance with Section 01300, Submittals.

B. Submittals are required for the following:

1. Power Wiring Diagram

2. Control Wiring Diagram

3. Enclosure Outline Drawings, including dimensions, weights, and conduit entrance locations

1.06 O&M MANUALS

A. Provide MCC O&M Manuals in accordance with Section 01782, Operation and Maintenance Data.

B. O & M Manuals must include all information from 1.03B and the additional information:

1. VFD User Manual

2. Network Communication Manual

3. VFD Parameters changed from factory default listing

4. Spare Part Recommendations

1.07 PACKING/SHIPPING

A. The VFD shall be shipped with a removable lifting angle, which will allow an easy means of attaching an overhead crane or other suitable lifting equipment.

1.08 STORAGE

A. The VFD must be stored in a clean and dry environment after shipment to the jobsite, free from temperature extremes.

1.09 WARRANTY

A. The MCC shall be warranted to be free from defects in materials and workmanship for a period of one (1) year from the date of completion and acceptance by the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. The manufacturer shall be Square D, Allen-Bradley, Cutler-Hammer, Toshiba, ABB, or approved equal.

2.02 GENERAL

A. The VFD shall be supplied with manufacturer incoming power short circuit protection and lockout disconnect.

B. The VFD will be pulse with modulation (PWM) technology.

C. The VFD shall be capable of operation at 110 percent (110%) output current rating for 60 seconds.

D. The VFDs shall operate variable torque loads unless otherwise indicated.

E. The VFD shall be free-standing and shall incorporate a self-contained air-based cooling system for operation in a NEMA 1 gasketed assembly.

F. The VFD must operate in an ambient temperature from 0 to 40° C.

G. The VFD must operate in humidity conditions up to ninety three percent (93%) at 40º C, non-condensing.

H. The VFD must operate at an input voltage of 480 VAC +/- 10% without fault.

I. The VFD must operate from an input frequency range of 57 to 63 Hz.

J. The VFD efficiency shall be ninety seven percent (97%) minimum.

K. The output carrier frequency shall be adjustable from .5 and 10 kHz.

L. The VFD shall be capable of open loop torque control with sensorless flux vector algorithms. The VFD default setting shall be vector control. The VFD will be able to develop rated motor torque at 0.5 Hz (60 Hz base) in a sensorless flux vector (SVC) mode using a standard induction motor without an encoder feedback signal.

M. The VFD shall have protection functions for output phase short circuits, ground faults, logic and analog output faults, overtemperature, and internal power supply faults.

N. The VFD shall have solid state overload protection that is UL 508C listed for Class 10 overload protection. The overload protection shall be adjustable to the driven motor full load nameplate value.

O. The VFD shall be setup to automatically reset on all faults other than ground fault, short circuit, or internal fault.

P. The VFD shall be setup to ride through a power loss or fluctuation.

Q. The VFD shall have a programmable skip frequency.

R. The VFD shall be setup to reduce frequency when an overload condition is detected.

S. The VFD shall have programmable form C contacts for VFD Fault and VFD Run.

T. The VFD shall have a minimum of two (2) analog speed reference inputs, one (1) for a potentiometer in the HAND mode of operation, and one (1) for a 4-20mA input for AUTO mode of operation.

U. The VFD shall be supplied with a keypad, mounted on the door. The keypad shall provide the ability to adjust all programming parameters. The keypad shall include at least two (2) lines of 40-character text, with the capability of monitoring volts, amps, frequency, speed reference, and other VFD monitor functions.

V. The VFD shall have adjustable acceleration and deceleration parameters with linear/S curve switchable patterns.

W. The VFD start/stop and speed reference will be controlled via terminal inputs on the VFD.

X. The VFD shall be provided with an integral incoming power short circuit disconnect, input line contactor, and three percent (3%) line reactor.

2.03 OPERATOR CONTROLS

A. Industrial rated 22 mm type control operators and pilot devices shall be door mounted and used independently of the keypad display to select operator control modes of HAND-OFF-AUTO.

B. HAND mode of operation – The HAND mode shall allow manual operation of start, stop, and speed control. The AC drive shall start when the control operator is in the HAND mode and run and at low-speed setting of the drive or higher as required by the position of the manual speed potentiometer. This mode shall function as 2-wire control and automatically restart after a power outage or auto restart after fault.

C. OFF - The Off position of the control operator shall stop the AC drive and prevent it from restarting while in the off position. This position shall also reset the AC Drive after a fault condition has occurred.

