



DETAILED SPECIFICATIONS
AND
CONTRACT DOCUMENTS
CITY OF BENTONVILLE, ARKANSAS
**BENTONVILLE WATER RESOURCE RECOVERY
FACILITY IMPROVEMENTS**
VOLUME II

HWEI PROJECT NO. 2018143

MARCH 2025

BID SET

PREPARED BY



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MASONRY

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to construct all masonry work as shown on the Drawings and as specified herein.
- B. Work under this Section includes, but is not necessarily limited to, the following:
 - 1. Unit masonry including:
 - a. Concrete masonry units (CMU)
 - b. Brick Veneer
 - c. Reinforced unit masonry
 - d. Masonry waste disposal
 - e. Waterproofing of exterior masonry
- C. Installation of deformed steel reinforcement provided under Section 03200, Concrete Reinforcement.
- D. Masonry horizontal joint reinforcement, ties, anchors, and through-wall flashing.
- E. Installation in masonry of lintels; window, door, and louver frames; vent pipes; conduits; and other items furnished by other trades.
- F. Grouting of masonry cells, bond beams, and lintels.
- G. Patching masonry damaged during construction.
- H. Provide masonry unit, mortar, and grout testing prior to installation by an independent testing laboratory in accordance with Section 01450, Field Quality Control.

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 01450 – Field Quality Control
- B. Section 03200 – Concrete Reinforcement
- C. Section 03600 – Grout
- D. Section 05500 – Miscellaneous Metal
- E. Section 07210 – Building Insulation
- F. Section 07600 – Flashing and Sheet Metal Work
- G. Section 07901 – Joint Sealants

1.04 REFERENCE STANDARDS

- A. The Masonry Society (TMS), latest edition:
 - 1. TMS 402 Building Code Requirements for Masonry Structures
 - 2. TMS 602 Specification for Masonry Structures
- B. ASTM International (ASTM), latest edition:
 - 1. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 2. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 3. ASTM C67 Standard Test Method for Sampling and Testing Brick and Structural Clay Tile
 - 4. ASTM C90 Standard Specification for Loadbearing Concrete Masonry Units
 - 5. ASTM C140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
 - 6. ASTM C144 Standard Specification for Aggregate for Masonry Mortar
 - 7. ASTM C150 Standard Specification for Portland Cement
 - 8. ASTM C207 Standard Specification for Hydrated Lime for Masonry Purposes

9. ASTM C270 Standard Specification for Mortar for Unit Masonry
10. ASTM C331 Standard Specification for Lightweight Aggregates for Concrete Masonry Units
11. ASTM C404 Standard Specification for Aggregates for Masonry Grout
12. ASTM C476 Standard Specification for Grout for Masonry
13. ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
14. ASTM C780 Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
15. ASTM C1019 Standard Test Method of Sampling and Testing Grout for Masonry
16. ASTM D226 Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
17. ASTM D2000 Standard Classification System for Rubber Products in Automotive Applications

C. International Building Code (IBC), latest edition:

1. International Building Code

1.05 SUBMITTALS

A. Submit shop drawings and product data, in accordance with Section 01300, Submittals, showing materials of construction and details of installation for:

1. Masonry reinforcement, including fabrication and placing drawings, details for mild steel, and prefabricated joint reinforcement. Reinforcement placing shall conform to the requirements of Section 03200, Concrete Reinforcement.
2. Cement, hydrated lime, and any mortar or grout admixtures,
3. Proposed mortar and grout proportions,
4. Material properties and test results letters for unit strength method,
5. Miscellaneous Items: joint filler and accessories.

B. Samples: Submit samples for review sufficiently in advance of installation of the materials to allow investigation and re-submittal of new samples if the original samples are found not to conform to the contract requirements. Submit samples of the following in sizes and quantities stated:

1. Concrete Masonry Units (CMU): One (1) sample of each size

2. Brick Veneer Units: One (1) sample of each size
3. Anchors and ties: Two (2) each type
4. Wall and horizontal joint reinforcement: Two (2) samples, each at least 16 inches long, of each type
5. Masonry joint material: Two (2) samples, each at least 16 inches long, of each type

C. Test Reports

1. Provide manufacturer's certifications for sieve analysis, mechanical properties, and deleterious substance content for coarse and fine aggregate for mortar and grout in accordance with ASTM C270.
2. Provide manufacturer's certifications for chemical analysis and physical tests for each type of cement.
3. Provide manufacturer's certifications for chemical analysis and physical tests for hydrated lime.
4. For each type of masonry unit, provide certified pre-construction test reports including compressive strength, absorption, dimensional analysis, unit weight, and moisture content in accordance with ASTM C140.
5. Mortar test results during construction.
6. Grout test results during construction in accordance with ASTM C1019.

D. Qualifications

1. Independent testing laboratory: Name, address, and qualifications. Laboratories affiliated with the Contractor or in which the Contractor or its offices have a beneficial interest are not acceptable.

E. Procedures

1. Cold weather construction procedures. Submit a description of procedures to be used.
2. Hot weather construction procedures. Submit a description of procedures to be used.
3. Review of hot and cold weather construction procedures will be for information only. The Contractor remains fully responsible for complying with the requirements of this Section, and for the adequacy of procedures employed.

1.06 QUALITY ASSURANCE

- A. Testing services required to demonstrate that the materials proposed for incorporation into the work comply with the requirement of the Contract Documents shall be provided in accordance with Section 01450, Field Quality Control.
- B. All field testing and inspection services to confirm that the properties of the materials actually incorporated into the work conform to these Specifications will be provided in accordance with Section 01450, Field Quality Control. Facilitate such testing and inspection as follows:
 - 1. Advise Engineer of installation far enough in advance to allow for assignment and scheduling of testing personnel.
 - 2. Furnish any labor necessary to assist the testing agency in obtaining and handling samples.
- C. Methods of testing shall conform to ASTM or other standards as indicated. Include in reports for prisms or test specimens a description of the portion of construction represented by the specimen(s), and a summary of conditions under which the specimens were stored prior to testing.
- D. Compression strength of masonry ($f'm$) is 1,500 psi. The Engineer has selected this compression strength based on the Unit Strength Method.
- E. Confirm properties of materials used for construction and test result for compressive strength as follows.
 - 1. Before the delivery of any masonry units or materials:
 - a. Submit a letter from the masonry unit supplier certifying that units conform to the reference standards specified when sampled and tested in compliance with ASTM C67 (brick and structural clay tile) or ASTM C140 (concrete masonry).
 - b. Submit a certification letter indicating the mortar type to be used, and laboratory test data demonstrating that the mortar has the minimum compressive strength specified when sampled and tested in accordance with ASTM C270.
 - c. Submit a certification letter from the grout supplier certifying that grout proportions conform to ASTM C476, and laboratory test results demonstrating that the grout has the minimum compressive strength specified when sampled and tested in accordance with ASTM C1019.
 - 2. During construction, test the following specimens for compressive strength. Provide and test one (1) set of specimens for each 5,000 ft² of masonry wall area, but not less than one (1) set per project.
 - a. One (1) set of three (3) 2-inch diameter x 4-inch cylindrical mortar specimens constructed and tested in compliance with ASTM C780, Appendix A7.

- b. One (1) set of three (3) grout specimens constructed and tested in compliance with ASTM C1019.
 - F. Mockup: Prior to installing unit masonry, construct sample wall panels to verify selections made under sample submittals and to demonstrate aesthetic effects of materials and execution. Build mockups to comply with the following requirements, using materials indicated for final unit of Work.
 - 1. Locate mockups on site in locations indicated or, if not indicated, as directed by Engineer.
 - 2. Build a 4-foot x 4-foot mockup of a typical brick veneer wall, showing masonry unit selections, color, and type of mortar joint.
 - 3. Clean exposed faces of mockups with masonry cleaner indicated, or as recommended by manufacturer.
 - 4. Notify Engineer one (1) week in advance of the dates and times when mockups will be constructed.
 - 5. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - a. Acceptance for mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Engineer in writing.
 - b. Acceptance of mockups does not constitute approval of deviations from the Contract Documents contained in mockups, unless such deviations are specifically approved by Engineer in writing.
 - c. When directed, demolish and remove mockups from Project site.
 - G. Cold and Hot Weather Construction: Masonry construction in cold and hot weather shall conform to the applicable requirements of TMS 402 and TMS 602 unless otherwise specified herein. Heat and enclosures will be the only protection method allowed for cold weather construction. No mortar additives shall be used for this purpose.
 - 1. Cold weather construction procedures: Submit an outline of procedures to be used.
 - 2. Hot weather construction procedures: Submit an outline of procedures to be used.
 - H. Construction tolerances shall be in accordance with TMS 602.
 - I. Erection shall conform to TMS 602, Article 3.3.
- 1.07 DELIVERY, STORAGE, AND HANDLING
- A. All materials for the work of this section shall be delivered and handled so as to preclude damage of any nature. Store materials off the ground and protect from weather. Prevent

wetting by capillary action, rain, or snow. Manufactured materials, such as cement and lime, shall be delivered and stored in their original containers, plainly marked with identification of materials and manufacturer. Materials in broken containers, or in packages showing water marks or other evidence of damage, shall not be used and shall be removed from the site.

- B. All masonry shall be shipped stacked with hay or straw protection or other suitable protective device and shall be similarly protected and stacked off the ground on the site. Masonry shall be protected from the weather and staining with the use of tarpaulins or other covering approved by the Engineer.

1.08 PROJECT CONDITIONS

- A. Protection of Masonry: During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
 - 2. Where one (1) wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near wall on edge at the end of each day to prevent rain from splashing mortar and dirt on completed masonry.

1.09 MAINTENANCE – SPARE MATERIAL

- A. Furnish spare masonry units, including at least the following items:
 - 1. CMU – One (1) pallet
 - 2. Brick Veneer – One (1) pallet of each brick specified
- B. Furnish all spare material in containers clearly identified with permanent markings as to their contents. Each container shall be packed with its contents protected for prolonged storage. Place containers for storage at locations indicated by the Engineer.

PART 2 PRODUCTS

2.01 GENERAL

- A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Like materials shall be the end products of one manufacturer in order to provide standardization for appearance.
- C. Materials shall conform to the standards listed herein and to any applicable state or local building code standards.

2.02 MATERIALS – MASONRY

A. Masonry Units: Concrete

1. General

- a. Outside corners of interior partition shall be made with bullnose units. Provide special units required by the drawings, including solid, corner, pilaster, lintels, bullnose, and jamb units.
- b. Use formed "U" shaped units for reinforced masonry lintels.
- c. Similar units shall be obtained from one manufacturer to ensure even color and texture.
- d. Units shall be sound and free of cracks or other defects that would interfere with the proper placing of the units or impair the strength or permanence of the construction. Minor cracks or defects incidental to the usual method of manufacture, or minor shipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection except that no more than five percent (5%) of a shipment shall contain chips larger than 1/4-inch from any edge or corner on the faces.
- e. Provide UL approved units where required for fire-rated construction where designated.

- 2. Hollow and solid CMU shall conform to ASTM C90, hollow, load bearing units of 8-inch by 16-inch (8" x 16") and 12-inch by 16-inch (12" x 16") nominal face size and bed dimension as shown on the Drawings. Weight classifications shall be as follows:
 - a. Light weight concrete with uniform texture for interior wall locations
 - b. Normal weight concrete units for exterior work, exterior walls, exterior walls with brick veneer, or where exposed to soil or weather

2.03 FACE BRICK

- A. Brick shall meet ASTM C216, Type FBS, Grade SW, modular dimension.
 - 1. Brick shall be of the type and manufacturer as designated on the Architectural drawings.

2.04 REINFORCEMENT, TIES, ANCHORS

- A. Deformed steel reinforcing bars shall conform to ASTM A615 and shall be as specified in Section 03200, Concrete Reinforcement.
 - 1. Fabricate reinforcement for masonry in accordance with the provisions of Section 03200, Concrete Reinforcement, except as amended by the following paragraphs.
 - 2. Hooks. The term "standard hook" as used herein or as shown on the Drawings for masonry reinforcement shall be as defined in the following paragraphs. Inside diameter of the bend shall not be less than that shown in Table 1 below.
 - a. A 180-degree (180°) bend plus an extension of at least four (4) bar diameters, but not less than 2-1/2 inches at the free end of the bar.
 - b. A 90-degree (90°) bend plus an extension of at least 12 bar diameters at the free end of the bar.
 - c. For stirrups or ties, either a 90-degree (90°) or a 135-degree (135°) bend plus an extension of at least six (6) bar diameters but not less than 2-1/2 inches at the free end of bar.

Table 1 Reinforcement Bend Diameter		
Bar		Min. Inside Diameter
Stirrups & Ties:	#4 & smaller	4 diameters
Other:	#3 through #8	6 diameters
	#9 through #11	8 diameters

- B. Joint reinforcement shall be welded wire units fabricated from cold-drawn steel wire with deformed continuous side rods and plain cross-rods, crimped for cavity wall construction if required, and having a width of 1-1/2 inches to 2 inches less than nominal thickness of wall or partition. Joint reinforcement shall conform to the requirements of TMS 602 and shall be prefabricated in straight lengths of not less than 10 feet with matching corner and tee units. Units shall be hot-dipped galvanized after fabrication to conform to ASTM A153, Class B-2, 1.5-oz/ft².
 - 1. Single wythe CMU wall horizontal reinforcement shall be Hohmann & Barnard 220 Ladder Mesh, or approved equal. For exterior walls, use wire that is hot-dipped galvanized after fabrication. Refer to Drawings for CMU wall thickness.
 - 2. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

3. Provide continuity at corners and wall intersections by using prefabricated “L” and “T” sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.
- C. Dovetail anchors shall be furnished for anchorage to concrete framework, walls, or ceilings. Anchor slots shall be fabricated from 16-gauge galvanized steel and shall be furnished with polystyrene fillers. Sizes are to be coordinated with the anchors used. Provide 16 gauge corrugated galvanized steel ties manufactured for use with the anchor slots provided.
- D. Masonry Straps shall be minimum 1/4-inch thick by 1-inch wide, and of the required length, fabricated from hot-dipped galvanized steel. Straps shall be similar to Heckmann Building Products No. 272, or approved equal.
- E. Weld on adjustable anchors and ties shall be 1/4-inch diameter hot-dipped galvanized steel. Anchors shall be Heckmann Building Products No. 315, or approved equal. Triangular ties shall be Heckmann Building Products No. 316, or approved equal. Web ties shall be 12-inch long by a width for the wall where it is used, and shall be Heckmann Building Products No. 318, or approved equal.
- F. Provide and install miscellaneous anchors and attachment members, required both for the anchorage of work of this Section and that of other trades requiring attachment to masonry, which are not specifically provided under separate Sections.
- G. Veneer Anchors (exterior metal stud backup): Hohmann & Barnard DW-10, hot dipped galvanized, 12 gauge, with Vee Wall Tie, hot dipped galvanized, 1/4-inch diameter, or approved equal. Provide Textroseal 40-mil dual barrier membrane. Provide two (2) #12 stainless steel “SX” fasteners per anchor.

2.05 MORTAR AND GROUT MATERIALS

A. Cementitious materials

1. Cementitious materials for mortar and grout shall not contain epoxy resins and derivatives, phenols, asbestos fiber, or fireclays.
2. Portland cement shall conform to ASTM C150, Type II. Masonry cements, mortar cements, and plastic cement shall not be used.
3. Lime for masonry shall be hydrated lime conforming to ASTM C207, Type-S.

B. Aggregates

1. Sand shall be clean, durable, particles, free from injurious amounts of organic matter, dust, lumps, shale, alkali, or surface coatings.
 - a. Sand for mortar shall conform to ASTM C144
 - b. Sand and grout shall conform to ASTM C404, Size No. 2
2. Coarse aggregate for grout shall conform to ASTM C404, Size No. 8.

- C. Water shall be from a potable water supply. Water shall be free from deleterious amounts of oils, acids, alkalis, or organic matter, and shall be clean and fresh.

- D. Admixtures/Additives

- 1. Additives and admixtures to mortar or grout shall not be used unless approved by the Engineer.
 - 2. Antifreeze Compounds. Antifreeze liquids, Chloride salts, or other such substances shall not be used in mortar or grout.
 - 3. Air Entrainment. Air entraining substances shall not be used in mortar or grout.

2.06 MORTAR MIXES

- A. Mortar for concrete and brick masonry shall be Portland cement – lime mortar providing a minimum compressive strength of 1,800 psi at 28 days. Mortar proportions shall comply with ASTM C270 except that increases in lime content may be permitted to adjust the mixture for initial rate of absorption of the masonry or for temperature if mortar strength tests are performed. Admixtures shall not be used in the mortar mix.
 - 1. Mix mortar in accordance with the requirements of TMS 602, using a mechanically operated mixer in which the quantity of water added can be accurately and uniformly controlled. Accurately measure mortar constituents by volume.
 - 2. The consistency of the mortar shall be adjusted to the satisfaction of the mason with water added as necessary to produce a workable mix. Mortar may be re-tempered by adding water as frequently as needed to restore the required consistency. When water is added, it shall be mixed into the mortar, not splashed over the surface.
 - 3. Mortar, which has begun to “set” or which has not been used within two and one-half (2-1/2) hours after initial mixing water was added to the dry ingredients, shall be discarded.
- B. Tuck point mortar for repairs to existing masonry shall conform to ASTM C270, Type O. Provide test data to substantiate minimum compressive strength requirements of 350 psi at 28 days.

2.07 GROUT MIXES

- A. Masonry grout for use in bond beams, lintels, reinforced masonry cells, and at other locations shown on the Drawings shall conform to ASTM C476. Admixtures shall not be used without prior approval by the Engineer. Control grout materials and water content to provide adequate fluidity for placement without segregation.
- B. Strength
 - 1. Grout shall attain a minimum compressive strength of 2,000 psi at 28 days when tested in accordance with ASTM C1019.

2. Grout shall have a slump of 8 to 11 inches and shall be cohesive without segregation.

C. Mixing and Handling

1. Accurately measure all ingredients according to the proportions specified for the batch and mix in a mechanically operated batch mixer. Mix grout for at least five (5) minutes but not more than ten (10) minutes after all ingredients have been added. Add water as required to provide the desired workability.
2. Do not handle or pump grout using aluminum equipment.
3. Transit mixed grout may be used. Continually rotate transit mixed grout from the time the water is added until the grout is discharged.
4. Grout mixing drums shall be completely emptied before the succeeding batch of materials is introduced for mixing.

D. Tempering

1. The consistency of grout shall be adjusted so that it will flow into place without segregation of ingredients. Water may be added to compensate for loss.
2. Grout that has begun final "set" and becomes harsh or which has not been used within one and one-half (1½) hours after initial mixing water was added to the dry ingredients shall not be used.

2.08 EMBEDDED FLASHING MATERIALS

- A. Dampproofing Fabric: Nervastral HD, 20 mil, non-reinforced elastomeric sheet as manufactured by Rubber Plastics Compound Co., Inc., or approved equal.

2.09 INSULATION

- A. Extruded Polystyrene Board Insulation: Rigid, cellular, polystyrene thermal insulation with closed cells and integral high-density skin, formed by the expansion of polystyrene base resin in an extrusion process to comply with ASTM C578, Type IV; in manufacturer's standard lengths and widths; and in thicknesses indicated.
- B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.10 MASONRY CLEANERS

- A. Acidic Cleaners: Manufacturer's standard-strength, general-purpose cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; expressly approved for intended use of manufacturer of masonry units being cleaned. Cleaner shall be compatible with the proposed waterproofing systems. Acidic cleaners shall not be used on masonry surfaces scheduled to receive paint.

2.11 MASONRY WATERPROOFING

- A. Master Protect H185 for block as manufactured by Master Building Solutions, Inc.; or approved equal.

2.12 WATERPROOFING ADMIXTURE

- A. Waterproofing Admixture: Hydrocide Powder as manufactured by Sonneborn Building Products.

2.13 WEEP HOLES

- A. Weep Holes: Cotton sash cord in length as required to provide 2-inch exposure on exterior and 18-inch exposure in cavity.

2.14 CAVITY DRAINAGE PROTECTION

- A. Cavity Drainage Protection: Mortar Net trapezoidal-shaped polyester/polyethylene mesh. Provide thickness to fill cavity width.

2.15 COMPRESSIBLE FILLER

- A. Compressible Filler: Pre-molded filler strips complying with ASTM D1056, Type 2, Class A, Grade 1. Compressible up to 35 percent (35%) of width and thickness indicated, formulated for Neoprene.

2.16 BOND BREAKER STRIPS

- A. Bond Breaker Strips: Asphalt – saturated, organic roofing felt complying with ASTM D226, Type I (No. 15 asphalt felt).

PART 3 EXECUTION

3.01 PREPARATION

- A. Before beginning masonry construction, verify that tolerances of supporting members are within allowable limits, and that any required reinforcing dowels have been placed in accordance with the requirements of the Contract Documents.
 - 1. Bearing surface for masonry shall be such that the thickness of the initial bed joint shall be not less than 1/4-inch nor more than 3/4-inch in thickness.
- B. Before laying masonry, remove laitance, loose aggregate, or anything else which would interfere with bond between the mortar and substrate.

3.02 MASONRY INSTALLATION

- A. Cold Weather Construction. When the ambient temperature or the temperature of masonry units falls below 40°F, conform to TMS 602, Article 1.8.C. Provide cold weather heating and protection for both mortar and grout.

- B. Hot Weather Construction. Where the ambient temperature exceed 100°F or 90°F with a wind velocity greater than eight (8) miles per hour (mph), conform to TMS 602, Article 1.8.D.
- C. Wetting Masonry Units
 - 1. Do not wet concrete masonry units before laying unless prior approval is obtained from the Engineer.
- D. Masonry units shall be laid in running bond, with full stretchers, unless otherwise indicated. Tool joints dense and neat. Placing of mortar and units shall conform to TMS 602.
- E. Joints of all masonry shall be tooled in accordance with the following:
 - 1. Wait until mortar is thumbprint hard before tooling joint. This may require as much as three (3) hours in the shade and one (1) hour in the sun in the summertime.
 - 2. The required personnel shall be kept on the job after hours, if necessary, to properly tool joints.
 - 3. Both vertical and horizontal joints shall be maintained uniform in spacing.
 - 4. Joints for all types of CMU shall be 3/8-inch and concave.
- F. Install all frames required to be set in masonry, set masonry tightly against frames, build in all frame anchors, and fill frames with mortar.
- G. Control joints shall be installed at the intersection of masonry walls with structural concrete and elsewhere as detailed on the Drawings. The maximum length, horizontally, between vertical control joints shall be 30 feet, but joints shall be located only as directed or shown. Joints shall be equal in width to the standard mortar joint. Extended control joints through bond beams and discontinue horizontal reinforcement across joint unless otherwise shown on the Drawings.
- H. All masonry slots, chases, or openings required for the proper installation, or the work of other Sections shall be constructed as indicated on the Drawings or in accordance with information furnished before the work is started at the points affected. No chase shall be cut into any wall constructed of hollow units after it is built, except as directed and approved by the Engineer.
- I. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting, where possible. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- J. Mix units for exposed unit masonry from several pallets or cubes as they are placed to produce uniform blend of colors and textures.

- K. Surfaces shall be brushed as work progresses and maintained as clean as is practicable. Protect sills, ledges, offsets, etc. from mortar droppings. Unfinished work shall be raked back where possible and toothed only where acceptable to the Engineer. The top of partially completed work shall be covered at all times while work is not in progress. Before leaving fresh or unfinished work, walls shall be fully covered and protected against rain, wind, frost, or the elements. Covers of waterproof paper, tarpaulins, or other means acceptable to the Engineer, shall be draped over the wall, shall extend a minimum of 2 feet down both sides, and shall be firmly held in place.
- L. Build in all miscellaneous items to be set in masonry for which placement is not specifically provided under separate divisions, including reglets, lintels, ties, electrical conduits and fixtures. Cooperate with other trades whose work is to be coordinated with the work under this Section.
 - 1. Do not embed pipes or electrical conduits in masonry unless their location has been detailed on the structural drawings. Pipes or conduits placed in unfilled cells of hollow unit masonry will not be considered as embedded. Sleeves through masonry shall not be placed closer than three (3) diameters, center to center, nor shall they be placed through reinforced courses or cells.
 - 2. Do not place dissimilar metals in contact with each other.
 - 3. Do not embed aluminum conduits, pipes or accessories in masonry, grout, or mortar, unless they have been coated or covered with materials which will effectively prevent chemical reactions with cement or steel.
 - 4. Do not insert through-wall flashing or other elements which stop bond in masonry joints unless approved by the Engineer.
- M. All anchorage, attachment, and bonding devices shall be set so as to prevent slippage and shall be completely covered with mortar or grout.
- N. All ties and joint reinforcing for masonry shall be furnished and installed under this Section. Horizontal reinforcement shall be installed continuously in every other course of 16 inches on center vertically.
- O. Bed and grout for items coming in contact with masonry where grouting is required, including, but not limited to, door bucks and frames set in masonry. Install all anchor bolts, base plates, and seats in masonry walls, and build in all items required for the completion of the building as they apply to masonry.

3.03 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces of columns, walls, and arises, do not exceed 1/4-inch in 10 feet, nor 3/8-inch in 20 feet, nor 1/2-inch in 40 feet or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4-inch in 20 feet nor 12-inch in 40 feet or more. For vertical alignment of head joints, do not exceed plus or minus 1/4-inch in 10 feet, nor 1/2-inch maximum.

- B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4-inch in 20 feet, nor 1/2-inch in 40 feet or more. For top surface of bearing walls, do not exceed 1/8-inch in 10 feet, nor 1/16-inch within width of a single unit.
- C. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls, and partitions, do not exceed 1/2-inch in 20 feet, nor 3/4-inch in 40 feet or more.
- D. Variation in Cross-Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4-inch nor plus 1/2-inch.
- E. Variation in Mortar-Joint Thickness: Do not vary from bed-joint thickness indicated by more than plus or minus 1/8-inch, with a maximum thickness limited to 1/2-inch. Do not vary bed-joint thickness from bed-joint thickness of adjacent course by more than 1/8-inch. Do not vary from head-joint thickness indicated by more than plus or minus 1/8-inch. Do not vary head-joint thickness from adjacent head-joint thickness by more than 1/8-inch. Do not vary from collar-joint thickness indicated by more than minus 1/4-inch or plus 3/8-inch.

3.04 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement-type joints, returns, and offsets. Avoid the use of less-than-half-size units at corners, jambs, and where possible at other locations.
- B. Lay walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.
- C. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs. Running bond.
- D. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- E. Stopping and Resuming Work: In each course, rack back 1/2-unit length for one-half running bond or 1/3-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar prior to laying fresh masonry.
- F. Built-in Work: As construction progresses, build-in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.
- G. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated. At exterior frames, insert extruded polystyrene board insulation around perimeter of frame in thickness indicated, but not less than 3/4-inch to act as a thermal break between frame and masonry.

- H. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.
- I. Fill cores in hollow concrete masonry units with grout 24-inch under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
- J. Build non-load-bearing interior partitions to height shown by partition schedule.

3.05 MORTAR BEDDING AND JOINTING

- A. Lay hollow concrete mortar as follows:
 - 1. With full mortar coverage on horizontal and vertical face shells.
 - 2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
 - 3. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.
 - 4. Maintain joint widths indicated, except for minor variations required to maintain bond alignment. If not indicated, lay walls with 3/8-inch joints.
- B. Lay veneer block as follows:
 - 1. Lay units with full head joints, unless otherwise indicated. Provide bed joints with full mortar coverage on face shells and webs.
 - 2. Maintain joint widths indicated, except for minor variations required to maintain bond alignment. If not indicated, lay walls with 1/4-inch to 3/8-inch joints.
- C. Tool exposed joints with a concave-joint, using a 20-inch-long sled runner for horizontal joints in veneer block and for all joints in concrete masonry, unless otherwise indicated.
- D. Cut joints flush for masonry walls that are to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

3.06 STRUCTURAL BONDING OF MULTI-WYTHE MASONRY

- A. Use individual metal ties installed in horizontal joints to bond wythes together. Provide ties as shown, but not less than one (1) metal tie per 4 ft² of wall area, spaced not to exceed 24 inches on center, horizontally and vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches on center vertical.

- B. Corners: Provide interlocking masonry unit bond in each course at corners, unless otherwise shown.
 - 1. Provide continuity with horizontal-joint reinforcement at corners by using prefabricated "L" units in addition to masonry bonding.
- C. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, provide same type of bonding specified for structural bonding between wythes and space as follows:
 - 1. Provide individual metal ties not more than 16 inches on center.
 - 2. Provide continuity with horizontal-joint reinforcement by using prefabricated "T" units.
 - 3. Provide rigid metal anchors not more than 24 inches on center. If used with hollow masonry units, embed ends in mortar-filled cores.

3.07 CAVITIES

- A. Keep cavities clean of mortar droppings and other materials during construction. Strike joints facing cavities flush.
 - 1. Use wood strips temporarily placed in cavity to collect mortar droppings. As work progresses, remove strips, clean off mortar droppings, and replace in cavity.
- B. Tie exterior wythe to back-up with individual metal ties. Stagger alternate courses.

3.08 ANCHORING MASONRY TO STRUCTURAL MEMBERS

- A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
 - 1. Provide an open space not less than 1-inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.
 - 2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.
 - 3. Space anchors as indicated, but not more than 24 inches on center vertically and 36 inches on center horizontally.

3.09 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to metal studs with masonry-veneer anchors to comply with the following requirements:
 - 1. Fasten each anchor section through sheathing to metal studs with two (2) metal fasteners of type indicated.

2. Embed tie section in masonry joints. Provide not less than 2-inch air space between back of masonry veneer and face of sheathing.
3. Locate anchor section relative to course where tie section is embedded to allow maximum vertical differential movement of tie up and down.

3.10 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joints in masonry where indicated. Build-in related items as the masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 1. Install Hohmann & Barnard Slip-Set Stabilizer, or approved equal, at 16 inches on center. Fill adjacent void in block with grout and vertical reinforcement. Discontinue wall reinforcing at the joint. Install backer rod and sealant in the vertical joint. Keep head joints at control joint free from mortar.
- C. Form expansion joints in veneer block as follows:
 1. Build-in joint fillers where indicated, but not less than 3/8-inch for installation of sealant specified in Section 07901, Joint Sealants. Building expansion joints shall have metal expansion joint covers where shown.

3.11 LINTELS

- A. Install steel lintels where indicated. Steel lintels shall be hot dipped galvanized and painted.
- B. Provide masonry lintels where shown and where openings of more than 24 inches for block size units are shown without structural steel or other supporting lintels.
 1. Provide prefabricated or built-in place masonry lintels. Use specially formed bond beam units with reinforcement bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.
- C. For steel lintels, provide minimum bearing of 8 inches at each jamb, unless otherwise indicated. For masonry lintels, provide minimum bearing of 2'-0" at each jamb, unless otherwise indicated.

3.12 FLASHING, WEEP HOLES, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to the downward flow of water in the wall, and where indicated.
- B. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Place through-wall flashing on sloping bed of mortar and cover with

mortar. Seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer before covering with mortar.

C. Install flashing as follows:

1. At composite masonry walls, including cavity walls, extend flashing from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 4-inch, and through the inner wythe to within 1/2-inch of the interior face of the wall in exposed masonry. Where interior surface of inner wythe is concealed by furring, carry flashing completely through the inner wythe and turn up approximately 2 inches, unless otherwise indicated.
2. At masonry-veneer walls, extend flashing from exterior face of veneer, through the veneer, up face of sheathing at least 8 inches, and behind air-infiltration barrier/building paper.
3. At lintels and shelf angles, extend flashing a minimum of 4 inches into masonry at each end. At heads and sills, extend flashing 4 inches at ends and turn up not less than 2 inches to form a pan.

D. Install weep holes in the head joints in exterior wythes of the first course of masonry immediately above embedded flashing and as follows:

1. Form weep holes with product specified in Part 2 of this Section.
2. Space weep holes 24 inches on center.
3. In cavities, place pea gravel to a height equal to height of first course, but not less than 2 inches, immediately above top of flashing embedded in the wall, as masonry construction progresses, to splatter mortar droppings and to maintain drainage.

3.13 BONDING, ANCHORS, AND TIES

- A. Unless otherwise shown, corners and intersections of load-bearing masonry walls shall be bonded in each course with a true masonry bond, except that when necessarily erected separately, they shall be anchored with rigid steel anchors spaced not more than 2 feet apart vertically.
- B. Intersections of non-load-bearing partitions with other walls or partitions shall be tied with corrugated metal anchors at vertical intervals of not more than 16 inches, or with masonry bonding in alternate courses.

3.14 REINFORCED MASONRY

- A. Provide reinforcement of the type, size, and spacing and at locations as indicated on the Drawings and specified herein.
- B. Concrete masonry unit walls shall be laid in such a manner as to preserve the alignment and unobstructed vertical continuity of cells. Cross webs adjacent to vertical cores that are to be filled with grout shall be fully bedded with mortar, to prevent grout leakage.

Mortar fins protruding from joints shall be removed before grout is placed. The minimum clear dimensions or vertical cores to be grouted shall be 2-inch by 3-inch (2" x 3").

- C. Reinforcement shall be free of dirt, oil and other materials that will adversely affect bond, and shall be straight except where bends or hooks are detailed on the plans. Reinforcement which, in the opinion of the Engineer, is bent or otherwise damaged so as to affect its structural capacity shall not be incorporated into the Work.
- D. Bond beams and horizontal joint reinforcing shall be continuous with lapped splices as specified except at vertical control joints, or at other locations noted on the Drawings.
- E. Reinforcing Around Openings
 - 1. Unless otherwise shown on the Drawings, at openings in masonry greater than or equal to 16 inches in any direction, provide a minimum of one (1) #4 bar in grouted cells or bond/lintel beams on all sides of the opening. Bars shall extend at least 48 bar diameters past the opening on each side.
 - 2. See lintel schedules and miscellaneous details on the Drawings for additional requirements.
- F. Reinforcing Details
 - 1. Support and fasten masonry reinforcement to prevent displacement beyond the tolerances noted herein.
 - 2. Install horizontal wire joint reinforcement in the second bed joint above the support for masonry and thereafter at 16-inch vertical intervals and at other locations as detailed on the Drawings.
 - a. Wire joint reinforcement shall be continuous throughout the wall and around corners except that it shall not pass through vertical masonry control joints unless so indicated on the Drawings.
 - b. Lap side rods at least 12 inches at splices.
 - c. Embed joint reinforcement in masonry bed joints with not less than 5/8-inch mortar coverage.
 - 3. Position and accurately space reinforcement in units as shown on the Drawings. Maintain a clear distance between reinforcement and any masonry surface or adjacent bar of not less than 1/4-inch for fine grout or 1/2-inch for coarse grout.

4. Tolerances for placing reinforcement shall be as shown in Table 2 below, where “d” equals distance from centerline of steel to the compression face of masonry.
 - a. If it becomes necessary to move reinforcement to avoid interferences with other reinforcement, conduits, or embeds, bars shall not be moved beyond their specified tolerances nor more than one diameter without prior approval by the Engineer.

Table 2 Reinforcement Placement in Walls, Beams, Lintels, and Bond Beams	
“d” (inches)	Placement Tolerance (inches)
$d \leq 8$	$\pm 1/2$
$8 < d \leq 24$	± 1
$d > 24$	$\pm 1 \frac{1}{4}$

5. Splice-deformed reinforcing steel at least 40 bar diameters unless otherwise noted on the Drawings. When adjacent lapped bars are spaced 3 inches apart or less, increase the lap length to 52 bar diameters, or stagger the laps at least 24 bar diameters with no increase in lap length.
6. Clear spacing between vertical bars in columns or pilasters shall be not less than 2-1/2 times the bar diameter nor 1½-inch. Stagger adjacent splices vertically.
7. Completely embed all reinforcing bars in mortar or grout with minimum cover (including the masonry unit) as follows:
 - a. Interior exposure: 1½-inch
 - b. Exposed to soil or weather: 2-inch
8. Provide masonry dowels cast into the supporting concrete at all corners of the structure, in the first adjacent cell in each direction from the corner, at cells requiring vertical reinforcement, and elsewhere as shown on the Drawings.

3.15 GROUTING

A. General

1. Walls shall be grouted at reinforced cells only unless otherwise indicated on the Drawings. Cells containing anchors or inserts shall be fully grouted for at least 8 inches each way past the embed.
2. Prior to grouting, the grout space shall be clean and free of mortar projections greater than 1/2-inch, mortar droppings, or other foreign materials.
3. Reinforcement shall be in place and adequately supported before commencing grouting operations. Reinforcement shall be clean and free of mortar droppings or other debris. Notify the Engineer at least 24 hours prior to any grouting operations so that reinforcement placement, support and laps may be observed before grouting. Accurately set embedded bolts with templates and hold in place to prevent

movement. Provide minimum 1-inch grout space between any bolt and an adjacent masonry surface.

4. Install barriers so that spaces designated for grouting will be filled with grout and the grout will be confined to those specific spaces. Place vertical barriers consisting of masonry units, or mortar in hollow bond beam units and grouted collar joint at maximum intervals of 30 feet to limit the horizontal flow of grout. The grouting of any section of wall between barriers shall be completed in one day with no interruptions greater than one (1) hour.
5. Control grout materials and water content during grouting to provide adequate fluidity for placement without segregation. Place grout within one and one-half (1-1/2) hours after the introduction of water into the mix and prior to initial set.
6. Solidly fill with grout all reinforced cells and other cells as indicated
7. on the Drawings. Place grout in a continuous pour to its maximum placement height using lifts of 5 feet or less and consolidating the grout after each lift.
8. Consolidate grout by mechanical vibration before loss of plasticity, in a manner which will solidly fill the grout space and minimize voids due to absorption of water into the masonry. Reconsolidate grout by mechanical vibration after initial water loss and settlement has occurred. Consolidation should normally occur when the plasticity of the grout approaches that of stiff mortar (when a touch leaves an indentation).
9. Complete grouting of beams over openings in one continuous operation. Provide approved material to confine the grout in a beam where grouting occurs over ungrouted cells below. Material used for confinement shall not inhibit bond between masonry units and mortar.
10. Use extreme care to prevent any grout or mortar from staining the face of masonry to be left exposed or unpainted. If any grout or mortar does contact the face of such masonry, it shall be removed immediately. Protect all sills, ledges, offsets, etc. from grout droppings.

11. Limitations on grout type (fine or coarse), and height of grout pours shall be as shown in Table 3 below. Units may be laid to the maximum height of the grout pour before grouting unless otherwise noted on the Drawings or specified. Where this table or notes on the Drawings indicate that walls are to be grouted at intervals less than their final height, use “low-lift” grouting procedures. Where walls are grouted to their final height in one pour, use “high-lift” grouting procedures.

Table 3 Grout and Pour Height Limitations			
Grout Type	Grout Pour Maximum Height ⁽¹⁾ (feet)	Least Clear Dimension ⁽²⁾	
		Width of Grout Space ⁽³⁾ (inches)	Cell Dimensions ⁽⁴⁾ (Inch x Inch)
Fine	1	3/4	1-1/2 x 2
	5	2	2 x 3
	12	1/2	2-1/2 x 3
	24	3	3 x 3
Coarse	1	1-1/2	1-1/2 x 3
	5	2	2-1/2 x 3
	12	2-1/2	3 x 3
	24	3	3 x 4

⁽¹⁾ Maximum pour heights may be used, when approved by the Engineer, when it can be demonstrated that the grout spaces can be properly filled.

⁽²⁾ The clear dimension is the cell width less mortar projections, or the grout space width less the sum of mortar projections plus the width of any horizontal reinforcement inside the space.

⁽³⁾ For grout spaces between masonry wythes.

⁽⁴⁾ For grouted cells in hollow unit masonry.

B. Low – Lift Grouting Procedures

- Between grout pours in vertical cells, form a horizontal construction joint “key” in walls by stopping all wythes at the same elevation, and stopping the grout lift a minimum of 1½-inch below the mortar joint, except at the top of a wall. Consolidate the grout and then continue the pour. For horizontal bond beams, grout cells below the bond beam and consolidate, then grout the bond beam itself stopping the grout pour 1/2-inch below the top of the masonry. At the finished course of both walls and bond beams, bring the last pour flush with the top of the masonry during initial placing and again after consolidation.

C. High-Lift Grouting Procedures

- Do not erect masonry to a height of more than 80 times the minimum clear cell or grout space dimension nor higher than 30 feet before grouting unless approval is obtained in writing from the Engineer.
- In multiple-wythe masonry, tie wythes together with metal ties or horizontal joint reinforcement adequate to resist the lateral from pressures produced by the grout.
- Where grout pour exceeds 5 feet in height, provide clean-outs in the bottom course of masonry. Clean-out openings shall be not less than 12 in² in area, and the least dimension of any opening shall not be less than 3 inches. In partially grouted

reinforced masonry, provide clean-out openings at each vertical bar. In solid grouted masonry, space clean-outs at each vertical bar, but not more than 32 inches on center.

4. Before grouting, clean cells and collar joints and close and seal clean-out openings. Brace closures to resist grout pressure. Pour grout at a rate which will minimize the potential for "blowouts" at the closed clean-out openings, but rapidly enough to allow consolidation before loss of plasticity.

3.16 REPAIR, POINTING, AND FINAL CLEANING

- A. Exposed masonry shall be protected against staining by wall coverings, and excess mortar shall be wiped off the surface as the work progresses to reduce need for cleaning at completion of the work.
- B. Where ordered, remove masonry units which are loose, chipped, broken, stained or otherwise damages, and units which do not match adjoining units and install new units in fresh mortar or grout, pointed to eliminate, as approved by the Engineer, evidence of replacement.
- C. Pointing
 1. During the tooling of joints, enlarge any voids or holes, and completely fill with mortar matching the color of the surrounding work as approved by the Engineer and tool to match. Point-up all joints at corners, openings and adjacent work to provide a neat, uniform appearance and properly prepare joints for application of sealants where required.
 2. Before final cleaning, repoint all unsatisfactory joints as specified above and as required by the Engineer.
- D. Final Cleaning of Masonry
 1. After mortar has thoroughly set and cured (three (3) weeks minimum during the summer, five (5) weeks minimum during the winter), a sample wall area (approximately 20 ft²), shall be cleaned, with an approved commercial masonry cleaner, diluted and mixed with potable water as recommended by the manufacturer and as approved. The sample area may be the sample wall panel specified above or an area in the finish work as approved by the Engineer.
 2. The Engineer's acceptance of sample cleaning shall be obtained before proceeding to clean the remainder of masonry work. A minimum of one (1) week of dry weather is required to evaluate effectiveness of cleaning and effect on masonry and mortar. Upon acceptance by the Engineer, all masonry shall be cleaned by the same method to the satisfaction of the Engineer.
- E. Acid solutions shall not be used for cleaning any CMU scheduled to receive paint. Upon completion of the work, all surfaces of CMU shall be washed with soap powder and warm water, applied with a scrubbing brush, and then rinsed thoroughly with clear water. Other cleaning methods may be ordered to obtain required appearance.

- F. Masonry areas not satisfactorily cleanable will be ordered to be replaced at no extra cost to the Owner.

3.17 MASONRY WASTE DISPOSAL

- A. Masonry Waste: Remove masonry waste from the site.

3.18 ABOVE GRADE MASONRY WATERPROOFING

- A. Surface preparation: Surfaces must be thoroughly dry, clean and free from oil, grease, tar, dirt or loose mortar. Seams, joints and cracks shall be filled with appropriate sealant material.
- B. Apply water repellent to a test patch of masonry work prior to building application. Do not proceed if noticeable staining occurs.
- C. All exterior masonry shall be treated. Surfaces shall be completely clean and dry. Prepare waterproofing in strict accordance with manufacturer's instructions and applications rate. Make a field test for application rate if recommended by manufacturer.
- D. Warranty: Upon completion and acceptance of the work the following written warranty shall be provided to the Owner prior to final payment:
 - 1. Installer's 2-year guarantee against defects, water penetration, efflorescence, discoloring, etc.
 - 2. Manufacturers 5-year labor and material warranty for moisture penetration.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor and materials required and install structural steel including bearing plates, columns, beams, and miscellaneous shapes and plates required to erect the structural framing as shown on the Drawings, and as specified herein.
- B. Furnish and install nuts and washers for anchor bolts. The Contractor is responsible for coordinating all pertinent trades in the installation of anchor bolts in concrete for structural steel framing, etc., using templates or other means as necessary. Additional requirements for installing anchor bolts are included in Division 3.

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 03100 Concrete Formwork
- B. Section 03200 – Concrete Reinforcement
- C. Section 03600 – Grout
- D. Section 05500 – Miscellaneous Metals
- E. Section 05513 - Galvanizing
- F. Division 09 – Finishes

1.04 REFERENCE STANDARDS

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

1. AISC Steel Construction Manual
2. AISC 303 Code of Standard Practice for Steel Buildings and Bridges
3. AISC 360 Specification for Structural Steel Buildings

B. 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 A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
4. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
5. ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
6. ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength (WITHDRAWN 2016) (Replaced by F3125)
7. ASTM A490 Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength (WITHDRAWN 2016) (Replaced by F3125)
8. ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
9. ASTM A501 Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
10. ASTM A992 Standard Specification for Structural Steel Shapes
11. ASTM F1554 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
12. 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

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

1. AWS A5.1 Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
2. AWS D1.1 Structural Welding – Steel

D. Research Council on Structural Connections (RCSC), latest edition:

1. Specification for Structural Joints using High Strength Bolts

1.05 SYSTEM DESCRIPTION

- A. Beam Connections not detailed on the Drawings shall be bolted framed beam connections as shown in Part 9 of the AISC Steel Construction Manual.
- B. Bolted shear connections shall be bearing-type connections unless otherwise shown.

1.06 DESIGN REQUIREMENTS

- A. Design Criteria for Stairs, Landings, and Elevated Platforms.
 1. Live loads: 100 lb/ft² uniform
250 lb concentrated
 2. Allowable deflection: Span/360 live load only
Span/240 dead plus live load
1/4-inch maximum
 3. Provide bracing against side sway in all directions. Coordinate with Drawings and equipment manufacturer to identify locations that cannot be obstructed for access or maintenance reasons.

1.07 SUBMITTALS

- A. See Section 01300, Submittals for submittal procedures.
- B. Submit erection drawings, detailed shop drawings, schedules and data for all structural steel. Approval will be for strength only and shall not relieve the Contractor of responsibility for ensuring proper fit of members, submittal of connections not detailed on the Drawings, or for supplying all material required by the Contract Documents. Mark numbers painted on the shop assembled pieces of steel shall be the same mark numbers used on the detailed shop and erection drawings.
- C. Submit certified mill test reports for the structural steel and bolting materials.
- D. Submit certifications that welders are qualified, in accordance with AWS D1.1, for the shop and field welding procedures to be used.
- E. Submit structural calculations stamped by an engineer registered in the State of Arkansas. Calculations shall include, but not be limited to, a description of the structural

design method and codes used in establishing the allowable stresses and safety factors applied in design. Review of the structural calculations by the Engineer shall be for conformance with the design criteria only and shall in no way relieve the structural steel fabricator of design responsibility.

- F. Submit coating thicknesses for all members and hardware in accordance with the ASTM Standards.