D. AUTO mode of operation - The Remote mode shall receive a start contact from the field mounted HAND-OFF-AUTO selector switch located at the pump. Speed control shall be from a customer supplied 4-20mA signal. Selector switch in HAND mode starts the pump. Selector switch in AUTO mode is started by the local RTU PLC control panel.

E. The VFD shall include door-mounted “Power On”, “VFD Run”, “VFD Fault”, and “Bypass” pilot lights. All pilot lights except “Power On” shall be Push-to-Test configurations.

PART 3 EXECUTION

3.01 GENERAL

A. Installation shall comply with manufacturer's instructions, drawings, and recommendations.

B. The VFD manufacturer shall provide a factory certified technical representative to supervise the contractor's installation, testing, and start-up of the equipment furnished under this specification for two (2) days. This period shall also be used as training for Owner personnel on operation of the equipment.

END OF SECTION

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SECTION 16500

LIGHTING FIXTURES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide, install, and test all interior and exterior lighting fixtures as specified herein.

B. Provide and install replacement LED fixtures as specified on the Drawings for existing plant buildings.

1.02 MATERIALS COMPLIANCE WITH AIS

A. P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works. This Project meets the definition of such work, and the Environment Protection Agency (EPA) implementation requirements for this AIS requirement are outlined within the DWSRF memorandum titled “Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014” included as part of the RLF Supplemental General Conditions.

B. All parties are required to comply with these requirements and to ensure that all qualifying iron and steel products used in this project must be produced in the United States. See RLF Supplemental General Conditions for additional details.

1.03 RELATED SECTIONS

A. Section 16110 – Raceways and Boxes

B. Section 16140 – Wiring Devices

1.04 SUBMITTALS

A. Submit in accordance with Specification Section 01300, Submittals, for all equipment specified herein.

B. Submit manufacturer data sheets listing all accessories.

PART 2 PRODUCTS

2.01 LED HIGH BAY

A. This article covers fixture schedule designation A.

B. The fixture housing shall be round cast aluminum, mounting to a 1/4" stainless steel threaded rod and attached to the structure with a Z-Purlin clip.

C. The driver shall be universal voltage input from 120-277V, certified by UL.

D. The fixture optics shall be clear tempered glass to protect LEDs.

E. The fixture warranty shall be 5 years.

F. The fixture shall be similar or equal to Lithonia JEBL series, with lumen output as noted on the Drawing Schedules.

2.02 LOW PROFILE ENCLOSED AND GASKETED LED FIXTURE

A. This article covers fixture schedule designation B.

B. The fixture construction shall be one-piece fiberglass housing with integral perimeter channel utilizing continuous poured-in-place closed cell gasket. The fixture shall be approved as a wireway and through wiring. The fixture shall be provided with stainless steel latches. The fixture shall have power connection pre-drilled holes at each end. The fixture shall be ceiling mounted.

C. The fixture optics shall be 100 percent (100%) impact modified frosted acrylic lens with lineal ribs.

D. The fixture shall use high-efficiency LED's on metal core circuit boards. The fixture shall be 4100K temperature. The fixture LED driver shall operate from 120V through 277V, 50-60HZ. The fixture integral surge protection shall be in accordance with IEEE/ANSI C62.41.2 to Category C Low. The fixture shall include a temperature-sensing component that will limit the temperature of the LEDs in case of excessive ambient temperatures or misapplication. The fixture shall be provided with 0-10V dimming driver standard. The fixture shall have an expected service life of 60,000 hours at 80 percent (80%) lumen maintenance.

E. The fixture warranty shall be 5 years.

F. The fixture shall be equal to Holophane EVT4 8000LM FST MD MVOLT GZ10 40K 80 CRI.

2.03 EXTERIOR LED WALL MOUNT FIXTURE

A. This article covers fixture schedule designation C.

B. The fixture housing shall be cast aluminum, mount to a standard wall junction box, IP65 rated, full cutoff downlight only.

C. The driver shall be universal voltage input from 120-277V, certified by UL.

D. The fixture optics shall utilize vacuum-metallized specular reflectors are engineered for superior field-to-beam ratios, uniformity and spacing.

E. The fixture surge protection shall meet ANSI/IEEE C62.41.2 Category C.

F. The light engine housing shall meet IP66.

G. The fixture shall be IES forward throw distribution.

H. The fixture shall be provided with button type photocell actuation.

I. The fixture warranty shall be 5 years.

J. The fixture shall be equal to Lithonia WDGE series, with mounting height driven fixture selection as shown on the Lighting Schedules on the Drawings.