1.08 QUALITY ASSURANCE

- A. Structural steel shall be in accordance with the AISC Specification for Structural Steel Buildings and the Code of Standard Practice for Steel Buildings and Bridges unless otherwise specified herein.
- B. Welding shall be in accordance with AWS D.1.1 unless otherwise specified herein or in the AISC Specifications.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials promptly so as to cause no delay with other parts of the work.
- B. Store materials on skids and not on the ground. Pile and block materials so that they will not become bent or otherwise damaged.
- C. Handle materials with cranes or derricks as far as practicable. Do not dump steel off delivery or erection vehicles nor handle in any other manner likely to cause damage.

1.10 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.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Structural Shapes: ASTM A992
- B. Plates, rods, and bars unless otherwise noted: ASTM A36
- C. Structural tube: ASTM A500, Grade B or ASTM A501
- D. Structural pipe: ASTM A53, Type S, Grade B
- E. Welding electrodes: AWS A5.1 E70XX
- F. High strength steel bolts, nuts, and washers: ASTM F3125

- G. Anchor bolts: ASTM F1554, Grade 36
- H. Shop Primer: As specified in Division 09, Painting
- I. Galvanizing: Zinc with 0.5 percent (0.5%) minimum, nickel added
- J. Galvanized surface primer: 95 percent (0.95%) zinc dust, organic vehicle primer

2.02 FABRICATION

- A. Match-mark materials for field assembly. Ream unmatched holes in shop assembly of field connections. Reject and replace with new pieces any piece weakened by reaming to a point where the strength of the joint is impaired.
- B. Welding of parts shall be done only where shown or specified and by welders and welding operators qualified for the procedures used.

2.03 FINISHES

- A. Prepare and shop prime non-galvanized members as specified in Division 09, Painting. Do not prime or paint surfaces of slip critical connections.
- B. Galvanize members and their attachments exposed in whole or part to the weather. Galvanize other members as indicated on the Drawings. Galvanizing shall be done after fabrication and in accordance with ASTM A123. Hardware galvanizing shall be in accordance with ASTM A153. Thoroughly clean, pickle, flux, and immerse members in bath of molten zinc until their temperature becomes the same as the bath.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Furnish and install temporary bracing to provide stability during erection and to prevent distortion or damage to the framing due to wind, seismic, or erection forces. Remove temporary bracing when erection is complete.
- B. Use drift pins only to bring members into position and not to enlarge or distort holes.
- C. Make all steel-to-steel connections by high strength bolting except where field welding is shown or specified. Provide not less than two (2) 3/4-inch bolts per connection and use not less than 1/4-inch-thick clip angles.
- D. Tighten bolted connections designated as bearing-type connections to the snug tight condition. Tighten all other bolted connections to full pretension by turn-of-nut or calibrated wrench tightening per the requirements of Section 8 of the Specification for Structural Joints Using High-Strength Bolts.
- E. Field welding shall be done only where shown or specified and only by welders qualified for the procedures used. No welding shall be done when surfaces are wet, exposed to

rain or wind, or when welders are exposed to inclement conditions that will hamper good workmanship.

- F. Each bolting crew and welder shall be assigned an identification mark. This mark shall be made at each completed connection with a paint stick.
- G. After erection, prime paint abrasions, field welds, and unprimed surfaces using shop primer except surfaces designated to be unpainted or surfaces in contact with concrete.
- H. After erection, prime paint abrasions, and field welds on galvanized surfaces with galvanized surface primer.

3.02 FIELD TESTING

- A. Allow the Engineer free access to the work. Notify the Engineer in writing four (4) working days in advance of high strength bolting or field welding operations.
- B. High strength bolting will be inspected visually. All high strength bolts shall have the turned portion marked with reference to the steel being connected after the nut has been made snug and prior to final tightening. Retighten rejected bolts or remove and provide new bolts. In cases of disputed bolt installations, the bolts in question shall be checked using a calibrated wrench certified by an independent testing laboratory approved by the Engineer. The certification shall be at the Contractor's expense.
- C. Field welding will be inspected visually by AWS certified welding inspectors provided by the Owner. Comply with all requests of inspectors to correct deficiencies.
- D. The fact that steel work has been accepted at the shop and mill will not prevent its final rejection at the site, before or after erection, if it is found to be defective.
- E. Remove rejected steel work from the site within ten (10) working days after notification of rejection.

END OF SECTION

SECTION 05400

COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 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 SUMMARY

- A. Section Includes:

- 1. Load-bearing wall framing
- 2. Exterior non-load-bearing wall framing
- 3. Floor joist framing
- 4. Roof rafter framing
- 5. Ceiling joist framing
- 6. Soffit framing
- 7. Rigid-Insulation framing system

- B. Related Requirements:

- 1. Section 05500 "Miscellaneous Metals" for masonry shelf angles and connections.
- 2. Section 09255 "Gypsum Board Assemblies" for interior non-load bearing, metal-stud framing and ceiling-suspension assemblies.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of cold-formed steel framing product and accessory.
- B. Delegated-Design Submittal: For cold-formed steel framing.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
 - 1. Steel sheet
 - 2. Expansion anchors
 - 3. Power-actuated anchors
 - 4. Mechanical fasteners
 - 5. Vertical deflection clips
 - 6. Horizontal drift deflection clips
 - 7. Miscellaneous structural clips and accessories
- C. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AllSteel & Gypsum Products, Inc.
 - 2. California Expanded Metal Products Company
 - 3. ClarkWestern Building Systems, Inc.
 - 4. Consolidated Fabricators Corp.; Building Products Division
 - 5. Craco Mfg., Inc.
 - 6. Custom Stud Inc.

7. Design Shapes in Steel
8. Dietrich Metal Framing; a Worthington Industries Company
9. Formetal Co. Inc. (The)
10. MarinoWARE
11. Nuconsteel; a Nucor Company
12. Olmar Supply, Inc.
13. Quail Run Building Materials, Inc.
14. SCAFCO Corporation
15. Southeastern Stud & Components, Inc.
16. State Building Products, Inc.
17. Steel Construction Systems
18. Steel Network, Inc. (The)
19. Steel Structural Systems
20. Steeler, Inc.
21. Super Stud Building Products, Inc.
22. Telling Industries, LLC
23. United Metal Products, Inc.
24. United Steel Manufacturing

2.02 PERFORMANCE REQUIREMENTS

- A. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI100 and AISI200.
- B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.03 COLD-FORMED STEEL FRAMING, GENERAL

- A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 1. Grade: ST33H or ST50H
 2. Coating: G60, A60, AZ50, or GF30
- B. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
 1. Grade: 33 or 50, Class 1
 2. Coating: G60

2.04 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 1. See plan
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. See plan
- C. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AllSteel & Gypsum Products, Inc.
 - b. ClarkWestern Building Systems, Inc.
 - c. Dietrich Metal Framing; a Worthington Industries company
 - d. MarinoWARE
 - e. SCAFCO Corporation
 - f. Steel Network, Inc. (The)
 - g. Steeler, Inc.

2.05 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 1. Supplementary framing
 2. Bracing, bridging, and solid blocking
 3. Web stiffeners
 4. Anchor clips
 5. End clips
 6. Foundation clips
 7. Gusset plates
 8. Stud kickers and knee braces
 9. Joist hangers and end closures
 10. Hole reinforcing plates
 11. Backer plates
 12. Rigid-Insulation Framing System:
 - a. Thermafast Pre-engineered framing system by The Steel Network.

2.06 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.
- B. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

C. Welding Electrodes: Comply with AWS standards.

2.07 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint20 or MIL-P-21035B.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.03 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 1. Cut framing members by sawing or shearing; do not torch cut.
 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

- E. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- F. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- G. Install insulation, specified in Section 07210 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- I. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.04 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As indicated
- C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Connect vertical deflection clips to bypassing studs and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
 - 1. Bridging: Cold-rolled steel channel welded or mechanically fastened to webs of punched studs.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.05 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

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SECTION 05500

MISCELLANEOUS METAL

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to install all miscellaneous metal 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. Section 05120 – Structural Steel

1.04 REFERENCE STANDARDS

- A. Aluminum Association (AA), latest edition:
 - 1. AA 5052 Aluminum Sheet and Plate, Rolled Rod and Bar and Drawn Tube
 - 2. AA 6061 T6 Aluminum Sheet and Plate
 - 3. AA 6061 T5 Aluminum Extruded Shapes
 - 4. AA 6063 T6 Aluminum Extruded Pipe
 - 5. AA 5005 Sheet and Plate

6. AA M31C22A41:
 - a. M31 Mechanical Finish, Fine Satin
 - b. C22 Chemical Finish, Medium Matte
 - c. A41 Clear Anodic Coating, Class I
- B. American Association of State and Highway Transportation Officials (AASHTO), latest editions:
 1. AASHTO HB-17 Standard Specifications for Highway Bridges
- C. American National Standards Institute (ANSI), latest edition:
 1. ANSI A14.3 Ladders – Fixed – Safety Requirements
- D. ASTM International (ASTM), latest edition:
 1. ASTM A36 Standard Specification for Carbon Structural Steel
 2. ASTM A48 Standard Specification for Gray Iron Castings
 3. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
 4. ASTM A108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
 5. ASTM A123 Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
 6. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 7. ASTM A276 Standard Specification for Stainless Steel Bars and Shapes
 8. ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
 9. ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength (WITHDRAWN - 2016) (Replaced by F3125)
 10. ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
 11. ASTM A501 Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
 12. ASTM A536 Standard Specification for Ductile Iron Castings

13. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 14. ASTM A992 Standard Specification for Structural Steel Shapes
 15. 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
 16. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 17. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 18. ASTM B429 Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
 19. ASTM B695 Standard Specification for Coating of Zinc Mechanically Deposited on Iron and Steel
 20. ASTM F1554 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
 21. 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
- E. American Welding Society (AWS), latest edition:
1. AWS D1.1 Structural Welding Code – Steel
 2. AWS D1.2 Structural Welding Code – Aluminum
- F. National Fire Protection Association (NFPA), latest edition:
1. 101 Life Safety Code
- G. Occupational Safety and Health Act (OSHA), latest edition:
1. Standards
- H. International Code Council (ICC), latest edition:
1. International Building Code (IBC)

1.05 SUBMITTALS

- A. See Section 01300, Submittals for submittal procedures.
- B. Submit shop drawings, working drawings, and product data showing at least sizes of members, method of assembly, materials, anchorage, and connection to other members to the Engineer for review before fabrication.
- C. Submit samples as requested by the Engineer during the course of construction.
- D. Design Data:
 - 1. Submit calculations or test data demonstrating that the railings, post-base mounts, and handrail wall brackets will resist the loads specified in the IBC at the post spacing provided. Calculations shall include design of anchors indicating size, type, and embedment.
 - 2. Submit manufacturer's load and deflection tables for grating and prefabricated hatches.
- E. Submit coating thicknesses for all members and hardware in accordance with the ASTM Standards.
- F. Submit certification that the railing system is in compliance with OSHA and IBC requirements.

1.06 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.

PART 2 PRODUCTS

2.01 GENERAL

- A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configurations desired.

2.02 MATERIALS

- A. Unless otherwise noted, materials for miscellaneous metals shall conform to the following standards:

Structural Steel	ASTM A992
Structural Steel Tubing	ASTM A500, Grade B

Welded and Seamless Steel Pipe	ASTM A501 or ASTM A53, Type E or S, Grade B Schedule 40. Use standard malleable iron fittings, galvanized for exterior work
Steel Sheets	ASTM A1008
Gray Iron Castings	ASTM A48, Class 35
Ductile Iron Castings	ASTM A536, Grade 65-45-12
Aluminum Extruded Pipe	AA 6063 T6
Aluminum Extruded Shapes	ASTM B221, Alloy 6061 T6
Aluminum Sheet and Plate	ASTM B209, Alloy 6061 T6
Stainless Steel Plates, Sheets and Structural Shapes Exterior, Submerged, or Industrial Use	ASTM A276, Type 316 (Type 316L for welded)
Interior and Architectural Use	ASTM A276, Type 304
Stainless Steel Bolts, Nuts, and Washers	ASTM A276, Type 316
Carbon Steel Bolts and Studs	ASTM A307, Grade A (hot dip galvanized nuts and washers where noted)
High Strength Steel Bolts, Nuts, and Washers	ASTM F3125 (mechanically galvanized per ASTM B695, Class 50, where noted)
Elevated Temperature Exposure	Type I
General Application	Type I or Type II
Galvanizing	ASTM A123, Zinc with 0.5 percent (0.5%) minimum Nickel
Galvanizing, hardware	ASTM A153, Zinc with 0.5 percent (0.5%) minimum Nickel

2.03 FABRICATION

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability.
- B. Connections and accessories shall be of sufficient strength to safely withstand stresses and strains to which they will be subjected. Steel accessories and connections to steel or cast iron shall be steel, unless otherwise specified. Threaded connections shall be made so that the threads are concealed by fitting.

- C. Welded joints shall be rigid and continuously welded or spot welded as specified or shown on the Drawings. The face of welds shall be dressed flush and smooth. Exposed joints shall be close fitting and jointed where least conspicuous.
- D. Welding of parts shall be in accordance with the AWS D1.1 or D1.2 and shall only be done where shown, specified, or permitted by the Engineer. All welding shall be done only by welders certified as to their ability to perform welding in accordance with the requirements of the AWS Code. Component parts of built-up members to be welded shall be adequately supported and clamped or held by other adequate means to hold the parts in proper relation for welding.
- E. Welding of aluminum work shall be on the unexposed side as much as possible in order to prevent pitting or discoloration.
- F. All aluminum finish exposed surfaces, except as otherwise specified, shall have Manufacturer's standard mill finish. Aluminum handrails shall be given an anodic oxide treatment in accordance with the Aluminum Association Specification M31C22A41.
- G. All steel finished work not galvanized shall be thoroughly cleaned, by effective means, of all loose mill scale, rust, and foreign matter before shipment and shall be given one (1) shop coat of primer compatible with finish coats after fabrication but before shipping. Paint shall be applied to dry surfaces and shall be thoroughly and evenly spread and well worked into joints and other open spaces. Abrasions in the field shall be touched up with primer immediately after erection.
- H. Galvanizing, where required, shall be the hot-dip zinc process after fabrication. Following all manufacturing operations, all items to be galvanized shall be thoroughly cleaned, pickled, fluxed, and completely immersed in a bath of molten zinc according to ASTM A653. The resulting coating shall be adherent and shall be the normal coating to be obtained by immersing the items in a bath of molten zinc and allowing them to remain in the batch until their temperature becomes the same as the bath.
- I. Zinc coating which has been burned by welding, abraded, or otherwise damaged shall be cleaned and repaired after installation. The damaged area shall be thoroughly cleaned by wire brushing and all traces of welding flux and loose or cracked zinc coating removed prior to painting. The cleaned area shall be painted with two (2) coats of zinc oxide-zinc dust paint. The paint shall be properly compounded with a suitable vehicle in the ratio of one (1) part zinc oxide to four (4) parts zinc dust by weight.

2.04 ANCHORS, BOLTS, AND FASTENING DEVICES

- A. Anchors, bolts, etc., shall be furnished as necessary for installation of the work of this Section.
- B. Anchor bolt material shall be ASTM F1554, Grade 36, hot dip galvanized unless otherwise noted.
- C. The bolts used to attach the various members to the anchors shall be the sizes shown on the Drawings or as required. Aluminum and stainless steel shall be attached to concrete or masonry by means of stainless-steel machine bolts and iron or steel shall be attached with steel machine bolts unless otherwise specifically noted.

- D. Compound masonry anchors shall be of the type shown on the Drawings or as required and shall be equal to Star Slugin compounded masonry anchors manufactured by Star Expansion Industries; equal by Phillips Drill Co.; Rahlplug; or approved equal. Anchors shall be minimum "two unit" type.
- E. For structural purposes, unless otherwise noted, expansion bolts shall be Hilti "Kwik-Bolt"; or approved equal. When length of bolt is not called for on the Drawings, the length of bolt provided shall be sufficient to place the wedge portion of the bolt a minimum of 1-inch behind the reinforcing steel within the concrete. Material shall be as noted on the Drawings. If not noted, provide in galvanized steel.
- F. Adhesive anchors, for fastening to hollow concrete block or brick, shall be a three-part stud, screen and chemical dispenser anchoring system. Adhesive cartridges shall contain pre-measured amounts of resin and hardener which are mixed and deposited in a screen tube by a dispenser. Stud assemblies shall consist of an all-thread anchor rod with nut and washer. Anchors shall be Hilti HIT-HY 200 in grout-filled CMU, Hilti HIT-HY 270 in hollow masonry, or approved equal.
- G. Bolts and nuts shall be hexagon type. Stainless steel bolts, nuts, screws, washers, and related appurtenances shall be equal to AISI Type 316. All exposed portions of anchor bolts installed in concrete shall be greased, wrapped in burlap or plastic sleeve, and tied.
- H. Automatic end welded headed anchor studs shall be flux ended studs made from cold drawn steel, ASTM A108 Grades C-1010 through C-1020. Headed anchor studs shall be Nelson H4L Headed Concrete Anchors, Nelson S3L Shear Connectors, or approved equal.

2.05 METAL GRATING

- A. Grating shall have rectangular, 3/16-inch thick, bearing bars spaced 1 3/16 inches on center with cross bars spaced at 4 inches on center. All grating panels shall be banded with a bar the same size as the bearing bars.
 - 1. Grating shall be of the depth shown on the Drawings, not exceed the fabricator's maximum recommended span, and meet or exceed the following load and deflection criteria for the maximum span length at the opening being covered by the grating.
 - a. The grating shall produce a deflection of 1/360 of the span or less under a uniform live load of 100 lb/ft² on the maximum span.
 - b. The grating shall produce a deflection of 1/360 of the span or less under a concentrated live load of 300 lb applied at the midpoint of the maximum span.
 - 2. Openings 2 inches or greater in diameter/dimension and grating edges shall be banded with a bar of the same depth and thickness as the bearing bars. Cut bearing bars or cross bars shall be welded to the banding bar.
 - 3. Provide trench grating with symmetrical cross bar arrangement.

4. Grating clamps, nuts, bolts, washers, and other fastening devices for grating supports shall be Type 316 stainless steel. All grating shall be anchored to the supporting system using saddle clips.
 5. Fabricate grating panels in sections not exceeding 48 inches in width (measured perpendicular to bearing bars) nor weigh more than 60 lb per panel.
- B. Aluminum grating material shall be AA 6063 T6 with a mill finish. Cross bars shall be attached to the bearing bars with interlocked swaged joints. The grating shall be Type BS by Harsco Industrial IKG (IKG), Channelview, Texas; Type 19 SG-4 by Ohio Gratings, Inc., Canton, Ohio; Type 19 SG-4 by Seidelhuber Metal Products, Hayward, California; or approved equal.
- C. Metal frames and supports for grating shall be of the same material as the grating unless otherwise shown on the Drawings. Where aluminum supports are used, they shall be fabricated from AA 6061 T6.

2.06 RAILINGS

- A. Handrail and guardrail systems shall comply with the requirements of OSHA and IBC.
- B. Aluminum railing and handrail shall be a welded or mechanically fastened, seamless, extruded aluminum pipe system. Rails shall be AA 6063-T6 alloy. Posts shall be AA 6063 T6 alloy. Splice and reinforcing sleeves, brackets, end caps, toeboards, etc. shall be AA 6063 T6 or AA 6061 T6. Railing system fastening hardware shall be Type 316 stainless steel. All railing, posts, toeboards, and exposed aluminum shall be anodized with an architectural Class I satin finish providing a minimum coating thickness of 0.7 mils and a minimum coating weight of 32 mg/in² in compliance with AA M12C22A41.
- C. Railings shall be fabricated with 1 1/2-inch nominal diameter pipe. Posts shall be Schedule 80 pipe, minimum and rails and handrail shall be Schedule 40 pipe, minimum. Posts and top rails shall be continuous. Spacing of posts shall not exceed 6 feet on center and shall be uniformly spaced except as otherwise shown on the Drawings. All railing posts shall be vertical.
- D. Welds shall be circumferential welds ground smooth and even to produce a railing that is neat in appearance and structurally sound. Welding methods shall be in conformity with AWS standards for the materials being joined. All rail to post connections shall be coped and fastened by continuous welds. There shall be no burrs, sharp edges, or protrusions on any weld on any part of the handrail system. After fabrication, the welds and surrounding area shall be cleaned and hand buffed to blend with the adjacent finish. All mechanical fasteners shall be unobtrusively located in countersunk holes with the top flush with the surface of the rail. Bends in the railing shall be as indicated by the Drawings. No distortion of the circular railing shape will be allowed. Bends and terminal sections shall be made without the use of fittings. Corner bends shall be mitered and welded bends or have a 3-inch centerline radius.

- E. Railing shall be assembled in sections as long as practical but shall not be greater than 24 feet in length. A field splice shall be used when an assembled section is to be attached to another section. Field splices shall be used in all railing panels that cross over structure expansion joints.
 - 1. Field splices shall use internal splice sleeves located within 8 inches of railing posts. The sleeve shall be welded to the rail on one side and fastened with a set screw to the rail on other side. The field splice shall be detailed to take the differential expansion between the railing system and the supporting structure.
 - 2. When the field splice occurs in a railing panel crossing a structure expansion joint, the sleeve shall be welded to the rail on one side and be free to slide in the rail on the other side. The field splice shall be detailed to take the same movement as the structure expansion joint.
- F. The bases or supports for railing posts and handrail shall be the types indicated on the Drawings.
 - 1. Railing posts, which may collect condensation, shall have a 3/16-inch drain hole drilled immediately above the concrete encased area, the base flange, or supporting socket on the side away from the walking area. The bottom of the rail post between the drain hole and the bottom of the post shall be filled with an inert material such as a compressed closed cell neoprene rod.
 - 2. Where handrail is to be fastened to walls, the rails shall be provided with screwed wall flanges fastened to the walls with three 3/8-inch stainless steel flat head machine screws.
- G. Safety gates, for railing openings, shall be fabricated of matching pipe and rail material and configuration. The gates shall be self-closing gates with approved stop, latch, and stainless-steel closure spring and hinges.
- H. Barrier chains, for railing openings, shall be fabricated of stainless-steel chains. Chain shall be 1/4-inch stainless steel links, with 11 links per foot as manufactured by Eastern Chain Works, Inc., New York; Lawrence Metal Products, Inc. or approved equal. Chains shall be fastened to the handrail posts at the elevation of each rail. One end of each chain shall be connected to one post with a 1/4-inch diameter stainless steel eye bolt and the other end shall be connected to the other post by means of a heavy chromium plated bronze swivel eye slide harness snap and a similar eye bolt.
- I. Collar material shall match post material. Place collars around post bases where shown on Drawings and fasten in place with set screws on the side of the post away from the walkway.
- J. Toeboards shall be provided on all railing adjacent to a drop in elevation of 4 feet or more. Toeboards are not required on the inclined portion of stairway railings or where concrete or steel curbs, 4 inches or more in height, are present. Toeboards shall be the same material as the railing. The toeboards shall have a minimum thickness of 3/32-inch for extruded shapes, and 1/8-inch for flat plates or channels. Channels shall have flanges of not less than 3/4-inch nor more than 1 1/2-inch in width. Toeboards shall be positioned with a maximum clearance of 1/4-inch from the floor and fastened to railing

posts with 1/4-inch stainless steel U-bolts, with J-bolts at corner posts and with clip angles and two (2) 1/4-inch stainless steel expansion bolts at walls.

- K. All railings shall be properly protected by paper, or by an approved coating or by both against scratching, splashes, or mortar, paint, or other defacements during transportation and erection, and until adjacent work by other trades has been completed. After protective materials are removed, the surfaces shall be made clean and free from stains, marks, or defects of any kind.