2.04 LAYIN LED FIXTURE

A. This article covers fixture schedule designation D.

B. The fixture is a 2x4 layin ceiling LED fixture, backlit panel, with selectable lumens and CCT.

C. The fixture shall accept input voltage from 120-277V.

D. The fixture shall have a color rendering index of 80+ CRI.

E. The fixture shall have an expected life of 60K hours at L70.

F. The fixture shall be DLC Listed.

G. The fixture shall install on standard and narrow T-grid ceiling systems.

H. The fixture warranty shall be 5 years.

I. The fixture shall be equal to Nora NPDBLSW-E24/334-W.

2.05 RECESSED DOWNLIGHT

A. This article covers fixture schedule designation F.

B. The fixture shall be constructed of architectural grade aluminum and 22 gauge steel housings.

C. The fixture optics shall be circular anidolic, with clear acrylic lens.

D. The LED electrical system shall have useful life of 70K hours at L80.

E. The fixture shall accept 120-277V input with less than 20% harmonic distortion.

F. The fixture warranty shall be 5 years.

G. The fixture shall be similar or equal to Fluxwerx TC1-R5, with options as shown in the Lighting Schedules on the Drawings.

2.06 CANOPY LED HIGH BAY

A. This article covers fixture schedule designation H.

B. The fixture housing shall be round high bay for demanding environments, mounting with a ¾" rigid conduit pendant and attached to the Z-Purlin.

C. The fixture optics shall be prismatic borosilicate glass, which doesn't fade, discolor, or degrade in harsh environments.

D. The housing shall be A380 cast aluminum with low copper content, and finished with thermoset powder coat finish.

E. The fixture shall have a hinged electrical enclosure and stainless-steel hardware, with two additional ¾" hubs. Gaskets shall be non-silicone EPDM.

F. The driver shall be universal voltage input from 277-480V, certified by UL.

G. The fixture shall be suitable for use in wet locations, NEMA 4X and IP 65/66 rated.

H. The fixture warranty shall be 5 years.

I. The fixture shall be similar or equal to Holophane HOLOBAY HOLO1 series, with lumen output and options as noted on the Lighting Schedules on the Drawings.

2.07 POLE MOUNTED AREA LIGHT

A. This article covers fixture schedule designation P.

B. The area light fixture construction shall be a die-cast aluminum body with heat dissipating fins and flow through venting. The fixture finish shall be thermoset powder coat, multi-stage process, with minimum thickness of 3 mils.

C. The optics shall be acrylic refractive lenses.

D. The driver shall be input voltage from 277-480V.

E. LED lumen maintenance shall be 60,000 hours.

F. The fixture pole shall be 20' round straight aluminum with brushed aluminum finish, equal to Lithonia RSA 12 4C.

G. The driver shall be universal voltage input from 277-480V.

H. The light engine shall be rated IP66, with standard 0-10V dimmer. The drivers shall provide power factor greater than 90% and less than 20% THD.

I. The fixture shall be DLC qualified, with International Dark Sky Association seal of approval. The fixture shall emit 0% uplight.

J. The fixture warranty shall be 5 years.

K. The fixture shall be pole mounted to Lithonia square steel SSS 20 4G DNAXD. The fixture and pole finish shall be natural aluminum.

L. The fixture shall be similar or equal to Lithonia RSX series. See the Fixture Schedules on the Drawings for model numbers and options required.

2.08 AREA LIGHTING CONTROL

A. For each source of power for area lighting, provide and install an Intermatic ET8015CR 7-Day Electronic Astronomic Time Switch to supply power for the exterior lighting as shown on the Drawings or approved equal. The timer shall be installed on the front of the area lighting MCC bucket.

B. The digital timer power supply shall be 120VAC 60Hz.

C. The digital timer shall have one (1) SPST relay output.

D. The digital timer shall be astronomic to automatically provide sunset ON and sunrise OFF settings to eliminate the need for photoelectric controls, and be capable of automatically adjusting for daylight savings time changes.

E. The digital timer must be capable of actuating up to twenty-eight (28) ON/OFF events and eight (8) astronomic events.

F. The programming will be stored in timer non-volatile EEPROM.

G. All programming functions must be accomplished via the integral timer keypad.

H. The enclosure shall be NEMA 3R painted steel.

I. The digital timer shall include a 100-hour supercapacitor to maintain date and accurate time, and must recharge fully in 1 hour of continuous power.

2.09 EMERGENCY/EXIT LIGHTING COMBO WITH REMOTE HEAD

A. This article covers fixture schedule designation X and XR.

B. The fixture construction shall be thermoplastic housing, impact-resistant, scratch-resistant, and corrosion-proof. The fixture faceplate and back cover shall be interchangeable on the housing. The fixture shall include universal, directional chevron inserts that are easily removed and reinserted. The fixture letters shall be 6 inches high with 3/4-inch stroke, with 100 foot viewing distance rating based upon UL924 standard. Low-energy LED lamp in sign shall operate in normal (AC input) and emergency (DC input) modes. The fixture shall include a low-profile, integrated test switch/pilot light.

C. Twin LED lamp heads operate in emergency (DC input) mode with 12 series-parallel white LEDs in each head.

D. The fixture shall be 120 or 277V input.

E. The fixture shall be equal to Lithonia LHQM LED R HO.

F. Each combo exit/emergency light shall be provided with a twin head wet location emergency remote light. The remote shall be equal to Lithonia ELMRW LP220L DNAX.

2.10 HAZARDOUS LOCATION LOW BAY

A. This article covers fixture schedule designation ZA.

B. The fixture shall be square low bay for Class 1 Division 1 environments, mounting with a ¾" rigid conduit pendant and attached to the joist or structural support.

C. The fixture construction shall be copper free aluminum housing, with tempered glass, black powder coat finish, three (3) ¾" NPT hubs, and stainless-steel fasteners.

D. The fixture electrical shall be 120-277V with 10kV surge protection.

E. The fixture shall be rated for L70 lumen maintenance at 60K hours.

F. The driver shall be universal voltage input from 277-480V, certified by UL.

G. The fixture shall be suitable for use in Class I, Class II, and Class III installations.

H. The fixture warranty shall be 5 years.

I. The fixture shall be similar or equal to Holophane HEXF series, with lumen output and options as noted on the Lighting Schedules on the Drawings.

2.11 HAZARDOUS LOCATION LED LINEAR

A. This article covers fixture schedule designation ZB.

B. The fixture shall be 4' linear for Class 1 Division 1 environments, for wall or ceiling mount.

C. The fixture construction shall be copper free aluminum housing, with tempered glass, black powder coat finish, three (3) ¾" NPT hubs, and stainless-steel fasteners.

D. The fixture electrical shall be 120-277V with 10kV surge protection.

E. The fixture shall be rated for L70 lumen maintenance at 60K hours.

F. The driver shall be universal voltage input from 277-480V, certified by UL.

G. The fixture shall be suitable for use in Class I, Class II, and Class III installations.

H. The fixture warranty shall be 5 years.

I. The fixture shall be similar or equal to Holophane HEXS series, with lumen output and options as noted on the Lighting Schedules on the Drawings.

2.12 HAZARDOUS LOCATION LED LINEAR WITH EMERGENCY BACKUP

A. This article covers fixture schedule designation ZC.

B. The fixture shall be 4’ linear for Class 1 Division 1 environments, for wall or ceiling mount.

C. The fixture construction shall be copper free aluminum housing, with tempered glass, gray powder coat finish, three (3) ¾” NPT hubs, and stainless-steel fasteners.

D. The fixture electrical shall be 120-277V with 10kV surge protection.

E. The fixture shall be rated for L70 lumen maintenance at 60K hours.

F. The driver shall be universal voltage input from 277-480V, certified by UL.

G. The fixture shall be suitable for use in Class I, Class II, and Class III installations.

H. The fixture shall include emergency backup battery with 90-minute capacity per UL924.

I. The fixture warranty shall be 5 years.

J. The fixture shall be similar or equal to Holophane HEXSEM series, with lumen output and options as noted on the Lighting Schedules on the Drawings.

2.13 HAZARDOUS LOCATION EXIT FIXTURE

A. This article covers fixture schedule designation ZX. The exit fixture shall be rated for installation in Class 1 Division 1 environments.

B. The fixture optics shall be a maintenance free 3-watt LED source with 25-year life expectancy.

C. The electrical shall be 120-277V input, with solid state circuitry.

D. The fixture body shall be low copper aluminum with epoxy powder coat gray finish, one piece silicone gasket, and stainless-steel hardware.

E. The fixture shall be similar or equal to Holophane HDXE and use red lettering. See the Fixture Schedule on the Drawings.

PART 3 EXECUTION

3.01 GENERAL

A. Each fixture shall be a completely furnished unit with all components, mounting, and hanging devices necessary for the proper installation of the fixture in the location as shown on the Drawings.

B. Coordinate all fixture locations with other trades.

END OF SECTION

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