2.07 STEEL STAIRS

- A. Furnish and erect steel stairs making metal parts complete as detailed. Stringers shall be structural tubes of sizes shown on Drawings with 1 1/4-inch x 1 1/4-inch x 1/8-inch (1 1/4" x 1 1/4" x 1/8") continuous angle brackets for treads and risers. Anchor stringers to concrete floor construction and steel frame. Provide intermediate structural supports as detailed. Close ends of stringers with 1/4-inch steel plate.
- B. Risers and sub-treads for concrete treads shall be 10-gauge sheet steel formed to the shapes shown on the Drawings. Sub-platform at landings shall be 10-gauge steel reinforced with angle or tee stiffeners spaced about 2-foot, 0-inch (2'-0") on center, unless otherwise noted on Drawings.
- C. Posts, caps, terminals, pickets and railing connections shall be as shown on the Drawings.
- D. Shop weld rails, stringers and platform framing in as large sections as possible. Use erection bolts and field welds for all other connections. Erection Bolts shall be kept to a minimum and where used shall be flat countersunk machine screws. Final connections shall be field welded. Risers and sub-treads shall be welded to stiffeners and to stringers.

2.08 LADDERS

- A. Ladders, ladder accessories, and ladder clearances shall conform to the requirements of OSHA.
- B. Aluminum ladders shall be fabricated as detailed on the Drawings. Ladder rungs shall be 1 3/8-inch diameter aluminum bars fabricated from extruded aluminum shapes, Type 6063 T5/T6, with a serrated tread, series L1D by Halliday Products, Orlando, Florida, or approved equal. Ladder rungs of 1 1/4-inch diameter are acceptable provided they meet OSHA load requirements. Side rails and wall support brackets shall be Type 6061 T6 with Type 316 stainless steel fasteners.

2.09 LADDER SAFETY EXTENSION

- A. Ladder safety extension for fixed ladders below access doors shall be Halliday Products Series L1E Ladder Extension, or approved equal. It shall be designed with a telescoping tubular section that locks automatically when fully extended. Upward and downward movement shall be controlled by a stainless-steel spring balancing mechanism. Unit shall be completely assembled with fasteners for securing to the ladder rungs in accordance with the manufacturer's recommendations.

2.10 ACCESS DOORS

- A. Access doors shall have single or double leaf doors as indicated by the Drawings. The doors shall be 1/4-inch aluminum diamond pattern plate with welded stiffeners, as necessary, to withstand either an AASHTO H-20-wheel loading or a live load of 300 pounds per square-foot as indicated on the Drawings. Hatches shall have a 1/4-inch aluminum channel frame with a perimeter anchor flange or strap anchors for concrete embedment around the perimeter. A 1 1/2-inch drain coupling is welded under the frame for a pipe connection to a disposal system. Hatches shall include a protective grating panel. The grating panel shall be powder-coated Safety Orange and have a load rating to match the hatch. All astragals shall be removable unless specifically noted on the plans.
- B. Unless otherwise noted on the Drawings, use pivot torsion bars for counterbalance or spring operators for easy operation along with automatic door hold open. Hardware shall be durable and corrosion resistant with Type 316 stainless steel hardware used throughout. Provide removable lock handle. Finish shall be the factory mill finish for aluminum doors and frames with coating per paragraph 3.02.C on the exterior of the frames in contact with concrete. Access hatches shall be of the manufacturer, including type and series, as shown on the Drawings or approved equal.

2.11 ROOF ACCESS DOORS

- A. Roof access door shall be Bilco Type D. Access door shall be double leaf, 11-gage aluminum with Type 316 stainless steel hardware used throughout. Access door shall include spring lifting mechanisms to provide smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. Access door curb shall be equipped with an integral metal capflashing that features the Bil-Clip® flashing system. Access door shall incorporate the Bil-Guard safety railing system. Access door shall be equipped with exterior padlock hasps. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a grip handle to permit easy release for closing. Finish shall be factory mill finish for aluminum doors.

2.12 MISCELLANEOUS ALUMINUM ITEMS

- A. Miscellaneous aluminum items shall include beams, angles, closure angles, hatches, floor plates, stop plates, stair nosings, and any other miscellaneous aluminum called for on the Drawings and not otherwise specified.
- B. Miscellaneous aluminum shapes and plates shall be fabricated as shown on the Drawings. Angle frames for hatches, beams, grates, etc. shall be furnished complete with welded strap anchors attached. Furnish all miscellaneous aluminum shown on the Drawings but not otherwise detailed. Structural shapes and extruded items shall conform to the detail dimensions or the plans within the tolerances published by the American Aluminum Association.
- C. Open aluminum stair treads shall be as of the depths and thickness shown on the Drawings and shall be Harsco Industrial IKG (IKG); Amico-Klemp Corp.; or approved equal. The ends of all grating sections shall be banded. Clamps and bolts used for

attaching grating to supporting member shall be stainless steel. Grating shall have abrasive, non-slip nosing.

- D. Aluminum nosing at concrete steps and concrete stair platforms shall be equal to Wooster Products, Inc., Alumigrit Treads, Type 116 x 4 inches (116" x 4") wide; equal to Barry Pattern and Foundry Co.; Andco; or approved equal. Furnish with wing type anchors and flat head stainless steel machine screws, 12 inches on center. Nosing shall extend to within 3 inches at each side of the stair.
- E. Checker plate aluminum cover plates shall be fabricated to the details shown and installed at the locations shown on the Drawings. Frames and supports shall be of aluminum construction. Fastening devices and hardware shall be Type 316 stainless steel.
- F. Manhole rungs for cast-in-place concrete work shall be Type 316 stainless steel drop front design, 17 3/4 inches wide with a serrated step surface. The manhole rungs shall conform to the requirements of OSHA.
- G. Structural aluminum angle and channel door frames shall be provided as shown on the Drawings and shall be anodized. Frames shall be fabricated with not less than three (3) anchors on each jamb.
- H. Aluminum railing and toeboard shall be anodized in accordance with AA M31C22A41. Other aluminum items shall have a cleaned and degreased mill finish.

2.13 MISCELLANEOUS STEEL ITEMS

- A. Miscellaneous steel shall be fabricated and installed in accordance with the Drawings and shall include: beams, miscellaneous angles, support brackets, door frames, splice plates, anchor bolts (except for equipment furnished in Divisions 11, 13, and 15); lintels coped back 3/4-inch where they bear on masonry; checker plates; bar racks; and any other miscellaneous steel called for on the Drawings and not otherwise specified.
- B. Sleeves shall be steel or cast-iron pipe in walls and floors with end joints as shown on the Drawings. All pipe sleeves shall have center anchor around circumference as shown on the Drawings.
- C. All miscellaneous lintels and closures required but not specifically shown on the Drawings shall be galvanized steel and shall be provided as a part of this Section sized as required for strength and coverage.
- D. Miscellaneous steel pipe for sleeves and lifting attachments and other uses as required including concrete filled galvanized steel bollards, shall be Schedule 40 pipe fabricated according to details as shown on the Drawings.
- E. Provide structural steel angle and channel door frames where shown on the Drawings. Angle and channel frames shall be galvanized. Frames shall be fabricated with not less than three (3) anchors on each jamb.
- F. Galvanized frame and covers for drop inlets shall be as shown on the Drawings.

- G. Steel Support Channels for Chemical Hose shall be of the dimensions and slope shown on the Drawings, conform to ASTM A36 and shall include all stainless-steel hardware as required or specified herein.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install all items furnished except items to be embedded in concrete or other masonry which shall be installed under Division 3 and Division 4, respectively. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown on the Drawings. Fastening to wood plugs in masonry will not be permitted. All dimensions shall be verified at the site before fabrication is started.
- B. Where aluminum contacts a dissimilar metal, field-apply a heavy brush coat of coal tar epoxy followed by two (2) coats of aluminum metal and masonry paint to the dissimilar metal.
- C. Where aluminum contacts masonry or concrete, field-apply a heavy brush coat of coal tar epoxy to the masonry or concrete. For embedded items, coat the embed.
- D. Where items are cast into concrete, back-paint contact areas before setting.
- E. Where aluminum contacts wood, apply two (2) coats of aluminum metal and masonry paint to the wood.
- F. All steel surfaces to come in contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instructions prior to installation.
- G. Specialty products shall be installed in accordance with the manufacturer's recommendations.
- H. Expansion bolts shall be checked for tightness a minimum of 24 hours after initial installation.
- I. Install adhesive capsule anchors using manufacturer's recommended drive units and adapters and in compliance with the manufacturer's recommendations.
- J. Headed anchor studs shall be welded in accordance with manufacturer's recommendations.
- K. All railings shall be erected to line and plumb.
- L. Between aluminum grating, aluminum stair treads, or aluminum handrail brackets and steel supports, insert 1/4-inch-thick neoprene isolator pads, 85 plus or minus 5 Shore A durometer, sized for full width and length of bracket or support.
- M. Protect all furnished items from damage due to work of adjacent trades.

3.02 ERECTION TOLERANCES

- A. Maximum offset from true alignment: 1/4-inch
- B. Maximum space between adjoining or abutting grating or cover plate sections: 1/4-inch
- C. Maximum variation from top surface plane of adjoining or abutting grating or cover plate sections or structure: 1/8-inch

END OF SECTION

SECTION 05530

GRATINGS AND COVER PLATES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install metal gratings and floor cover plates along with embedded or attached support frames as shown on the Drawings or 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

1.03 RELATED SECTIONS

- A. Section 05120 – Structural Steel
- B. Section 05500 – Miscellaneous Metal

1.04 REFERENCE STANDARDS

- A. American Welding Society (AWS)
 - 1. AWS D1.2 Structural Welding Code – Aluminum
- B. ASTM International (ASTM), latest edition:
 - 1. ASTM A276 Standard Specification for Stainless Steel Bars and Shapes
 - 2. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 - 3. ASTM B241 Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

C. National Association of Architectural Metal Products (NAAMP), latest edition:

1. NAAMM MBG 531 Metal Bar Grating Manual 531

1.05 SUBMITTALS

- A. See Section 01300, Submittals for submittal procedures.
- B. Submit detailed shop drawings showing sizes of members, method of assembly, anchorage and connection to other members. Submittals shall include the following:
 1. Manufacturer's product data for gratings and plates including span and deflection tables and details of construction, including type and location of all fasteners;
 2. Manufacturer's installation instructions;
 3. Samples 12-inch x 12-inch (12" x 12") in size, illustrating surface finish, color, texture, and jointing details.

1.06 QUALITY ASSURANCE

- A. Fabrication tolerances shall be in accordance with applicable provisions and recommendations of NAAMM Metal Bar Grating Manual 531.

1.07 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.

PART 2 PRODUCTS

2.01 RECTANGULAR ALUMINUM BAR GRATING AND APPURTENANCES

- A. Provide aluminum grating of the depths and bearing bar thicknesses noted on the Drawings, with bearing bars spaced at 1 3/16 inches on center and cross bar supports at 4 inches on center. Grating material shall be aluminum alloy Type 6063 T6 per ASTM B221. Approved manufacturers are Harsco Industrial IKG (IKG) – Type BS, Channelview, Texas; Type 19 SG-4 by Ohio Gratings, Inc., Canton, Ohio; Type 19 SG-4 by Seidelhuber Metal Products, Hayward, California, or approved equal.
 1. Grating cross bars shall be attached to the bearing bars with interlocked swaged joints having no exposed welding.

2. Grating provided shall meet or exceed the following load and deflection criteria for the number of spans and span lengths at which it will be utilized:
 - a. The span at which the grating is installed shall not exceed the fabricator's maximum recommended span.
 - b. The grating shall produce a deflection of 1/4-inch or less under a uniform live load of 100 lb/ft².
 - c. Grating shall produce a deflection of 1/4-inch or less under a concentrated live load of 300 lb applied at mid-span.
3. Openings 2 inches or greater in diameter/dimension and grating edges shall be banded with a bar of the same depth and thickness as the bearing bars. All cut bearing and cross bars shall be welded to the banding bar.
4. Bearing bars shall have equal length "stubs" on each end of the trench grate.
- B. Grating, frames and supports shall be all galvanized steel construction, as shown on the Drawings and specified. Apply one (1) coat of coal tar epoxy to provide dielectric separation between aluminum and galvanized steel.
- C. Grating clamps, nuts, bolts, washers and other fastening devices for grating and grating supports shall be Type 316 stainless steel.
 1. Provide saddle clip grating anchors.
- D. Finishes
 1. Grating and frames - Mill finish
 2. Surface - Plain, except in chemical storage areas where serrated grating is required.

2.02 ALUMINUM COVER PLATES

- A. Cover plates shall be aluminum tread plate, alloy Type 6061-T6 having a raised figure pattern on one surface to provide improved traction.
 1. Unless otherwise noted, provide 3/8-inch plate thickness.
 2. Cover plates shall meet or exceed the following load and deflection criteria for the number of spans and span lengths at which it will be utilized:
 - a. Dead Loads: Self-weight Dead Load Superimposed Dead Load, 10 lb/ft²
 - b. Live Loads: 60 lb/ft² uniform 400 lb concentrated in any location
 - c. Allowable deflection: Span/240 maximum

3. Submit structural calculations stamped by an Engineer registered in the State of Arkansas. Calculations shall include, but not be limited to a description of the structural design method and codes used in establishing the allowable stresses and safety factors applied in design. Review of the structural calculations by the Engineer shall be for conformance with the design criteria only and shall in no way relieve the aluminum cover plate fabricator of design responsibility.
- B. Plate, frames and supports shall be all aluminum construction as shown on the Drawings and specified herein.
- C. Cover plate fastening devices and hardware shall be Type 316 stainless steel.
- D. Mill Finish

2.03 FABRICATION

- A. Provide work true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture free from defects impairing strength or durability.
- B. Field verify dimensions prior to fabrication.
- C. Provide connections and accessories of sufficient strength to safely withstand stresses and strains to which they will be subjected. Threaded connections shall be made so that the threads are concealed by fitting.
- D. Angle frames for grating and floor plates shall be welded and mitered with welded strap anchors attached.
- E. Welded joints shall be rigid and continuously welded or spot welded as specified or as shown on the Drawings. Dress the face of welds flush and smooth. Exposed joints shall be close fitting and located where least conspicuous.
- F. Welding of parts shall comply with the latest edition of AWS D1.2. Welding only to be done where shown on the Drawings, as specified, or when permitted by the Engineer. Welding shall be done by welders certified to perform welding in accordance with the requirements of the AWS Code. Component parts of built-up members to be welded shall be adequately supported and clamped or held by other adequate means to hold the parts in proper relation for welding.
- G. Weld aluminum work on the unexposed side when possible in order to prevent pitting or discoloration.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that opening sizes and dimensional variations are acceptable for installation of grating or cover plates at the specified tolerances. Report any non-complying areas to the Engineer prior to proceeding with installation.

3.02 INSTALLATION

- A. Install all items furnished except items to be embedded in concrete which shall be installed under Division 3 and as indicated on the Drawings. Install items to be attached to concrete or masonry after such work is completed and in compliance with the Drawing details.
- B. Field cutting of finished surfaces is not allowed unless specifically approved by the Engineer. When cutting is approved, use mechanical cutting tools; do not use flame cutting tools. All cut surfaces shall be field banded unless otherwise directed by the Engineer.
- C. Secure grating with fastening devices as specified to prevent movement, except where removable grating is called for on the Drawings.
- D. Where aluminum contacts a dissimilar metal, field-apply a heavy brush coat of coal tar epoxy followed by two (2) coats of aluminum metal and masonry paint to the dissimilar metal.
- E. Where aluminum contacts masonry or concrete, field-apply a heavy brush coat of coal tar epoxy to the masonry or concrete. For embedded items, coat the embed.
- F. Where aluminum contacts wood, field-apply two (2) coats of aluminum metal and masonry paint to the wood.

3.03 FIELD QUALITY CONTROL

- A. Tolerances
 - 1. Maximum space between adjoining or abutting sections: 1/4-inch
 - 2. Maximum variation from top surface plane of adjoining or abutting sections or structure: 1/8-inch

END OF SECTION

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SECTION 06100

ROUGH CARPENTRY

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Framing with dimension lumber
 - 2. Wood furring, grounds, nailers, and blocking
 - 3. Sheathing

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 06200 – Finish Carpentry
- B. Division 07 – Thermal and Moisture Protection
- C. Division 08 – Doors & Windows

1.04 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Section 01300, Submittals.

1.05 REFERENCE STANDARDS

A. ASTM International (ASTM), latest edition:

1. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
2. ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod – 60,000 PSI Tensile Strength
3. ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts

B. American Wood Protection Association (AWPA), latest edition:

1. AWPA C2 Lumber, Timber, Bridge Ties and Mine Ties Preservative Treatment by Pressure Processes
2. AWPA C9 Plywood – Preservative Treatment by Pressure Process (Standard Withdrawn)

C. American Softwood Lumber Standard (ASLS), latest edition:

1. ASLS DOC PS 20

1.06 DELIVERY, STORAGE, AND HANDLING

A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.

1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

PART 2 PRODUCTS

2.01 LUMBER, GENERAL

A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

B. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

C. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

1. Provide dressed lumber, S4S, unless otherwise indicated

2. Provide dry lumber with 19 percent (19%) maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated

2.02 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. General: Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPAC2 (lumber) and AWPAC9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.
- B. Pressure treat above ground items with waterborne preservatives to a minimum retention of 0.25 lb/cu. ft. After treatment, kiln-dry lumber and plywood to a maximum moisture content of 19 and 15 percent (19% and 15%), respectively. Treat indicated items and the following:
 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing
 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete
 3. Wood floor plates installed over concrete slabs directly in contact with earth
- C. Complete fabrication of treated items before treatment, where possible. If cut after treatment, apply field treatment complying with AWPAC4 to cut surfaces. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.
- D. Fasteners used to secure, or in contact with preservative treated lumber shall meet the requirements of the treated lumber manufacturer.

2.03 DIMENSION LUMBER

- A. Lumber - For lumber not exceeding 4-inch thick or 4-inch wide, use Construction Grade lumber of any species, or board size lumber, as required. For framing 2-inch to 4-inch thick and no more than 6-inches wide provide No. 2 Southern Pine, 19 percent (19%) maximum moisture content. For framing 2-inch to 4-inch thick and 8-inch to 12-inch wide, provide No. 1 Dense Southern Pine, 19 percent (19%) maximum moisture content.

2.04 PLYWOOD

- A. Plywood - Where exposed on interior use APA Interior Type with Grade A exposed face and Grade D concealed. Where concealed by other work, APA Type C-D Plugged Interior Grexterior glue. For roof use APA Plugged Exterior Grade.

2.05 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A153 or of Type 304 stainless steel.
- B. Nails, Wire, Brads, and Staples: FS FF-N-105
- C. Power-Driven Fasteners: CABO NER-272
- D. Wood Screws: ASME B18.6.1
- E. Lag Bolts: ASME B18.2.1
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.
- C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
- D. Apply field treatment complying with AWWPA M4 to cut surfaces of preservative-treated lumber and plywood.
- E. Securely attach rough carpentry work to substrate by anchoring and fastening.
- F. Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; pre-drill as required.
- G. Use hot-dip galvanized or stainless steel nails where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity.

3.02 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

- A. Install wood grounds, nailers, blocking, and sleepers where shown and/or where required for screening or attaching other work. Form to shapes shown and cut as required for

true line and level of attached work. Coordinate locations with other work involved. Blocking shall include supports for walls, ceiling breaks, cabinets, counters, doors, shelves, platforms, windows, railings, partitions, wood trim and bases.

- B. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

3.03 WOOD FRAMING, GENERAL

- A. Framing Standard: Comply with AFPA's "Manual for Wood Frame Construction," unless otherwise indicated.
- B. Install framing members of size and at spacing indicated.
- C. Do not splice structural members between supports.

3.04 MISCELLANEOUS (NOT USED)

END OF SECTION

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SECTION 06200

FINISH CARPENTRY

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes wood trim, wood railings and other mill items, installation of hardware and hanging wood doors.

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 05500 – Miscellaneous Metals
- B. Section 06100 – Rough Carpentry
- C. Section 06400 – Interior Architectural Woodwork
- D. Section 08211 – Flush Wood Doors

1.04 STANDARDS

- A. Except as otherwise shown or specified comply with provisions of Architectural Woodwork Institute (AWI) "Quality Standards".

1.05 SUBMITTALS

- A. Submit shop drawings and manufacturer's product data. Shop drawings shall show location of each item, dimensioned plans and elevations, large scale details, attachment devices and other components.

- B. Submit fabricator's certification stating that the fabricated work meets the woodwork grades specified.

1.06 PROTECTION

- A. Protect woodwork during transit, delivery, storage and handling to prevent damage, soiling and deterioration.
- B. Do not deliver woodwork until painting, wet work and similar operations which could damage, soil or deteriorate woodwork have been completed in installation areas. If, due to unforeseen circumstances, woodwork must be stored in other than installation areas, store only in areas which meet the requirements specified for installation areas.
- C. Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within a 1.0 percent tolerance of the optimum moisture content, from the date of installation through the remainder of the construction period. The fabricator of the woodwork shall determine the optimum moisture content and required temperature and humidity conditions.

1.07 QUALITY STANDARDS

- A. For the following types of architectural woodwork comply with the indicated standards:
 - 1. Standing and running trim and rails - AWI Section 300
 - 2. Miscellaneous work - AWI Section 700

PART 2 PRODUCTS

2.01 MATERIALS

- A. Provide kiln-dried lumber with an average moisture content range of 6% to 11% interior work. Maintain temperature and relative humidity during fabrication, storage and finishing operations so that moisture content values for woodwork at time of installation do not exceed 5% to 10% for interior wood finish.
- B. Interior wood for painted finish:
 - 1. Solid wood - Poplar complying with requirements for specified woodwork grade
 - 2. Plywood - Softwood with exterior glue and Medium Density Overlay, PS 1
- C. Interior wood for transparent finish:
 - 1. Solid wood – Plain-sliced Red Oak from selected First Grade Lumber; Custom Grade
- D. Screws: Select material, type, size, and finish required for each use. Comply with FS FF-S-111 for applicable requirements. For attachment of wood trim to interior steel framing use USG Type S Trim Head Screws, or equal.

- E. Nails: Select material, type, size, and finish required for each use. Comply with FS FF-N-105 for applicable requirements.

2.02 WOODWORK DESIGN AND FABRICATION

- A. Comply with the details shown for profile and construction of architectural woodwork and, where not otherwise shown, comply with applicable Quality Standards, with alternate details at Fabricator's option.
- B. Machine and sand woodwork to comply with requirements of Standards for specified grade.
- C. Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain measurements and verify dimensions and shop drawing details as required for accurate fit. Where sequence of measuring substrates before fabrication would delay the project, proceed with fabrication (without field measurements) and provide ample borders and edges to allow for subsequent scribing and trimming of woodwork for accurate fit.

2.03 INTERIOR ARCHITECTURAL WOODWORK

- A. Fabricate interior woodwork to dimensions, profiles and details shown. Rout or groove reverse side (backed-out) of trim members to be applied to flat surface, except for members with ends exposed in finish work.
- B. Interior woodwork will have either a transparent finish or painted finish as noted on the Drawings for each condition.
- C. Standing and Running Trim, Rails, and Miscellaneous Items - Custom Grade.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas prior to installing.
- B. Install the work plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8" in 8'-0" for plumb and level; and with 1/16" maximum offset in flush adjoining surfaces, 1/8" maximum offsets in revealed adjoining surfaces.
- C. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.
- D. Anchor woodwork to anchors or blocking built-in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing for a complete installation. Use fine finishing nail for exposed nailings, countersunk and filled flush with woodwork, and matching finish where transparent finish is indicated.
- E. Install standing and running trim with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to the greatest extent possible.

Stagger joints in adjacent and related members. Cope at returns, miter at corners, and comply with Quality Standards for joinery.

- F. Repair damaged and defective woodwork wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace woodwork. Adjust joinery for uniform appearance.

END OF SECTION

SECTION 06400

INTERIOR ARCHITECTURAL WOODWORK

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 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 DESCRIPTION

- A. This section includes wood shelving, cabinets, counters, and other mill items.

1.04 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 06100 - Rough Carpentry
- B. Section 06200 - Finish Carpentry
- C. Section 08800 - Glazing
- D. Section 09900 - Painting
- E. Section 10800 - Toilet and Bath Accessories
- F. Division 15 - Plumbing Fixtures

1.05 STANDARDS AND WARRANTIES

- A. Except as otherwise shown or specified comply with provisions of Architectural Woodwork Institute (AWI) "Quality Standards".
- B. Provide a labor and material warranty for all casework to repair or replace defective materials or workmanship for 5 years from the date of Substantial Completion.

1.06 SUBMITTALS

- A. Submit shop drawings, samples and other data as indicated. Shop drawings shall show location of each item, dimensioned plans and elevations, large scale details, attachment devices and other components.
- B. Furnish samples of proposed plastic laminate for use in selecting colors.
- C. Submit fabricator's certification stating that the fabricated work meets the woodwork grades specified.

1.07 PROTECTION

- A. Protect cabinet work during transit, delivery, storage, and handling to prevent damage, soiling and deterioration.
- B. Do not deliver cabinetwork until painting, wet work, and similar operations which could damage, soil or deteriorate cabinetwork have been completed in installation areas. If, due to unforeseen circumstances, cabinetwork must be stored in other than installation areas, store only in areas which meet the requirements specified for installation areas.
- C. Maintain temperature and humidity in installation area as required to maintain moisture content of installed cabinetwork within a 1.0 percent tolerance of the optimum moisture content, from the date of installation through the remainder of the construction period. Fabricator of cabinetwork shall determine the optimum moisture content and required temperature and humidity conditions.

1.08 GENERAL

- A. Provide kiln-dried with an average moisture content range of 6% to 11%. Maintain temperature and relative humidity during fabrication, storage and finishing operations so that moisture content values for cabinetwork at time of installation do not exceed 5 - 10%.
- B. Comply with the details shown for profile and construction of cabinetwork and, where not otherwise shown, comply with applicable Quality Standards, with alternate details at Fabricator's option.
- C. Fabricate cabinetwork with pre-cut openings, wherever possible, to receive hardware, plumbing fixtures, electrical work and similar items. Insure proper fit of equipment to be inserted in cabinetwork. Locate openings accurately and use roughing-in diagrams for proper size and shape. Smooth edges of cutouts and, where located in countertops, seal edges of cutouts with a water-resistant coating.
- D. Before proceeding with fabrication of cabinetwork required to be fitted to other construction, obtain measurements and verify dimensions and shop drawing details as required for accurate fit. Where sequence of measuring substrates before fabrication would delay the project, proceed with fabrication (without field measurements) and provide ample borders and edges to allow for subsequent scribing and trimming of woodwork for accurate fit.

1.09 QUALITY STANDARDS

- A. For the following types of architectural woodwork comply with the indicated standards as applicable:
 - 1. Wood cabinetwork - AWI Sections 400A Premium Grade
 - 2. Countertops - AWI Section 400C

PART 2 PRODUCTS

2.01 CASEWORK

- A. Where noted on Drawings provide transparent finish or laminate-covered, flush overlay cabinetwork, AWI Premium Grade
- B. Plastic Laminate, Formica, Wilsonart, Nevamar, or equal:
 - 1. For horizontal surfaces - NEMA GP-50.
 - 2. For vertical surfaces - NEMA GP-50 or GP-28.
- C. Plastic laminate finish shall be suede. Colors and patterns will be selected by Architect from manufacturer's standard and premium products.
- D. Face construction shall be flush overlay type. Provide 3/4" thick doors, drawer fronts and fixed panels except where required to be thicker by the Standards; and provide flush units.
- E. Exposed veneer and solid wood parts shall be Plain-Sliced Red Oak.
- F. Interior wood for painted finish:
 - 1. Solid wood - Poplar complying with requirements for specified woodwork grade.
 - 2. Plywood - Softwood with exterior glue and Medium Density Overlay, PS 1.

2.02 PLASTIC LAMINATE COUNTERTOPS FOR CASEWORK

- A. Countertops shown to be laminate covered shall be AWI Premium Grade.
- B. Construct counters as shown or, if details are not shown, comply with standards. Where back and side splashes are shown they shall be 4" high, top mounted square butt joint, fully covered with matching plastic laminate, eased edges.
- C. Exposed counter edges shall have plastic laminate matching surface, unless otherwise indicated. Ease exposed edges of overlap sheet.
- D. Cut openings for equipment to be installed. Comply with equipment manufacturer's requirements, but provide internal corners of 1/8" minimum radius. Smooth saw cut and ease edges.

- E. Seal cut edges of counter at openings for sinks and other "wet" equipment, using waterproofing compound recommended by plastic laminate manufacturer and compatible with laminating adhesive.

2.03 CABINETWORK HARDWARE

- A. Provide operating cabinetwork hardware as follows:
 - 1. Each drawer: BLUM Metabox 320 Series $\frac{3}{4}$ extension drawer assembly.
 - 2. Each hinged cabinet door: 1 pair hinges, BLUM CLIP. Provide locks where shown on Drawings. Keying shall be compatible with drawer locks.
 - 3. Adjustable shelf hardware: K&V standards 255AL, (side mounted) with 4 - K&V supports 256 per shelf, or equal.
 - 4. Drawer Locks: K&V drawer lock number 987NP.
 - 5. Pulls: EPCO AS53-108-SS (@ Base and Upper cabinets)
EPCO AS53-268-SS (@ Tall cabinets)

2.04 MISCELLANEOUS

- A. Grommets for cable passage through countertops: 2" o.d. Black, molded plastic grommets with 1-1/2" hole and plastic cap with slot for wire passage.
- B. Concealed brackets for countertops: RAKKS inside wall mount counter support bracket, or equal. Size per countertop dimension, unfinished – to be field painted.
- C. Tackable Surface: Shall be Claridge products Claridge Cork 1/4" cork on 1/4" hardboard, or equal. Color of cork to be selected by Architect from manufacturer's standard color selections.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Deliver cabinetwork to building completely assembled where possible. Where units are too large to pass through openings deliver partially assembled, after parts have been shop assembled for fit. Provide scribe pieces of sufficient length and width to fit wall and ceiling conditions. Anchor each unit in place using suitable devices.
- B. Install the work plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8" in 8'-0" for plumb and level (including countertops); and with 1/16" maximum offset in flush adjoining surfaces, 1/8" maximum offsets in revealed adjoining surfaces.
- C. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.
- D. Anchor cabinetwork to anchors or blocking built-in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Use fine finishing nail for exposed nailings, countersunk and filled flush with woodwork, and matching final finish where transparent finish is indicated.

- E. Install cabinetwork without distortion so that doors and drawers will fit openings properly and be accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.
- F. Anchor countertops securely to base units and other support systems as indicated.
- G. Complete the assembly of storage shelving and install in the areas indicated, including hardware and accessories as shown.
- H. Repair damaged and defective woodwork wherever possible to eliminate defects, functionally and visually; where not possible to repair properly, replace woodwork. Adjust joinery for uniform appearance.

END OF SECTION

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SECTION 07110

FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Fluid-applied membrane air barrier, vapor permeable.
- B. Scope of Work: Install fluid-applied membrane air barrier on all exposed exterior walls and soffits. Tie into roofing systems and below-grade waterproofing systems to maintain a continuous air barrier assembly.
- C. Related Sections include the following:
 - 1. Section 04200 - Unit Masonry
 - 2. Section 07210 - Building Insulation
 - 3. Section 07920 - Joint Sealants

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 DEFINITIONS

- A. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air and water movement through the wall.

1.04 PERFORMANCE REQUIREMENTS

- A. Retain one of first two options in paragraph below depending on whether a vapor-retarding or -permeable air barrier is required. Consider retaining third option if air barrier will serve as a primary or secondary drainage plane.
- B. General: Air barrier shall be capable of performing as a continuous vapor- permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
 - 1. Connect and seal exterior wall air/vapor barrier membrane continuously to roofing membrane, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings using accessory materials according to manufacturer's tested assembly.
- C. Membrane Air Permeance: Not to exceed 0.004 cfm/ sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E2178.
- D. Membrane Vapor Permeance: Not less than 10 perms; ASTM E96.
- E. Air Barrier Assembly Air Leakage: Not to exceed 0.04 cfm x sq. ft. of surface area at 1.57 lbf/sq. ft.; ASTM E 2357.

1.05 SUBMITTALS

- A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.
- B. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 1. Include details of interfaces with other materials that form part of air barrier
 - 2. Include details of mockups
- C. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.
- D. Qualification Data: For Applicator.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers.

1.06 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Pre-installation Conference: Conduct conference at Project site.
 - 1. Include air barrier manufacturer's representative and installers of other construction connecting to air barrier, including roofing, waterproofing, masonry, sealants, windows, glazed curtain walls, and door frames.
 - 2. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.
- B. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- C. Store rolls according to manufacturer's written instructions.
- D. Protect stored materials from direct sunlight.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.09 COORDINATION

- A. Coordinate installation of fluid-applied membrane air barrier with related Work specified in other Sections to ensure that wall assemblies, including sheathing and flashings, are protected against damage from the effects of weather, age, corrosion, moisture, and other causes. Do not allow water to penetrate behind fluid-applied membrane air barrier.

PART 2 PRODUCTS

2.01 FLUID-APPLIED MEMBRANE AIR BARRIER

- A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier:
 - 1. Basis-of-Design Product: The design is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable

product by one of the other specified manufacturers. Comparable products are subject to review and approval through the submittal process specified.

a. W. R. Grace & Co., Perm-A-Barrier VPL.

2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Carlisle

b. PROSOCO

2.02 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier membrane. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid primer recommended for substrate by manufacturer of air barrier material.
- C. Counter flashing Strip: Manufacturer's standard self-adhering sheet consisting of rubberized asphalt laminated to a cross laminated polyethylene film with release liner backing.
- D. Joint Reinforcing Strip: Air barrier manufacturer's glass-fiber-mesh tape.
- E. Corner Reinforcing: Air barrier manufacturer's glass-fiber-mesh preformed fabric.
- F. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- G. Adhesive and Tape: Air barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.
- H. Modified Bituminous Transition Strip: Manufacturer's standard -vapor-retarding,, smooth-surfaced, self-adhering rubberized asphalt laminated to a polyethylene film with release liner backing.
- I. Sprayed Polyurethane Foam Sealant: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft density; flame spread index of 25 or less according to ASTM E162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
 - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.

2. Verify that concrete has cured and aged for minimum time period recommended by air barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.
4. Verify that masonry joints are flush and completely filled with mortar.
5. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate patching membrane.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another as recommended by the manufacturer to provide continuous support for air barrier.
- H. Prime substrates as recommended by air barrier manufacturer.

3.03 JOINT TREATMENT

- A. Concrete and Masonry: Fill small voids and cracks up to 1/8" with substrate patching membrane. Prepare, treat, rout, and fill joints and cracks in substrate greater than 1/4" in according to ASTM C1193 and air barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D4258 before coating surfaces.
 1. Prime substrate and apply a single thickness of substrate patching membrane extending a minimum of 3" along each side of joints and cracks. Apply a double thickness of air barrier membrane and embed a joint reinforcing strip in preparation coat.
- B. Gypsum Sheathing: Fill joints greater than 1/4" with sealant according to ASTM C1193 and with air barrier manufacturer's written instructions. Apply first layer of fluid air barrier

membrane at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air barrier membrane over joint reinforcing strip.

3.04 TRANSITION STRIP INSTALLATION

- A. Install strips, transition strips, and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
 - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 - 2. Install modified bituminous strip on roofing membrane or base flashing so that a minimum of 3" of coverage is achieved over both substrates.
- B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Re-prime areas exposed for more than 24 hours.
 - 1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- C. Connect and seal exterior wall air barrier membrane continuously to roofing membrane air barrier, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- E. Apply joint sealants forming part of air barrier system within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- F. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors and apply corner reinforcing according to air barrier manufacturer's written instructions.
 - 1. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.
- G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with foam sealant.
- H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- I. Seal top of through-wall flashings to air barrier with an additional 6" wide, counter flashing strip.

- J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counter flashings or ending in reglets with termination mastic.
- K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6" beyond repaired areas in strip direction.

3.05 AIR BARRIER MEMBRANE INSTALLATION

- A. Apply air barrier membrane to form a seal with strips and transition strips and to achieve a continuous air barrier according to air barrier manufacturer's written instructions.
- B. Apply air barrier membrane within manufacturer's recommended application temperature ranges.
- C. Retain one or both paragraphs and subparagraphs below if priming of substrates is required; verify requirements with manufacturer.
- D. Apply primer, as required, to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.
 - 1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- E. Apply a continuous unbroken air barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions such as masonry ties.
 - 1. Vapor-Permeable Membrane Air Barrier: 44-mil wet/25-mil minimum dry film thickness.
- F. Apply counter flashing and transition strips according to air barrier manufacturer's written instructions.
- G. Do not cover air barrier until it has been inspected by air barrier manufacturer's representative.
- H. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:
 - 1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.

2. Continuous structural support of air barrier system has been provided.
 3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.
 4. Site conditions for application temperature and dryness of substrates have been maintained.
 5. Maximum exposure time of materials to UV deterioration has not been exceeded.
 6. Surfaces have been primed, if applicable.
 7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fish mouths.
 8. Termination mastic has been applied on cut edges.
 9. Strips and transition strips have been firmly adhered to substrate.
 10. Compatible materials have been used.
 11. Transitions at changes in direction and structural support at gaps have been provided.
 12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
 13. All penetrations have been sealed.
- C. Tests: Testing to be performed will be determined by Owner's testing agency from among the following tests:
1. Quantitative Air Leakage Testing: Testing not to exceed the test pressure differential, positive and negative, indicated in "Performance Requirements" Article for air barrier assembly air leakage according to ASTM E2357.
- D. Remove and replace deficient air barrier components and retest as specified above.

3.07 CLEANING AND PROTECTION

- A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed for more than 30 days.
 2. Protect air barrier from contact with creosote, uncured coal-tar products and sealants not approved by air barrier manufacturer.

- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION

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SECTION 07111

SHEET MEMBRANE WATERPROOFING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

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 SUMMARY

- A. This Section includes sheet membrane waterproofing systems.
- B. Types of sheet waterproofing specified in this Section include rubberized asphalt sheet waterproofing.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM) International latest edition:
 - 1. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension
 - 2. ASTM D570 Standard Test Method for Water Absorption of Plastics
 - 3. ASTM D746 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

1.05 SYSTEM PERFORMANCE

- A. General: Provide sheet waterproofing products that have been produced and installed to establish and maintain continuous watertight seals.

1.06 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Section 01300, Submittals.
- B. Product data and general recommendations from waterproofing materials manufacturer for types of waterproofing required.
- C. Certification by waterproofing materials manufacturer that products supplied comply with local VOC regulations.
- D. Shop drawings showing locations and extent of waterproofing.
- E. Samples 3-inch x 6-inch minimum size of each waterproofing material required for project.

1.07 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Obtain primary waterproofing materials of each type required from a single manufacturer to the greatest extent possible. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. Installer Qualifications: Engage an installer who has completed waterproofing similar to that indicated for this project and who is acceptable to waterproofing manufacturer.

1.08 PROJECT CONDITIONS

- A. Substrate: Proceed with work after substrate construction, openings, and penetrating work have been completed and areas are free of standing or running water, ice, and frost. Verify that concrete is dry, smooth, and free from sharp or ragged out-angles, honeycombing, rock pockets, depressions, and projections.
- B. Weather: Proceed with waterproofing and associated work only when existing and forecasted weather conditions will permit work to be performed in accordance with manufacturers' recommendations and warranty requirements.

1.09 WARRANTY

- A. Warranty: Submit a written warranty executed by the manufacturer, agreeing to repair or replace sheet membrane waterproofing that fails in materials or workmanship five (5) years from date of Substantial Completion. The warranty shall cover the full cost of labor and materials necessary to repair the defective installation.
- B. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 RUBBERIZED ASPHALT SHEET WATERPROOFING

- A. Miradri 860/861, as manufactured by Carlisle Coatings & Waterproofing, or equal, rubberized asphalt self-adhering membrane integrally bonded to polyethylene sheeting, formed into uniform flexible sheets of not less than 60 mils thick, complying with the following:
 - 1. Tensile Strength: 250 psi minimum; ASTM D412
 - 2. Ultimate Elongation: 300% minimum; ASTM D412
 - 3. Brittleness Temperature: Minus 25°F; ASTM D746
 - 4. Hydrostatic Head Resistance: 150 feet minimum
 - 5. Water Absorption: Not more than 0.5% weight gain after 48 hours immersion at 70F; ASTM D570

2.02 AUXILIARY MATERIALS

- A. Adhesives and Joint Tape: Provide types of adhesive compound and tapes recommended by waterproofing sheet manufacturer for bonding to substrate (if required), for waterproofing seams in membrane, and for waterproofing joints between membrane and flashings, adjoining surfaces, and projections through membrane.
- B. Primers: Provide type of concrete primer recommended by manufacturer of sheet waterproofing material for applications required.
- C. Flashing Materials: Except as otherwise indicated, provide types of flexible sheet material for flashing as recommended by waterproofing sheet manufacturer.
- D. Protection Board: Provide type of protection board recommended by waterproofing sheet manufacturer. Include adhesives recommended by manufacturer.
- E. Use termination bar or details appropriate for given situation. Use manufacturer's recommended termination detail.

2.03 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel for Wall Applications: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to 1 side and a polymeric film bonded to the other side of a 3-dimensional, nonbiodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of 9 to 15 gpm per ft..

2.04 INSULATION

- A. Extruded-Polystyrene Board Insulation: Rigid, cellular polystyrene thermal insulation formed by the expansion of polystyrene base resin in an extrusion process using hydrochlorofluorocarbons as the blowing agents to comply with ASTM C 578 for type and other requirements indicated below:
 - 1. For Vertical Applications: Type VI, 1.8-lb/cu. ft. minimum density and 40-lb/sq. in. minimum compressive strength.

PART 3 EXECUTION

3.01 PREPARATION

- A. General: Comply with manufacturer's instructions for preparing surface.
- B. On vertical foundation walls chip off projections where necessary to properly place and adhere waterproofing sheet.
- C. Apply primer to substrate surfaces at rate recommended by manufacturer of primary waterproofing materials. Prime only area that will be covered by waterproofing membrane in same working day. Reprime areas not covered by waterproofing membrane within 24 hours.

3.02 INSTALLATION

- A. Comply with manufacturer's instructions for handling and installing sheet waterproofing materials.
- B. Coordinate installing waterproofing materials with associated work to provide complete system complying with combined recommendations by manufacturers and installers involved in Work. Schedule installation to minimize exposure of sheet waterproofing materials.
- C. Seal projections through membrane and seal seams. Bond to vertical surfaces and also, where shown or recommended by manufacturer, bond to horizontal surfaces.
- D. Top Edge Seal: For vertical membrane finish under flashing. Caulk exposed edges with mastic or sealant.
- E. Protection Board: Install protection board over completed membrane, complying with manufacturer's recommendations for both waterproofing sheet and protection course materials.

3.03 FIELD QUALITY CONTROL

- A. In-Place Testing: Before completed membranes on horizontal surfaces are covered by protection course or other work, test for leaks with a 1-inch depth of water maintained over the high point for 24 hours. Repair any leaks observed; repeat test and repairs until no leaks remain.

3.04 CLEANING

- A. General: After completion, remove any masking materials and stains from exposed surfaces caused by waterproofing installation.

3.05 PROTECTION

- A. General: Protect completed membrane during installation of other materials or processes over membrane and throughout remainder of construction period. Do not allow traffic of any type on unprotected membrane.

END OF SECTION

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SECTION 07210

BUILDING INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 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 SUMMARY

- A. This Section includes the following:
 - 1. Foundation wall insulation (supporting backfill)
 - 2. Concealed building insulation
 - 3. Sound insulation
 - 4. Cavity wall insulation is located in Section 04200
 - 5. Exterior Continuous Insulation (outboard of the sheathing)
 - 6. Spray-Foam Insulation
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 04200 - Unit Masonry (for cavity wall insulation)
 - 2. Section 09255 - Gypsum Board Assemblies

1.04 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

- B. Product Data for each type of insulation product specified.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

1.06 CODES AND STANDARDS

- A. Foam Plastic Insulation shall meet AFPC requirements as follows: AFPC V2 717.1.2, 717.2, 717.4.1.3, 717.4.1.4, 717.4.1.5.
- B. Insulating materials concealed as installed shall have a flame spread rating of not more than 75 and a smoke developed rating of not more than 450. [AFPC V2 719.2.1] Insulating materials exposed as installed shall have a flame spread rating of not more than 25 and a smoke developed rating of not more than 450 [AFPC V2 719.3].

PART 2 PRODUCTS

2.01 INSULATING MATERIALS

- A. General: Provide insulating materials that comply with requirements and with referenced standards.
 - 1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.
- B. Extruded-Polystyrene Board Insulation: Rigid, cellular polystyrene thermal insulation formed from polystyrene base resin by an extrusion process using hydrochlorofluorocarbons as blowing agent to comply with ASTM C 578 for type and with other requirements indicated below:
 - 1. Perimeter Insulation: Install in thickness referenced where shown on Drawings, including but not limited to, the outside face of all perimeter walls below grade.
- C. Kraft Faced Mineral-Fiber Blanket Insulation: Thermal insulation combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665, Type II, Class C with vapor-retarder membrane on 1 face.
 - 1. Mineral-Fiber Type: Fibers manufactured from glass.
 - 2. 3-1/2" thick with thermal resistance of R-13.
 - 3. 6-1/4" thick with thermal resistance of R-19.
 - 4. 8-1/2" thick with thermal resistance of R-25.
 - 5. 10-1/4" thick with thermal resistance of R-30.
 - 6. 13" thick with thermal resistance of R-38.
- D. Sound Attenuation Batts: Unfaced glass fiber acoustical insulation complying with ASTM C665, Type I, 3-1/2" thick or 6-1/4" x 16" wide x 96" long. Install sound batts in all interior metal stud walls separating occupied spaces from other occupied spaces including

corridors and bathrooms. Batts to run full height of gypsum board applied to studs. All mechanical room walls shall have sound attention batts.

- E. Exterior Continuous Insulation: Owens-Corning FOAMULAR 250 - Rigid, cellular, polystyrene, thermal insulation with closed cells and integral high-density skin, formed by the expansion of polystyrene base resin in an extrusion process to comply with ASTM C 578, Type IV; in manufacturer's standard lengths and widths; and in thicknesses indicated.
- F. Spray-Foam Insulation: Johns Manville Corbond, closed and open-cell spray foam insulation reference Drawings for thicknesses indicated.

2.02 AUXILIARY INSULATING MATERIALS

- A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or that interfere with insulation attachment.

3.03 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, unsoiled, and has not been exposed at any time to ice and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

3.04 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

- B. Seal joints between closed-cell (non-breathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
- D. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:
 - 1. Use blanket widths and lengths that fill cavities formed by framing members. Where more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
 - 2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3.05 PROTECTION

- A. General: Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07213

PRE-ENGINEERED BUILDING INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

1.02 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 SUMMARY

- A. This Section includes the following:
 - 1. Simple Saver System for new Pre-Engineered Metal Buildings – Roof and Walls
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 07210 – Building Insulation
- C. Work Included: Interior liner system fabric of the color specified, support strapping of the appropriate color, fasteners of the appropriate type and color, sealants, thermal break materials and formaldehyde free thermal insulation of the appropriate type to insulate the roof and wall areas to the full designed R-value of the building as specified. The installed liner system shall also provide the following OSHA required compliances to save and protect contractors, workers, inspectors, owners and other individuals (29 CFR-1926.751 "Controlling Contractors") from injury, penalty and liability, without added cost:
 - 1. "Through fall protection" (29 CFR-1926.501, 1926.760)
 - 2. "Protection from falling objects" (29 CFR-1926.759)
 - 3. "Protection from falls through roof openings" (29 CFR-1926.759)

4. "Product-related project safety training" (29 CFR-1926.761)
5. "Product-related project specific safety plan" (29 CFR-1926.752)

1.04 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of insulation product specified.
- C. Include manufacturer's product brochures; component specifications, samples of the painted support strapping, and samples of the Syseal® reinforced polyethylene vapor retarder fabric, including a sample of the triple extrusion welded seam; specific detailed drawings from Thermal Design for the project showing purlin spacings, support strap locations and spacings, fastening points, liner system fabric sizes and locations; insulation widths and thicknesses, sizes and locations and detailed installation instructions for quality assurance and OSHA compliance.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

1.06 QUALITY ASSURANCE

- A. Provide the materials in original manufacturer's packages together with detailed instructions and project drawings of the installation. Materials shall be inspected for damage, proper sizes and quantities upon delivery and stored in a dry, secure manner. Post the detailed training instructions, project specific safety drawings and plans for OSHA compliance using the product. Installation shall proceed with care to assure proper sealing of the liner system fabric. Insulation shall be placed on (roof) or behind (walls) the liner system fabric in the full-specified thickness without voids and with minimal compression of top layer (if applicable in roofs). Substitutions of systems that do not have a continuous vapor retarder on the inside plane of the purlins or girts will not be allowed. Substitutions of systems that do not have OSHA compliant through fall protection will not be allowed. Purlins, girts and insulation must be completely isolated from the inside conditioned air with an effective vapor retarder. Taping or stapling of vapor retarder lap joints is not acceptable. Sealing field joints with a permanent vapor retarder lap sealant is required. Field seams, if any, shall be made on a structural member and mechanically attached with a steel strap and fasteners along its full length.
- B. All exposed parts of the liner system shall be Class A material and have flame spread of 25 or less based on ASTM E84 standards. Vapor retarder fabric shall be white or colored woven coated fabric and triple extrusion-welded seams fabricated in one piece, to fit not less than the full bay length by the width of the building. Buildings more than 100' wide may have field seams on the bottom of a purlin but no less than 50' apart. Any field seams must be sealed with vapor retarder lap sealant. Wall bay minimum fabric size shall be not less than one entire wall bay or end wall column space from the ceiling to the floor. Perimeter edges of the vapor retarder fabric shall be trimmed and sealed to the

adjoining steel or fabric with vapor retarder lap sealant. All edges of liner system fabric, including field seams, shall be mechanically fastened with steel retaining straps the full perimeter. In the event that the crew is not experienced in the installation procedures, videotaped or on-site installation training shall be required by the installing contractor from Thermal Design to assure proper installation procedures.

PART 2 PRODUCTS

2.01 INSULATING MATERIALS

- A. Roof Liner System: Acceptable systems shall be the Simple Saver insulation system (with free OSHA compliant through fall protection) manufactured by Thermal Design with an installed total roof insulation R-value of 35 and an average installed thickness of 12 inches. Roof system shall be a multi-layer system – 2" above the purlins and 10" in between the purlins.
- B. Wall Liner System: Acceptable systems shall be the Simple Saver insulation system manufactured by Thermal Design with an installed total insulation R-value of 25 and an average installed thickness of 8 inches. Simple Saver System includes a ten-year limited material warranty and shall meet the following minimum specifications:
 - a. UVMAX® Steel Strap: 100 KSI minimum yield high tensile strength steel, galvanized, primed and then painted the specified color on the exposed side with a clear coat primer on the unexposed side. Minimum size shall be 0.02" x 1" x continuous length. The strap color shall be UVMAX 8 White.
 - b. Fasteners: #12 x 3/4", plated self-drilling screws with sealing washers painted to match the specified color for fastening to light gauge steel (up to 12 GA purlins) or #12 x 1-1/4" plated self-drilling screws with sealing washers, painted to match the specified color for heavier gauge steel (up to 3/8" purlins / barjoist). Special fasteners for wood, concrete and other structure types are available from Thermal Design and should be used when appropriate. Always install two (2) fasteners in the end of each strap for safety and to withstand fasteners in the end of each strap for safety and to withstand installation stress, and one (1) fastener at all other designated fastening points.
- C. Syseal® Fabric: Shall be woven reinforced high-density polyethylene yarns coated on both sides with a continuous white or colored polyethylene film. The fabric grade for the roof shall be Syseal FP (White). The fabric grade for the walls shall be Syseal FP (White). The fabric shall comply with UL/ULC 723 or ASTM E84 and be Class A compliant with a low flame spread index of 25 or less based on ASTM E84 test standards. This material shall be manufactured in large custom pieces by extrusion welding from roll goods. Pieces shall be fabricated to substantially fit the large defined building areas with minimum practical sealing to be done on job site. Fabric shall be folded to allow for rapid pull-out on the strap support system. The fabric shall be certified for free fall protection by the manufacturer. Custom colors available by special order. Call 800.255.0776 for details. Syseal liner system fabric perm rating shall be < 0.02 grains per hour per square foot based on ASTM E96.

- D. Sealants: Shall be Simple Saver System G524 High Tack Sealant™ for sealing vapor retarder laps and/or Syseal Sticky Tape (double-sided bonding tape) 3/4" wide by 1/32" thick extruded vapor retarder sealant from Thermal Design.
- E. Insulation: Shall be formaldehyde free fiberglass blanket or batt insulation meeting STM C991 Type 1, ASTM E136 and ASTM C991 Type 1, ASTM E136 and ASTM E84.
- F. Fast-R™ Insulation Hangers: Shall be Fast-R™ preformed, rigid insulation hangers for supporting insulation between wall girts or roof hangers for supporting insulation between wall girts or roof purlins in roof pitches over 4:12. Coiled hangers are not allowed.
- G. Thermal Break: Thermal break shall be 3/16" thick by 3" wide white Quik-Stop™, closed cell polyethylene foam with pre-applied adhesive film and peel-off backing. The selection shall be provided as thermal break where there is no existing thermal break and/or if additional depth space is desired.

PART 3 EXECUTION

3.01 SIMPLE SAVER ROOF SYSTEM

- A. Cut to length and install painted steel straps in the pattern and spacings as shown on the project shop drawings. The straps are installed in tension and span immediately below the bottom plane of the purlins. Position the pre-folded vapor retarder liner system fabric on the strap platform along one eave purlin. Clamp the two bottom corners squarely at the eave and centered on the bay. Pull the other end of the pleat-folded fabric across the building width on the strap platform but below the purlins, pausing only at the ridge to fasten the straps and fabric into position where the plane of the roof changes. Once positioned, the remaining fasteners are installed from the bottom side at each purlin/strap intersection and the edges are sealed and trimmed along the rafters. A similar method can be used starting at the ridge purlin space and pulling the fabric to each eave. Insulation is unpacked and placed on the vapor-retarder liner system. Shake insulation to the specified thickness and install parallel, between purlins. In multi-layer systems, the uppermost layer of insulation is placed over and perpendicular to the purlins as the roof sheeting is applied. It is important that the insulation cavity be filled, or the cavities be ventilated to minimize the probability of condensation (ventilated and/or dehumidified roof systems are possible with the Simple Saver System). Call Thermal Design 800.255.0776 for details.
- B. Simple Saver Wall System: Sheet the building with just the thermal break (if specified) applied to the exterior of the girts. Insulation is cut to the required lengths to fit vertically between the girts and installed in the girt spaces and impaled on Fast-R insulation hangers. Fluff the insulation to the specified thickness, making sure there are no gaps or voids. Insulate the complete wall section. Apply the wall vapor retarder fabric by clamping it into position over the eave strap. Once in position, the fasteners are installed through the wall straps, eave strap and into each roof strap, permanently clamping the wall fabric between them. Seal the wall fabric and to the roof fabric and to the base angle, or base cee channel as well as the column flanges. Additional straps are installed along the base angle and each column to retain the system permanently in place. Detailed installation instructions are to be sent along with the project drawings specific for the project and included with the materials in each shipment. Pertinent information is included on the drawings for each project. Review all information and instructions prior

to commencement. If any questions arise, contact the manufacturer prior to installation. On-site installation training is available for actual expense. The manufacturer's toll-free hotline is 800.255.0776.

3.02 PROTECTION

- A. General: Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

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SECTION 07410

ARCHITECTURAL METAL WALL PANELS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Furnish and install all metal siding and accessories including:

1. Flashing
2. Trim

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 SPECIFIED ELSEWHERE

- A. Section 05500 – Miscellaneous Metals
- B. Section 07600 – Flashing and Sheet Metal

1.04 QUALITY ASSURANCE

- A. General: The intent of these specifications and drawings is to establish a quality and performance level for material, durability and workmanship.
- B. Erection shall be by an erector who has erected and is completely familiar with building components of the specific manufacturer.

1.05 SUBMITTALS AND SHOP DRAWINGS

- A. Prior to fabrication submit shop drawings to the Architect for review. Drawings shall be prepared by the manufacturer.

1.06 GUARANTEES

- A. Building supplier shall provide material warranties and a 1-year guarantee of workmanship for this division of the work. These must be in written form and delivered to the Architect prior to the final payment.
- B. Manufacturer shall furnish 20-year color fade warranty and a 10-year weather tightness warranty.

PART 2 PRODUCTS

2.01 PANELS

A. Metal Soffit Panels:

- 1. Metal Soffit Panel: PAC-CLAD, Flush Panels by Petersen Aluminum Corp. 12" wide panel, 24 ga. G90 galvanized steel, or equal. Where vented soffit is required, provide 0032" aluminum panels. Color to be selected from PAC-CLAD standard finishes.

B. Metal Wall Panels:

- 1. Metal panels at back (roof side) of parapet walls to be MBCI "R" Panel, 36" wide x 1-1/4" deep with bead at 12" o.c., 24 ga. as shown on Drawings, stucco embossed galvanized steel conforming to ASTM A 446, Grade A hot dipped, commercial quality, galvanized coating, designation G-90, or equal.

C. Architectural Metal Wall Panels:

- 1. Architectural Metal Wall Panel: PAC-CLAD, Flush Panels by Petersen Aluminum Corp. 12" wide panel, 24 ga. G90 galvanized steel, or equal. Color to be selected from PAC-CLAD standard finishes.

D. Flashing and trim: Exposed flashings and trim shall be same gauge as wall panel and shall be of the same finish as the panels. Trim colors shall be as selected from the manufacturer's standard colors.

E. Fasteners: Fasteners shall be self-drilling structural fasteners for panel to secondary connections. Panel to panel connections shall be self-tapping screws. Wall fasteners shall have colored heads to match the colors of the material fastened.

F. Sealants, Mastics and Closures:

- 1. Tube sealant shall be synthetic elastomer-based material which become tack-free in less than 2 hours at 75°F, but remains flexible. Service range shall be -30°F to 160°F.
- 2. Tape mastic shall be preformed butyl rubber-based compound. Service shall be -30°F to 160°F.

3. Panel closures shall be Ethylene-Propylene-Diene-Monomer or equivalent closed cell strips formed to match panel configuration.
4. Sealants, mastics and closures shall be applied in strict accordance with manufacturer's drawings.

2.02 SECONDARY METAL SUBGIRT FRAMING

- A. Miscellaneous Framing Components, General: Cold-formed metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z180).
 1. Hat Channels: 0.06 inch/16 ga. (1.52 mm) minimum – nominal thickness.
 2. Sill Channels: 0.06 inch/16 ga. (1.52 mm) minimum – nominal thickness.
 3. (Zee) Z-girts: 1"x18 ga., or as noted on Drawings – ThermaFast Rigid Insulation Framing System by The Steel Network.

PART 3 EXECUTION

3.01 INSTALLATION OF WALL PANELS

- A. Panels shall be factory caulked or caulked on job with a non-hardening, non-toxic, non-corrosive and non-shrinking compound as recommended by panel manufacturer for a long-lasting waterproof seal. In lieu of factory caulking a vinyl gasket may be used if the panel side joint is also field caulked to ensure tested weather tightness.
- B. Install neoprene closures at top and bottom of each panel in all vertical exterior locations.
- C. Attach panels to supporting structural steel framing as recommended by manufacturer. Assembled panels shall have no screws or fasteners visible except as noted in this specification.
- D. Erection of panels in each run shall be started correctly and all panels held true to line. Horizontal lines are to be level and vertical lines plumb.
- E. Provide all miscellaneous accessories required to complete the installation including but not limited to flashings, drips, closures, trims, edging, bracing, corners, sheet metal girts, reinforcing, head and sill angles.
- F. Care shall be exercised during panel system installation to prevent steel shavings build-up on panel system components and other finish construction materials. All metal filings must be carefully and completely removed from raceways. Any rust staining resulting from negligence shall be corrected prior to acceptance.
- G. Strip off all plastic-coated surfaces after danger of damage to finishes is past. Do not allow plastic strippable film to be directly exposed to the sun. Any residual adhesive or foreign substance remaining after protective film is removed shall be cleaned off of panel surfaces with appropriate cleaning agent prior to acceptance. All material surfaces shall be left free of any dirt or dust collecting residues.

- H. Wall panel manufacturer shall indicate in writing their recommendations for repairs of potential scratches and abrasions to factory applied coatings and type of field touch up paint that is entirely compatible with the factory applied finish. Touch up paint shall be equal in all respects to performance capabilities to the factory applied protective coatings.

END OF SECTION

SECTION 07429

SOFFIT AND LINER PANELS (INTERIOR)

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes Flush-profile, concealed fastener, lap-seam metal soffit and liner panels, with related metal trim and 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 RELATED SECTIONS

- A. Section 05120 - Structural Steel for steel framing supporting metal panels.
- B. Section 05400 - Cold-Formed Metal Framing for cold-formed metal framing supporting metal panels.
- C. Section 07210 - Building Insulation for thermal insulation installed under metal panels.

1.04 REFERENCES

- A. American Architectural Manufacturer's Association (AAMA): www.aamanet.org:
 - 1. AAMA 621 - Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) & Zinc-Aluminum Coated Steel Substrates.
 - 2. AAMA 809.2 Voluntary Specification Non-Drying Sealants.

B. ASTM International (ASTM): www.astm.org:

1. ASTM A755 Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
2. ASTM A792/A792M Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
3. ASTM C920 Specification for Elastomeric Joint Sealants.
4. ASTM D2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
5. ASTM D4214 Test Methods for Evaluating Degree of Chalking of Exterior Paint Films.
6. ASTM E1592 Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.

1.05 QUALITY ASSURANCE

- A. Manufacturer/Source: Provide metal panel assemblies and accessories from a single manufacturer accredited under IAS AC472, Part B.
- B. Installer Qualifications: Experienced Installer [certified by metal panel manufacturer] with minimum of five years' experience with successfully completed projects of a similar nature and scope.
 1. Installer's Field Supervisor: Experienced mechanic [certified by metal panel manufacturer] supervising work on site whenever work is underway.
- C. Steel Construction Publications: Comply with published recommendations in the following, unless more stringent requirements are indicated.
 1. American Institute of Steel Construction (AISC): "Steel Construction Manual."
 2. American Iron and Steel Institute (AISI): "Cold Formed Steel Design Manual."

1.06 SUBMITTALS

- A. Product Data: Manufacturer's data sheets for specified products. Include data indicating compliance with performance requirements.

- B. Shop Drawings: Show layouts of metal panels. Include details of each condition of installation, panel profiles, and attachment to building. Provide details at a minimum scale 1-1/2-inch per foot of edge conditions, joints, fastener and sealant placement, flashings, openings, penetrations, and special details. Make distinctions between factory and field assembled work.
 - 1. Indicate points of supporting structure that must coordinate with metal panel system installation.
 - 2. Include structural data indicating compliance with performance requirements and requirements of local authorities having jurisdiction.
- C. Samples for Initial Selection: For each exposed product specified including sealants. Provide representative color charts of manufacturer's full range of colors.
- D. Samples for Verification: Provide 12-inch- long section of each metal panel profile. Provide color chip verifying color selection.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect products of metal panel system during shipping, handling, and storage to prevent staining, denting, deterioration of components or other damage. Protect panels and trim bundles during shipping.
 - 1. Deliver, unload, store, and erect metal panels and accessory items without misshaping panels or exposing panels to surface damage from weather or construction operations.
 - 2. Store in accordance with Manufacturer's written instruction. Provide wood collars for stacking and handling in the field.
 - 3. Shield foam insulated metal panels from direct sunlight until installation.

1.08 WARRANTY

- A. Special Manufacturer's Warranty: On manufacturer's standard form, in which manufacturer agrees to repair or replace metal panel assemblies that fail in materials and workmanship within [one] year from date of Substantial Completion.
- B. Special Panel Finish Warranty: On Manufacturer's standard form, in which Manufacturer agrees to repair or replace metal panels that evidence deterioration of factory-applied finish within the warranty period, as follows:
 - 1. Fluoropolymer Two-Coat System:
 - a. Basis of Design System: MBCI, Signature 300.
 - b. Color fading in excess of 5 Hunter units per ASTM D2244.
 - c. Chalking in excess of No. 8 rating per ASTM D4214.
 - d. Failure of adhesion, peeling, checking, or cracking.
 - e. Warranty Period: [40] years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design Manufacturer: MBCI Metal Roof and Wall Systems, Division of NCI Group, Inc.; Houston TX. Tel: (877)713-6224; Email: info@ecoficientseries.com; Web: www.mbc.com.

2.02 PERFORMANCE REQUIREMENTS

- A. General: Provide metal panel system meeting performance requirements as determined by application of specified tests by a qualified testing facility on manufacturer's standard assemblies.
- B. Structural Performance: Provide metal panel assemblies capable of withstanding the effects of indicated loads and stresses within limits and under conditions indicated, as determined by ASTM E1592:
 - 1. Wind Loads: Determine loads based on uniform pressure, importance factor, exposure category, and basic wind speed indicated on drawings.
 - a. Wind Negative Pressure: Certify capacity of metal panels by actual testing of proposed assembly.
 - 2. Deflection Limits: Withstand inward and outward wind-load design pressures in accordance with applicable building code with maximum deflection of 1/120 of the span with no evidence of failure.
 - 3. Seismic Performance: Comply with ASCE 7 Sections 9, "Earthquake Loads."
- C. Thermal Movements: Allow for thermal movements from variations in both ambient and internal temperatures. Accommodate movement of support structure caused by thermal expansion and contraction. Allow for deflection and design for thermal stresses caused by temperature differences from one side of the panel to the other.

2.03 FORMED METAL SOFFIT AND LINER PANELS

- A. Flush Profile, Concealed Fastener Metal Wall Panels: Metal panels consisting of formed metal sheet with vertical panel edges with nested lapped edges, and attached to supports using concealed fasteners.
 - 1. Basis of Design: MBCI, Artisan Series Panel.
 - 2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, structural quality, Grade 50, Coating Class AZ50 prepainted by the coil-coating process per ASTM A755/A755M.

a. Nominal Thickness: 24 gage coated thickness, with smooth embossed surface.

- 1) Exterior Finish: As selected by Architect from manufacturer's Fluoropolymer two-coat system, or Modified silicone-polyester two coat system
- 2) Color: As selected by Architect from manufacturer's standard colors
- 3) Panel Width: 12 inches
- 4) Panel Thickness: 1 inch

2.04 MISCELLANEOUS MATERIALS

- A. General: Provide complete metal panel assemblies incorporating trim, fasciae, and miscellaneous flashings. Provide required fasteners, closure strips, and sealants as indicated in manufacturer's written instructions.
- B. Flashing and Trim: Match material, thickness, and finish of metal panels.
- C. Fasteners: Self-tapping screws and other acceptable fasteners recommended by metal panel manufacturer. Where exposed fasteners cannot be avoided, supply corrosion-resistant fasteners with heads matching color of metal panels by means of factory-applied coating, with weathertight resilient washers.

2.05 FABRICATION

- A. General: Provide factory fabricated and finished metal panels, trim, and accessories meeting performance requirements, indicated profiles, and structural requirements.
- B. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's written instructions, approved shop drawings, and project drawings.

2.06 FINISHES

- A. Finishes, General: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- B. Modified Silicone-Polyester Two-Coat System: 0.20 – 0.25 mil primer with 0.7 – 0.8 mil color coat [meeting solar reflectance index requirements].
 1. Basis of Design: MBCI, Signature 200
- C. Fluoropolymer Two-Coat System: 0.2 – 0.3 mil primer with 0.7 - 0.8 mil 70 percent PVDF fluoropolymer color coat, AAMA 621.
 1. Basis of Design: MBCI, Signature 300

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine metal panel system substrate with Installer present. Inspect for erection tolerances and other conditions that would adversely affect installation of metal panels.
 - 1. Inspect framing that will support insulated metal panels to determine if support components are installed as indicated on approved shop drawings and are within tolerances acceptable to metal panel manufacturer and installer. Confirm presence of acceptable framing members at recommended spacing to match installation requirements of metal panels.
- B. Correct out-of-tolerance work and other deficient conditions prior to proceeding with insulated metal panel installation.

3.02 METAL PANEL INSTALLATION

- A. Concealed-Fastener Formed Metal Soffit Panels: Install metal panel system in accordance with manufacturer's written instructions, approved shop drawings, project drawings, and referenced publications. Install metal panels in orientation, sizes, and locations indicated. Anchor panels and other components securely in place. Provide for thermal and structural movement.
- B. Fasten metal panels to supports with fasteners at each location indicated on approved shop drawings, at spacing and with fasteners recommended by manufacturer. Fasten panel to support structure through leading panel flange. Fit back flange of subsequent panel into secured flange of previous panel.
 - 1. Cut panels in field where required using manufacturer's recommended methods.
 - 2. Dissimilar Materials: Where elements of metal panel system will come into contact with dissimilar materials, treat faces and edges in contact with dissimilar materials as recommended by metal panel manufacturer.
- C. Attach panel flashing trim pieces to supports using recommended fasteners.

3.03 ACCESSORY INSTALLATION

- A. General: Install metal panel accessories with positive anchorage to building and weather tight mounting; provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal panel assembly, including trim, flashings, sealants, closure strips, and similar items.
 - 2. Comply with details of assemblies utilized to establish compliance with performance requirements and manufacturer's written installation instructions.
 - 3. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently weather resistant.

3.04 CLEANING AND PROTECTION

- A. Clean finished surfaces as recommended by metal panel manufacturer.
- B. Replace damaged panels and accessories that cannot be repaired to the satisfaction of the Architect.

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SECTION 07552

MODIFIED BITUMEN ROOFING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Furnish all material, labor, and equipment necessary for installation of a modified bitumen, torch adhesive applied, sheet roof system. Include installation of roof penetrations furnished by others.

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 WORK SPECIFIED ELSEWHERE

- A. Roof construction ready to receive finished roofing.
- B. Wood blocking at openings through roof and at roof edges.
- C. Sheet metal work including metal flashing and counter flashing, and pitch pockets.
- D. Cap flashing of vent stacks or other pipes passing through roof.

1.04 RELATED SECTIONS

- A. Section 05310 – Steel Decking
- B. Section 07760 – Flashing and Sheet Metal

1.05 SUBMITTALS

- A. Submit a complete list of materials to be used together with manufacturer's printed technical data and installation instructions for the roofing system.

- B. Submit two copies of "Roofing Warranty" in form and content indicated by printed form attached to this Section, covering roofing and associated work indicated therein, signed by Installer. Provide two-year roofing warranty period, starting on the date of substantial completion of roofing work. Contractor shall countersign roofing warranty. Sixty days prior to expiration, the Installer shall examine the roof and furnish a written inspection report to the Owner.

1.06 QUALITY ASSURANCE

- A. Installer's Qualifications: Installers specializing in modified bitumen, torch applied, sheet roofing system application familiar with the specified requirements and methods needed for proper performance of the work of this section. Installer shall be approved by the roof materials manufacturer and be a licensed applicator of one of the specified systems prior to the bidding of this project, and have successfully completed a minimum of three projects equal in size and scope to the project specified herein.
- B. Agency Approvals: The proposed roof system shall conform to the following requirements. No other testing agency approvals will be accepted.
 - 1. Underwriters Laboratories Class A acceptance of the proposed roofing system (including mopping asphalt or cold adhesive) without additional requirements for gravel or coatings.
 - 2. The roof membrane system shall meet the approval requirements of the U.S. EPA Energy Star program.

1.07 PRE-ROOFING CONFERENCE

- A. All parties concerned with the built-up roofing and associated work, including roofing installer, installers of deck or substrate construction to receive roofing work, installer of other work in and around roofing which must precede or follow roofing work, and other representatives directly concerned with performance of the work including representatives of roofing and substrate manufacturers, Architect and Owner. Meeting will be coordinated by the General Contractor on a date approved by Architect. Architect will record discussions of conference and decisions and agreements reached and furnish copies to each party attending. Review foreseeable methods and procedures to roofing work including but not necessarily limited to the following:
 - 1. Review roofing system requirements (drawings, specifications and other contract documents).
 - 2. Review required submittals, both completed and yet to be completed.
 - 3. Review status of substrate work (not by roofing installer), structural loading limitations and similar considerations.
 - 4. Review availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.

5. Review required inspection, testing, certifying and material usage accounting procedures.
 6. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions including possibility of temporary roofing.
 7. Review procedures needed for protection of roofing during remainder of construction period.
 8. Consider each party's expert advice and judgment as expressed in the interest of successful completion of the work.
- B. Prepare change orders for work agreed upon (in pre-roofing conference) which is not in accordance with project requirements (Contract Documents). Record in change order reasons for changes and note names of parties disagreeing with changes, if any.

1.08 DELIVERY, STORAGE AND HANDLING OF MATERIALS

- A. Delivery:
1. No materials are to be delivered to the site prior to approval of the materials submitted by the Architect.
 2. Deliver materials in manufacturer's original containers, dry, undamaged, seals and labels intact.
- B. Storage: Storage of sheet materials (roll goods) and all insulation shall be subject to the following requirements:
1. If within fifty miles of contractor's warehouse: All sheet materials (roll goods), insulation, etc., shall be trucked to the job site daily from enclosed warehouse storage.
 2. All other storage shall conform to the following:
 - a. Enclosed trailer, van or truck storage on the job site.
 - b. Canvas (no plastic sheeting is acceptable) tarpaulins, with material on wooden pallets, 6 inches minimum above ground, secured by ropes, top and sides of all material protected from moisture and rain.

1.09 PREPARATION OF SUBSTRATE

- A. The Installer must examine the substrate and the conditions under which roofing work is to be performed, and notify the Contractor in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

1.10 GUARANTEE

- A. Furnish manufacturer's standard roof membrane guarantee for a term of twenty (20) years. Guarantee shall be submitted to the Architect on the manufacturer's standard form, signed by a corporate officer. Provide joint warranty for roof.
- B. Provide Installer's (Roofing Contractor) 2-year roof guarantee to repair or replace defective roofing material and/or workmanship to keep roof system free of leaks or defects for two years from date of final acceptance.

1.11 JOB CONDITIONS

- A. Proceed with roofing work only when weather conditions are in compliance with manufacturer's recommended limitations, and when conditions will permit the work to proceed in accordance with requirements and the manufacturer's recommendations.
- B. Coordinate installation of roofing materials and associated work so as to provide a complete system complying with combined recommendations of manufacturers and installers involved in the work.
- C. Protect other work from spillage of roofing materials, and prevent liquid materials from entering and clogging drains. Replace or restore other work which is soiled or otherwise damaged by performance of roofing and associated work.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Provide and install complete Siplast roof system 2030 FR CBT, or equal.
- B. Asphalt coated Base Sheet: Siplast Parabase FS.
- C. Modified Bitumen Roof Sheets: Siplast Paradiene 20 TG.
- D. Cap Sheet: Siplast Paradiene 30FR TG
- E. Cant Strips: Permalite Cant Strips, or equal, of rigid Pereline board by International Permalite Inc.
- F. Base Flashing: aluminum clad asphalt elastomer glass-reinforced sheet of 90 lbs. per square minimum weight, Type Veral.
- G. Asphalt to be Turmbull Type IV, or equal.
- H. Insulation: Atlas Energy Products AC Foam II, or equal.

2.02 ACCEPTABLE SUBSTITUTES

- A. Johns Manville DynaWeld 1805 Base Sheet / DynaWeld Cap 250.
- B. TAMKO Roofing Products, Inc., Awaplan Versa Smooth/Awaplan Heat Welded Cap.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Base Sheet Securement to Prepared Substrate (light weight concrete): Lay the base sheet over the entire area to be roofed, lapping sides 3" and ends 6". Using the specified fasteners, fasten each sheet every 9" through laps and stagger fasteners the remainder of the sheet in two rows on nominal 12" centers with fasteners in each row on 12" centers. Increase the fastening pattern by 70% at the perimeter of the roof and 160% in the corners.

3.02 INSPECTION

- A. General: The manufacturer's recommended installation procedures, when approved by the Architect, shall become the basis for inspecting and accepting or rejecting actual installation.
- B. Roof Inspection: Provide safe access to the roof for proper inspection by the Architect. Keep the Architect informed of the status of the project and schedule for completion.
- C. Roof Tests, Roof Cuts:
 - 1. Roof cuts will be made only when considered absolutely necessary to determine compliance with specifications.
 - 2. When necessary, cut test samples of installed roofing as directed by the Architect. Immediately repair roof to conform to adjacent construction without cost to the Owner.
- D. Correction of Defective Work: In the event that analysis of test samples or inspection indicates that the roofing system, or a portion thereof, does not conform to the specifications, and approved submittals, such defective work shall be corrected by removal and/or replacement, at no cost to the Owner.
- E. Architect: Coordinate all roofing activities with the Installer's representative(s) designated at the Pre-Installation Conference.
- F. Installer's Representative (Job Superintendent):
 - 1. The installer shall designate a representative who will be responsible for, and follow the application of, all roofing work from start to finish.
 - 2. The Installer's representative shall attend the Pre-Installation Conference and be informed of the scope of the work and procedures for all corrective work.
 - 3. The Installer's representative shall have a complete set of drawings and specifications on the job at all times.

3.03 PROTECTION AND CLEAN-UP OF ROOFTOP, BUILDING AND GROUNDS

A. Rooftop Protection and Clean-up:

1. Protect roof surfaces over which work is to be performed.
2. Exercise care and caution that roofing materials placed on rooftop do not overload structure, damage decking or rooftop equipment.
3. Take care to prevent bitumen and debris from running into and clogging roof drains and water conductors. Remove trash and debris promptly.
4. Schedule work in order not to track over and damage newly installed roofing in place. If absolutely necessary to cross a newly applied roof area, or existing roof, coordinate exact procedures with Architect.
5. The Installer shall be responsible for all damage to any related items to his trade and will be responsible for the cleaning and repair or replacement of any such items.

B. Building Protection and Clean-up:

1. Properly and efficiently protect building and work of other trades from damage by roofing materials during the performance of the work.
2. The Installer shall protect building walls and other surfaces from disfiguration by bitumen stains, runs or spillage, etc., and the Installer shall bear the labor and material cost of repair of these surfaces damaged by the roofing installer's work.

C. Grounds Protection and Clean-up:

1. Coordinate access, parking, storage of materials and equipment on the grounds with the Architect designated at the Pre-Installation Conference.
2. Protect the grounds, lawn, landscaping, shrubbery, etc., from abuse and damage during the roofing work.
3. Remove trash, debris, wrapping, etc., promptly and clean up daily around the job.
4. The Installer shall be responsible for removing all equipment and surplus material from the grounds prior to final acceptance of the work. Installer shall leave his portion of the work, as specified, clean and in complete order. Upon final completion, the grounds shall be cleaned of all trash, debris, bitumen, lumber, scraps, etc., and the grounds raked to its previous condition.

3.04 "PHASED CONSTRUCTION"

- A. The Installer shall not "phase" the application of the modified bitumen, torch applied, sheet roofing system. All roof system components shall be applied consecutively as recommended by the manufacturer (within the limit of a day's work), and be weathertight so that in the event of inclement weather no damage will occur to the roof components or interior contents of the building.

3.05 SCHEDULING OF WORK

- A. The Installer shall schedule this work in such a manner as to cause no disruption in the use of the building.
- B. The building shall be maintained weatherproof at all times. The Installer shall schedule and regulate all activities in order to complete each day's work in a weathertight condition.
- C. The Installer's representative shall keep the Architect informed of his schedules and procedures for the project.
- D. The Installer shall schedule work so as to not be moving over, or hauling equipment over, finished areas of new work.

3.06 WEATHER LIMITATIONS

- A. General: Installer is cautioned to proceed with roofing and related work only when weather conditions will permit. Proceed with roofing only when the roofing system can be installed without "phasing" construction.

3.07 USE OF POWER-DRIVEN EQUIPMENT

- A. The Roofing Installer shall exercise good judgment in the use of all power driven or heavy equipment to prevent any damage to the roof system or interior of the building.

3.08 FIRE AND SAFETY PROTECTION EQUIPMENT

- A. Installer shall provide all necessary equipment, barricades, and flagging to protect the building occupants and workmen performing the work as mutually agreed upon with the Architect during set-up. All equipment and work areas, ladders, scaffolding, and vehicles used in debris removal, shall be flagged or barricaded around.
- B. Installer shall have a working fire extinguisher on the roof with each workman using a propane torch and on the ground at the portable asphalt kettle.

3.09 APPLICATION

- A. Modified Bitumen, Torch Applied, Sheet Roofing: Install in accordance with the approved roofing materials manufacturer's latest published manual for the slope and type of substrate indicated.
- B. Base Flashing: Install base flashing at all curbs, other vertical surfaces, where indicated, and as required to complete the installation in accordance with roofing materials manufacturer's specifications for the guarantee period required and as applicable for the indicated conditions.
- C. Accessories: Furnish and install all accessories as required to complete the roofing, flashing, and insulation systems, in accordance with the manufacturer's requirements and as specified.
- D. Water Cut-Offs: Provide water cut-offs at end of day's work and whenever rain or snow is imminent, at exposed edges of roof insulation. Where insulation is installed over metal

decks, block flutes as required to prevent water from running under insulation. Remove water cut-offs before continuing with the installation of the roof insulation system.

- E. Roof Metal Work: Roofing Installer shall be responsible for the proper attachment of specified work to any roofing metal that is embedded in, or in contact with, and becomes an integral part of the specified roofing system.
- F. Embedded Items: Install or flash all embedded items, or items in contact with the roof system, such as, but not limited to:
 - 1. Pre-fabricated curbs for fans, etc.
 - 2. Lead jacks. At existing roofs, remove and replace with new material.
 - 3. Roof drains, scuppers, overflow/emergency roof drains.
 - 4. Flashing and/or pitch pans as required for mechanical equipment, electrical conduits, etc., which pass through roof system. At existing roofs, remove old flashings and replace with new flashings.
 - 5. Metal counterflashing, metal cap flashing.
 - 6. Perimeter fascia metal.
 - 7. Mechanical rooftop equipment.

3.10 ROOF DRAIN FLASHING

- A. Drain installation shall be pre-flashed over the glass base membrane with overlapping 1/2 sections of full roll width modified bitumen material, installed by torch method, prior to installation of the field membrane.
- B. All roof drains shall be flashed, clamp rings installed and strainers set back in place, as in total completion and the day the surrounding roof membrane is installed.
- C. No later, next day, or end of the job membrane detailing will be acceptable. Re-flash all drains as recommended by the manufacturer furnishing materials for the project. If lead sheeting is required under clamp rings, it shall be installed.
- D. Where applicable, insulation shall be shaped in an 18" radius from the centerline of the drain. Square cut sumps around the drains are not acceptable. Insulation shall be tapered prior to application of the roofing systems. No exceptions.

3.11 INSTALLER'S SIGNS

- A. Furnish and install Roof Warranty signs, 10" x 12" min. size made of .040" aluminum painted gloss white with gloss black lettering.
- B. Sign shall read: "DO NOT MAKE REPAIRS OR ALTERATIONS TO THIS ROOF without written approval from the Owner or authorized representative. The roof is maintained

until (insert the month and two years after the date of final acceptance) by (insert Contractor's name, address, and telephone number).

- C. Permanently post sign where directed by the Owner's Representative(s), prior to submission of and as a condition for final invoice and subsequent payment.
- D. Provide one sign per small roof area. Two or more should be installed on larger roof areas generally one near a roof access point.

END OF SECTION

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ROOFING WARRANTY

WHEREAS _____

of (Address) _____

herein called the "Roofing Contractor", has performed roofing and associated ("work") on following project:

Owner: _____

Address: _____

Name and Type of Building: _____

Address: _____

Area of Work: _____ Date of Acceptance: _____

Warranty Period: _____ Date of Expiration: _____

AND WHEREAS Roofing Contractor has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period.

NOW THEREFORE Roofing Contractor hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work, and as are necessary to maintain said work in watertight condition.

This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by: a) lightning, windstorm, hailstorm, and other unusual phenomena of the elements; b) fire; c) failure of roofing system substrate including cracking, settlement, excessive deflection, deterioration, and decomposition; d) faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work; e) repeated vapor condensation on bottom of roofing and f) activity on roofing by others including construction contractors, maintenance personnel, other persons, and animals whether authorized or unauthorized by Owner. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Contractor, and until cost and expense thereof has been paid by Owner or by another responsible party so designated.
2. The Roofing Contractor is responsible for damage to work covered by this Warranty, but is not liable for consequential damages to building or building contents, resulting from leaks or faults or defects of work.
3. During Warranty Period, if Owner allows alterations of work by anyone other than Roofing Contractor, including cutting, patching, and maintenance in connection with penetrations,

attachment of other work, and positioning of anything of roof, this Warranty shall become null and void upon date of said alterations, but only to extent said alterations affect work covered by

this Warranty. If Owner engages Roofing Contractor to perform said alterations, Warranty shall not become null and void, unless Roofing Contractor, prior to proceeding with said work, shall have notified Owner in writing, showing reasonable cause for claim that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

4. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty become null and void upon date of said change, but only to extent said change affect work covered by this Warranty.
5. The Owner shall promptly notify Roofing Contractor of observed, known or suspected leaks, defect or deterioration, and shall afford reasonable opportunity for Roofing Contractor to inspect work, and to examine evidence of such leaks, defects or deterioration.
6. This Warranty is recognized to be the only warranty of Roofing Contractor on said work, and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to him in cases of roofing failure.

IN WITNESS THEREOF, this instrument has been duly executed this

_____ DAY OF _____ 20____

Roofing Contractor:

By: _____

SECTION 07600

FLASHING AND SHEET METAL

PART 1 GENERAL

1.01 DESCRIPTION

- A. Include all labor, materials and equipment necessary to complete all sheet metal work as shown on the drawings and as specified herein. Briefly, this includes:
 - 1. Flashing
 - 2. Counter-flashing (including counterflashing at all roof-mounted HVAC equipment). See National Roofing contractors Detail BUR-14
 - 3. Metal copings
 - 4. Pitch pans
 - 5. Through-wall scuppers
 - 6. Incidental caulking
 - 7. Sill flashing at 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 WORK SPECIFIED ELSEWHERE

- A. Duct work
- B. Flashing around plumbing vent stacks through roof
- C. Base flashing
- D. Cavity wall flashing

1.04 SUBMITTALS

- A. Prior to fabrication, submit shop drawings to Architect for approval. Drawings shall show sizes, bends, joints, anchorage and metal gauges.
- B. Full size samples may be required in addition to shop drawings on particular items of work.

1.05 PROTECTION

- A. The flashing subcontractor shall advise the Contractor of required procedures for surveillance and protection of the completed flashing and trim. Furnish such advice for period of installation of other work, and also for the remainder of the construction period.

1.06 GUARANTEE

- A. Contractor shall guarantee sheet metal work to be free from defects in materials and workmanship for a period of two (2) years from date of acceptance of building. Should any leaks or defects occur within the period of guarantee, Contractor shall repair leaks or defects immediately upon notification by Owner, at his own expense.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Sheet metal for each item shall be as specified under each heading and as shown on the drawings.
 - 1. Sheet Metal at Copings: Peterson Aluminum Corp., (PAC-CLAD) or equal, prefinished 24-gauge galvanized steel, commercial quality, Armco Zincgrip, ASTM A446, Grade A, primed and finished one side with flouropolymer coating 1.0 plus or minus 0.1 mil total dry thickness, PPG Duranar 200 with a strippable plastic film applied for protection during fabrication and a wash coat of 0.3 - 0.4 mil dry film thickness applied to reverse side. Color to be selected by Architect from manufacturer's basic colors
 - 2. Two (2) Piece Counterflashings: Prefinished 24-gauge galvanized steel
 - 3. Through Wall Scuppers: See Drawings
 - 4. Sheet Metal Expansion Joints: Prefinished 24-gauge galvanized steel
 - 5. Windowsill Flashings: Prefinished .040 aluminum sheet. Finish shall be the same as window frame
- B. Screws and Rivets: Same material as flashing sheet, or other as recommended by manufacturer of flashing sheet.
- C. Nails: Long enough to penetrate back 1", #12-gauge diameter, flat head, annular thread aluminum nails. Use neoprene washers under the heads where exposed to the weather.

- D. Cleats: Same metal and gage as sheet being anchored, unless specified otherwise.
- E. Bituminous Coating: FS TT-C-494 or SSPC Paint 12, cold-applied solvent-type bituminous mastic coating for application in dry film thickness of 15 mills per coat.
- F. Roofing Felt: Asphalt saturated, unperforated felt, complying with ASTM D226, #15 type.
- G. Sealant: Sonneborne NP-1 - clear, or equal.

2.02 FABRICATION (GENERAL)

- A. Except as otherwise shown or specified, comply with applicable recommendations and details of the most current edition "Architectural Sheet Metal Manual" by SMACNA and the manufacturer of the sheet metal being installed.
- B. Provide for thermal expansion of flashing and other items exposed for more than 15'-0" continuous length. Maintain a water-tight installation at expansion seams. Locate expansion seams with the following maximum spacings for each general flashing use:
 - 1. Flashing and Trim: At 10'-0" intervals and 2'-0" each side corners and intersections.
 - 2. Gutter Expansion: In accordance with SMACNA, 4th Ed., Plate 6, "E" value chart.
- C. Fixed joints and seams shall be flat lock seams, soldered, unless otherwise indicated, with minimum of 1/2" wide hooked flanges.
- D. Clean exposed metal surfaces of substances which would interfere with uniform oxidation and weathering.
- E. Fabricate and install work with lines and corners of exposed unit true and accurate. Form exposed faces flat and free of buckles, excessive waves and avoidable tool marks. Provide uniform, neat seams with minimum exposure of solder, welds and sealant. Except as otherwise shown, fold back the sheet metal to form a hem on the concealed side of exposed edges.
- F. Conceal fasteners and expansion provisions wherever possible in exposed work, and locate as to minimize the possibility of leakage. Cover and seal work as required for a watertight installation. Provide cleat-type anchorages for metal flashing and trim wherever practical.
- G. On vertical surfaces lap 2-piece flashings a minimum of 3". On sloping surfaces for slopes of not less than 6" in 12", lap unsealed flashings a minimum of 6". For embedment of metal flashing flanges in roofing, extend flanges for a minimum of 4" embedment.
- H. PITCH PAN AND STORM COLLAR
 - 1. Penetration pans fabricated from .040 aluminum with leak proof corners shall be not more than 3" high and sized to the penetration with a minimum 2" clearance all sides.
 - 2. Set pans on a bead of melted down modified bitumen.

3. Fill pan to within 1/2" of top with Foam Urethane and top cover with Lion Oil Co., W. R. Meadows or other approved (Two Component) Pitch Pans Sealer sloped to shed water. Note to prime, as well as paint, steel supports.
4. Storm Collar to be 24 GA prefinished "Colorklad" steel with stainless steel screw type clamp ring. Storm Collars, where used, should be set high enough above pitch pans to visibly check sealers during routine roof maintenance.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Copings: Install one-piece sheet metal coping on parapet walls as indicated on Drawings, with joints not more than 10'-0" o.c. Secure to wall with continuous 20 ga. galvanized steel cleats on exterior face and with screws through neoprene washers not more than 12" o.c. on back face. At joints lap the exterior and back faces at least 1" and seal the laps with sealant. On the top, fold the ends and join with a locking strip. Turn the locking strip ends down 3/4" over the front and back faces. Install a 6" wide backing plate under the joint and apply sealant where the coping ends overlap the backing plate. Joints are not to be soldered.
- B. Installation of Sheet Metal: Counterflashing at junction between roof and vertical surfaces shall be two-piece as detailed on Drawings. Where shown, receiver flashing shall extend into walls and turn up 1-1/2". The masonry joint shall then be filled with mortar to within 1/4" of the face of the wall. Fill the remaining 1/4" with sealant. Upper edge of counterflashing shall be locked into receiver. Hem lower edge of counterflashing and set close to base flashing to prevent entrance of wind-blown water. Make corners tight with special formed and soldered corner pieces.
- C. Seal masonry joints above counterflashing. Do not seal weep holes.
- D. Through wall scupper as detailed on Drawings and similar to SMACNA Plate 30, Fig. A.
- E. Expansion joints at roof and roof - wall intersections shall be as detailed on drawings. Where a detail is not shown for a particular location, the joint shall be fabricated as shown in the SMACNA Manual for similar conditions.
- F. Miscellaneous Sheet Metal Work: Provide sheet metal angles and closures, and other items of sheet metal work shown on Drawings and not specifically mentioned in this Specification, making each item complete and watertight.

END OF SECTION

SECTION 07610

STANDING SEAM ROOF

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to design, install, and adjust standing seam roof 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. Section 07600 – Flashing and Sheet Metal

1.04 SUMMARY

- A. Furnish all material, labor, and equipment necessary for installation of standing seam roof and curved standing seam roof with trim and fasteners. Furnish all sheet metal roof flashing.

1.05 SUBMITTALS

- A. Submit shop drawings and product data in accordance with Section 01300, Submittals, showing materials of construction and details of installation.
- B. Submit shop drawings showing panel layout, fastening devices, trim pieces, integral flashings, sealants, and ridge caps. Shop drawings shall show fasteners, shape by dimension, gage, and kind of metal for all miscellaneous sheet metal.

1.06 CODES AND STANDARDS

- A. Comply with provisions of the following codes and standards, except as otherwise shown or specified:
 - 1. Light Gage Cold-Formed Steel Design Manual, American Iron and Steel Institute.

1.07 WARRANTIES

- A. Furnish Owner with two (2) year warranty upon completion of work as a condition to roof acceptance, final payment, and project closeout.
- B. Furnish warranty on company's printed letterhead, agreeing to correct leaks and defects in roofing system to satisfaction of Owner and manufacturer of installed roof system.
- C. During two (2) year warranty period, roofing installer shall, upon notice from Owner or Architect, respond promptly to determine and repair source of leaks and defects at no cost to the Owner.
- D. Regardless of cause of leak or defect, Owner and roofing installer shall document and correspond as to problem, location, and corrective action needed or taken to prevent future similar occurrences.
- E. Panel Finish: Provide manufacturer's standard 20-year warranty on fluorocarbon finish.

1.08 QUALITY ASSURANCE

- A. Provide installation by firm authorized by roofing manufacturer. Roof assembly shall be classified as Class UL90.
- B. There shall be no evidence of water penetration at inward static air pressure differential of not less than 6.24 PSF or more than 12.00 PSF per ASTM E331.
- C. Static Air Infiltration - Completed roof system shall have maximum of .06 CFM/square foot with 6.24 PSF air pressure differential per ASTM E283.

1.09 PROJECT CONDITIONS

- A. Where possible, prior to fabrication of panels, take field measurements of structure to receive panel system.
- B. Coordinate work with work of other trades.

PART 2 PRODUCTS

2.01 MATERIALS: Standing Seam Roof

- A. Roof Panels: Provide units of 24-gauge non-embossed steel. Panels shall be 1-1/2-inch Snap-Seam 18 inches on center as manufactured by Petersen Aluminum Corp., or equal. The constructed assembly must be listed by Underwriters Laboratory as Class 90 Uplift Classification.
 - 1. Panels and seams shall be roll-formed in continuous lengths. Certification shall be submitted, based on independent testing, indicating no measurable water penetration through the standing roof system when tested in accordance with ASTM E331-86 and E283.
 - 2. The standing seam roof covering shall be 24 gauge (minimum) hot-dipped galvanized steel ASTM A446-85, Grade C, G-90 coating ASTM A653-94 and A924-94.
 - 3. Finish: Panels will be finished with PAC-CLAD, a 2-coat Kynar 500® or Hylar 5000® finish, applied over a polyester prime coat. A 20-year warranty shall be supplied covering finish performance.
 - 4. U.L. Construction No. 303
- B. Sealants: As recommended by manufacturer.
- C. Fasteners: Fasteners shall be SNAP-CLAD non-penetrating clips machine-tooled from galvanized steel and fastened on centers appropriate to both material gauge and panel width.
- D. Ridge Cap: Shall be constructed of base material equal to that of the roof panels and of manufacturer's standard configuration.
- E. Trim: Shall be formed from the same base metal as the roof sheets and shall be designed to provide for expected movement of roof panels due to thermal expansion and contraction. Details shall conform to the suggested details provided by the manufacturer. Color shall be selected from manufacturer's standards. Finish on manufacturer's standard trim items and flat sheets used for on-site fabrication shall conform to specifications for panels. Trim components formed by the roofing contractor shall conform to details submitted and approved by the Architect.
- F. Moisture Protection Membrane: W.R. Grace Ice and Water Shield, 40 mil or approved equal. Self-adhering membrane of rubberized asphalt integrally bonded to embossed slip resistant polyethylene sheeting. Install on composite roof insulation OSB over entire roof to receive standing seam roof.
- G. Flashing: Shall be of same material and finish as panel system. See Section 07600, Flashing and Sheet Metal Work.
- H. Gutters: Install new gutters as shown on the Plans.

- I. Downspouts: Install new downspouts as shown on the Plans.
- J. Snow Guards: Polycarbonate snow guard shall be manufactured by Sno-Gem, Inc., SnoBlox – Snojax, Inc., or equal. Integral color to match standing seam roof. Install per manufacturer's recommendations.

PART 3 EXECUTION

3.01 INSTALLATION OF STANDING SEAM ROOF PANELS

- A. Preparation of Substrate: The Installer must examine the solid sheathed substrate and the conditions under which roofing work is to be performed and notify the Contractor in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer. Entire roof must be covered with a minimum of one (1) layer of number thirty roof felt and lapped horizontally starting at the eave. Lap succeeding courses a minimum of 2 inches and end laps a minimum of 4 inches. Fasten with sufficient fasteners to hold felt in place until roofing is installed.
- B. Roof Panels: Install in continuous panel lengths from ridge to eave with no end laps. Fasten to substrate with ribs up and attached by concealed clips resting on the substrate.
- C. Fasteners shall be capable of transmitting all design live loads and dead loads to the roof structure.
- D. Protection of Roofing: Upon completion of roofing work (including associated work), Installer shall advise Contractor of recommended procedures for surveillance and protection of roofing during remainder of construction period. At end of construction period, or at a time when remaining construction work will in no way affect or endanger roofing (at Contractor's option), Installer shall make a final inspection of roofing and prepare a written report (to Contractor with copy to Owner) of deterioration or damage found in the Work.
 - 1. Only Installer shall repair or replace deteriorated or defective work found at time of final inspection. Only Installer shall be engaged by Contractor to repair damages to roofing which occurred subsequent to roofing installation and prior to final inspection. Repair or replace the work so that there will be no question as to condition of roofing and associated work at time of substantial completion.

3.02 INSTALLATION OF SHEET METAL

- A. All miscellaneous sheet metal shall be furnished and installed under this section of the specifications.

END OF SECTION

SECTION 07720

ROOF SPECIALTIES AND ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

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 DESCRIPTION

- A. This section includes all roofing specialties shown on the Drawing such as roof hatches.

1.04 SUBMITTALS

- A. Submit manufacturer's technical product data for each item to be provided under this section as specified in the GENERAL CONDITIONS.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Roof Hatch: Bilco, Type E-50TB Ladder Access Roof Hatch, or equal, mill finish aluminum, size 36" x 36".
- B. Ladder Safety Post: Bilco LadderUp Safety Post, Model LU-4, mill finish aluminum. Design shall include a telescoping tubular section that locks automatically when fully extended. Upward and downward movement shall be controlled by a stainless-steel spring balancing mechanism. Unit shall be completely assembled with fasteners for

securing to ladder rungs. Install one unit on each fixed roof access ladder below hatch cover.

C. Roof Access Ladder: by Precisions Ladders LLC, P. O. Box 2279; Morristown, TN 37816-2279; Toll Free Tel: 800-225-7814; Tel: 423-586-2265; Email: info@PrecisionLadders.com; Web: www.PrecisionLadders.com

1. Model: Model FLH Aluminum Heavy Duty Fixed Vertical Ladder as manufactured by Precision Ladders, LLC.
2. Capacity: Unit shall support a 1,500 lb loading without failure, and individual treads shall withstand a 3,000 lb loading without failure.
3. Performance Standard: Units designed and manufactured to meet or exceed ANSI A14.3, OSHA 1910.23, OSHA 1910.28 and OSHA 1910.29.
4. Ladder Stringer: 3 inch by 1 inch by 1/8 inch extruded 6005-T5 aluminum tubing. Pitch: 90 degrees.
5. Ladder Tread: 2-1/4 inch by 3/4 inch by 1/4 inch extruded 6005-T5 aluminum with deeply serrated top surface.
6. Ladder Mounting Bracket: 8-1/2 inch by 2 inch by 3 inch by 1/4 inch thick aluminum angle.
7. Fall Arrest System: Complete system with rail, sleeves, and harness to limit any fall to 6 inches. Removeable Post for Hatch Access Ladders with Fall Arrest System. Harness by others.
8. Walk-Thru:
 - a. Handrails: 1-1/4 inch aluminum square tube with rounded edges
 - b. Side Rails: 42 inch side rail extension for through ladder exits
9. Rest Platform:
 - a. Bar grating
 - b. Platform Size: 30" inches by 48 inches standard
 - c. Toe Boards. 6005 T-5 aluminum
 - d. Handrails: 1-1/4 inch aluminum square tube 42 inches high
 - e. Security Gate: Hinged gate at bottom of cage with padlock provision
 - f. Floor Brackets: Floor bracket at foot of each stringer, 3 by 2 by 1/4 inch

10. Finishes:

- a. Standard: Mill finish on aluminum ladder components

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install the roof hatch as shown on the Drawings. Secure hatch to the wood grounds using heavy wood screws. Make installation watertight with built-up roof flashing.

END OF SECTION

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SECTION 07840

FIRESTOPPING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 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 SUMMARY

- A. This section includes firestopping for through-penetrations and joints in or between the following fire-resistance rated assemblies, including both blank openings, linear openings, and openings containing penetrating items:
 - 1. Floor-ceiling assemblies
 - 2. Roof-ceiling assemblies
 - 3. Walls and partitions
 - 4. Smoke barriers
 - 5. Construction enclosing compartmentalized areas
- B. Related Sections include the following:
 - 1. Section 03300 – Cast-In-Place Concrete
 - 2. Section 07210 – Building Insulation
 - 3. Section 09255 – Gypsum Board Assemblies
 - 4. Division 15 – Plumbing
 - 5. Division 16 – Electrical

1.04 PERFORMANCE CRITERIA

A. FIRE TEST REQUIREMENTS

1. Underwriters Laboratories, Inc. (UL), latest edition:
 - a. UL1479 Fire Tests of Through Penetration Firestops
 - b. UL2079 Tests for Fire Resistance of Building Joint Systems
 - c. UL263 Fire Tests of Building Construction and Materials
 - d. UL723 Surface Burning Characteristics of Building Materials
2. American Society of Testing and Materials (ASTM), latest edition:
 - a. ASTM E814 Fire Tests of Penetration Fire Stops
 - b. ASTM E1966 Test Method for Fire Resistive Joint Systems
 - c. ASTM E119 Fire Tests of Building Construction and Materials
 - d. ASTM E84 Surface Burning Characteristics of Building Materials
 - e. ASTM E2307 Fire Tests of Perimeter Fire Barrier Systems Using Intermediate Scale, Multi-Story Test Apparatus
 - f. ASTM E2837 Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies
 - g. ASTM E2174 Standard Practice for On Site Inspection of Installed Fire Stops
 - h. ASTM E2393 Standard Practice for On Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers

B. REFERENCES

1. Underwriters Laboratories (UL) of Northbrook, IL "Fire Resistance Directory"
 - a. Through Penetration Firestop Systems (XHEZ)
 - b. Joint Systems (XHBN)
 - c. Perimeter Fire Containment Systems (XHDG)
 - d. Continuity Head-of-Wall Joint Systems (XHBO)
 - e. Fill, Void or Cavity Materials (XHHW)
 - f. Firestop Devices (XHJI)
 - g. Forming Materials (XHKU)
 - h. Wall Opening Protective Materials (CLIV)

2. All major building codes:
 - a. International Building Code published by ICC
3. National Fire Protection Association (NFPA) of Quincy, MA "NFPA 101: Life Safety Code"
4. National Fire Protection Association (NFPA) of Quincy, MA "NFPA 70: National Electrical Code"
5. Factory Mutual Approvals (FM) of Norwood, MA "FM 4991: Standard for Approval of Firestop Contractors"
6. Underwriters Laboratories (UL) of Northbrook, IL "UL Qualified Firestop Contractor Program"

C. PERFORMANCE REQUIREMENTS

1. Provide products that upon curing do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.
2. When intumescent products are used, provide products that do not contain sodium silicate or any other water-soluble intumescent ingredient in the formulation.
3. Provide firestop products that do not contain ethylene glycol.
4. Provide firestop sealants sufficiently flexible to accommodate motion such as pipe vibration, water hammer, thermal expansion and other normal building movement without damage to the seal.
5. Pipe insulation shall not be removed, cut away or otherwise interrupted through wall or floor openings. Provide products appropriately tested for the thickness and type of insulation utilized.
6. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur. Such devices shall be:
 - a. Capable of retrofit around existing cables
 - b. Designed such that two or more devices can be ganged together
 - c. Maintenance free such that no action is required to activate the smoke and fire sealing mechanism
7. When mechanical cable pathways are not practical, openings within walls and floors designed to accommodate voice, data and video cabling shall be provided with re-enterable products specifically designed for retrofit.

8. Provide fire-resistive joint sealants sufficiently flexible to accommodate movement such as thermal expansion and other normal building movement without damage to the seal.
9. Provide fire-resistive joint sealants designed to accommodate a specific range of movement and tested for this purpose in accordance with a cyclic movement test criteria as outlined in Standards, ASTM E1966, or ANSI/ UL 2079.
10. Provide penetration firestop systems, fire-resistive joint systems, or perimeter fire barrier systems subjected to an air leakage test conducted in accordance with Standard, ANSI/ UL1479 for penetrations and ANSI/UL2079 for joint systems with published L-Ratings for ambient and elevated temperatures as evidence of the ability of firestop system to restrict the movement of smoke.
11. Provide T-Rating Collar Devices tested in accordance with ASTM E814 or ANSI/UL1479 for metallic pipe penetrations requiring T-Ratings per the applicable building code.
12. Provide a fire-rated grommet for all individual or small grouped cable applications up to 0.53 in. (14 mm).
13. Provide moisture-curing products where inclement weather or greater than transient water exposure is expected.

1.05 SUBMITTALS

- A. Product Data: For each type of firestopping product indicated.
- B. System Drawings: Submit documentation from a qualified third-party testing agency that is applicable to each firestopping system configuration for construction, joint opening width and/or penetrating items.
- C. Product Certificates: Certificate of conformance signed by manufacturers of firestopping products certifying that products comply with requirements.

1.06 QUALITY ASSURANCE

- A. Provide firestopping systems that comply with the following requirements and those specified in "Performance Criteria" Article:
 1. Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
 2. Firestopping products bear classification marking of qualified testing and inspection agency.
- B. Engage an experienced installer who is certified, licensed, FM Approved in accordance with FM 4991, Certified by UL as a Qualified Contractor, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install

firestop products per specified requirements. A manufacturer's willingness to sell its firestopping products to Contractor or to an installer engaged by Contractor does not in itself confer qualifications on buyer.

- C. Obtain firestop systems for each type of penetration or joint opening and construction condition indicated from a single manufacturer.
- D. Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings".

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturer's labels identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instructions for multi-component materials.
- B. Store and handle materials for firestopping products to prevent their deterioration or damage due to moisture, temperature changes, contaminants or other causes.

1.08 PROJECT CONDITIONS

- A. Do not install firestopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer.
- B. Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.
- C. Do not use materials that contain flammable solvents.

1.09 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes or cut openings to accommodate through-penetration firestop systems.
- C. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

PART 2 PRODUCTS

2.01 FIRESTOPPING, GENERAL

- A. Provide firestopping products that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by firestopping products manufacturer based on testing and field experience.

- B. Provide components for each firestopping system that are needed to install fill materials. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

2.02 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with through-penetration firestop systems (XHEZ) and/or wall opening protective materials (CLIV) and/or joint systems (XHBN) and/or perimeter fire containment systems (XHDG) and/or continuity head-of-wall joint systems (XHBO) listed in Volume 2 of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:
 - 1. Acceptable Manufacturer: Specified Technologies Inc., 210 Evans Way, Somerville, NJ 08876. Tel: (800) 992-1180, Fax: (908) 526-9623, Email: specseal@stifirestop.com, Website: www.stifirestop.com.
 - 2. Substitutions: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A/D Fire Protection Systems Inc.
 - b. Hilti, Inc.
 - c. Isolatek International
 - d. Nelson Firestop Products
 - e. 3M Fire Protection Products
 - f. Tremco
 - g. Single Source: Obtain firestop systems for each type of penetration and construction condition indicated only from a single manufacturer

2.03 MATERIALS

- A. General: Use only firestopping products that have been tested for specific fire-resistance-rated construction conditions conforming to construction assembly type, penetrating item type or joint opening width and movement capabilities, annular space requirements, and fire-rating involved for each separate instance.
- B. Intumescent Sealants: Single component intumescent latex formulations containing no water-soluble intumescent ingredients capable of expanding a minimum 8 times, the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) SpecSeal Series SSS Intumescent Sealant
 - 2. Specified Technologies, Inc. (STI) SpecSeal Series LCI Intumescent Sealant
- C. Endothermic Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture, the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) SpecSeal Series LC Endothermic Sealant

- D. Elastomeric Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture and accommodate minimum ± 25 percent movement, the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) SpecSeal Series AS Elastomeric Spray
 - 2. Specified Technologies, Inc. (STI) SpecSeal Series ES Elastomeric Sealant
- E. Firestop Devices: Factory-assembled steel collars lined with intumescent material capable of expanding a minimum 30 times sized to fit specific outside diameter of penetrating item, the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) SpecSeal Series SSC Firestop Collars
 - 2. Specified Technologies, Inc. (STI) SpecSeal Series LCC Firestop Collars
- F. Fire Rated Cable Pathways: Gangable device modules capable of being retrofitted around existing cables and comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill and requiring no additional action in the form of plugs, twisting closure, putty, pillow, or sealant to achieve fire and leakage ratings, the following products are acceptable:
 - 1. Specified Technologies Inc. (STI) EZ-Path Fire Rated Pathway
- G. Wall Opening Protective Materials: Intumescent, non-curing pads or inserts for protection of electrical switch and receptacle boxes to reduce horizontal separation to less than 24" (610 mm), the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) SpecSeal Series SSP Firestop Putty Pads
 - 2. Specified Technologies, Inc. (STI) SpecSeal Series EP PowerShield Insert Pads
- H. Firestop Putty: Intumescent, 100% solids, non-hardening, water resistant, butyl rubber-based putties containing no solvents or silicone compounds, the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) SpecSeal Series SSP Firestop Putty
- I. Wrap Strips: Single component intumescent elastomeric strips faced on both sides with a plastic film and capable of expanding a minimum 30 times, the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) SpecSeal Series RED2 Wrap Strip
 - 2. Specified Technologies, Inc. (STI) SpecSeal Series BLU2 Wrap Strip
- J. Firestop Pillows: Re-enterable, non-curing, mineral fiber core encapsulated with an intumescent coating on all six sides contained in a flame-retardant poly bag, the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) SpecSeal Series SSB Firestop Pillows

- K. Mortar: Portland cement based dry-mix product formulated for mixing with water at Project site to form a non-shrinking, water-resistant, homogenous mortar, the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) SpecSeal Series SSM Firestop Mortar
- L. Silicone Sealants: Moisture curing, single component, silicone elastomeric sealant for horizontal surfaces (pourable or nonsag) or vertical surface (nonsag), the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) SpecSeal SIL300 Silicone Firestop Sealant
 - 2. Specified Technologies, Inc. (STI) SpecSeal SIL300 SL Self-Leveling Silicone Firestop Sealant'
- M. All-Weather Coatings: Moisture curing, single component silicone copolymer elastomeric spray coatings for horizontal surfaces where greater water resistance is required or inclement weather is anticipated, the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) SpecSeal FT305 Firestop Spray
- N. Silicone Foam: Multicomponent, silicone-based liquid elastomers, that when mixed, expand and cure in place to produce a flexible, non-shrinking foam, the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) Pensil 200 Silicone Foam
- O. Composite Sheet: Intumescent material sandwiched between a galvanized steel sheet and steel wire mesh protected with aluminum foil capable of sustaining a minimum 2,500 lbs (1,134 kg) when subjected to load testing, the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) SpecSeal CS Composite Sheet
- P. Cast-In-Place Firestop Device: Single component molded firestop device installed on forms prior to concrete placement with totally encapsulated, tamper-proof integral firestop system and smoke sealing gasket, the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) SpecSeal CD Cast-In Firestop Device
- Q. Fire-Rated HVAC Retaining Angles: Steel angle system with integral intumescent firestop gasket for use on steel HVAC ducts, the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) SpecSeal FyreFlange Firestop Angles
- R. Firestop Plugs: Re-enterable, foam rubber plug impregnated with intumescent material capable of expanding minimum 10 times with expansion beginning at 350°F (177°C) for use in blank openings and cable sleeves, the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) SpecSeal Series FP Firestop Plug

- S. Fire-Rated T Rating Collar Device: Louvered steel collar system with synthetic aluminized polymer coolant wrap installed on metallic pipes where T Ratings are required by applicable building code requirements, the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) SpecSeal T-Collar Device
- T. Fire-Rated Cable Grommet: Molded two-piece grommet made from plenum grade polymer with a foam inner core for sealing cable penetrations up to 0.53 in. (14 mm) diameter, the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) EZ-Firestop Grommet (RFG1 or RFG2)
- U. Fire-Rated Closet Flange Gasket: Molded, single-component, intumescent gasket for use beneath a closet flange in floor applications, the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) SpecSeal Series CF34 Closet Flange Firestop Gasket

PART 3 EXECUTION

3.01 PREPARATION

- A. Examination of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
- B. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion.
- C. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.02 FIRESTOPPING INSTALLATION

- A. General Requirements: Install through-penetration firestop systems and fire-resistive joint systems in accordance with "Performance Criteria" Article and in accordance with the conditions of testing and classification as specified in the published design.
- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of firestopping products.
 - 1. Seal all openings or voids made by penetrations to ensure an air and water-resistant seal.
 - 2. Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of through-penetration firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
 - 3. Protect materials from damage on surfaces subjected to traffic.

4. Apply a suitable bond-breaker to prevent three-sided adhesion in applications where this condition might occur such as the intersection of a gypsum wallboard/steel stud wall to floor or roof assembly where the joint is backed by a steel ceiling runner or track.
5. Where joint application is exposed to the elements, fire-resistive joint sealant must be approved by manufacturer for use in exterior applications and shall comply with ASTM C-920, "Specification for Elastomeric Joint Sealants".

3.03 FIELD QUALITY CONTROL

- A. Inspections: Owner shall engage a qualified independent inspection agency to inspect through-penetration firestop systems in accordance with ASTM E2174, "Standard Practice for On Site Inspection of Installed Fire Stops" or joint systems in accordance with ASTM E2393, "Standard Practice for On Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers". NOTE: Manufacturers are not qualified inspection agencies, and it is a conflict of interest for the manufacturer to perform inspections of installed firestopping systems according to the aforementioned inspection standards.
- B. Keep areas of work accessible until inspection by authorities having jurisdiction.
- C. Where deficiencies are found, repair or firestopping products so they comply with requirements.

3.04 ADJUSTING AND CLEANING

- A. Remove equipment, materials, and debris leaving area in undamaged, clean condition.
- B. Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.

END OF SECTION

SECTION 07901

JOINT SEALANTS

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes joint sealants for the following locations:

1. Exterior joints in vertical surfaces and non-traffic horizontal surfaces as indicated below:
 - a. Joints between masonry and sheet metal
 - b. Joints between exposed steel lintels and masonry at front edge and at ends of lintels
 - c. Control and expansion joints in unit masonry (Do not seal weep holes)
 - d. Joints between masonry and louvers or duct penetrations
 - e. Joints between flashing and equipment mountings at equipment bases on roof
 - f. Perimeter joints between materials listed above and frames of doors and windows
 - g. Seal other joints in exterior walls and roof which are required to be sealed to prevent entrance of water and to give a weathertight building
 - h. Joints between cast stone and cast stone
2. Interior joints in vertical surfaces and horizontal nontraffic surfaces as indicated below:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls
 - b. Perimeter joints of exterior openings where indicated
 - c. Vertical control joints on exposed surfaces of interior unit masonry and partitions
 - d. Joints between gypsum board partitions and masonry walls
 - e. Perimeter joints between interior wall surfaces and frames of interior louvers, doors, and windows
 - f. Perimeter joints of toilet fixtures and mop sinks
 - g. Other joints as indicated

3. Interior joints in horizontal traffic surfaces as indicated below:

- a. Control and expansion joints in tile flooring
- b. Bed exterior door thresholds in sealant

4. Exterior joints in horizontal traffic surfaces as indicated below:

- a. Expansion joints in concrete paving, concrete sidewalks and concrete curb and gutter.

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 DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.04 RELATED SECTIONS

- A. Section 03300 – Cast-In-Place Concrete
- B. Section 07600 – Flashing and Sheet Metal
- C. Section 08410 – Aluminum Doors, Windows and Frames
- D. Section 08800 – Glazing
- E. Section 09216 – Gypsum Board Assemblies

1.05 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

- B. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

1.06 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM) International, latest edition:
 - 1. ASTM C1193 Standard Guide for Use of Joint Sealants

1.07 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data from manufacturers for each joint sealant product required.

1.08 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.10 PROJECT SITE CONDITIONS

- A. Environmental Conditions: Do not proceed with installation of joint sealants when ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer or below 40° F and/or when joint substrates are wet.
- B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.11 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall

be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

- B. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period of two (2) years from date of Substantial Completion.
- C. Special Manufacturer's Warranty: Written warranty, signed by elastomeric sealant manufacturer agreeing to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period of 20 years from date of Substantial Completion. Warranty shall cover structural adhesion, weather seal, and non-staining.

PART 2 PRODUCTS

2.01 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2.02 POLYURETHANE JOINT SEALANTS

- A. Polyurethane joint sealants for concrete shall be installed in all water vault structures in accordance with sealant manufacturer's recommendations.

2.03 ELASTOMERIC JOINT SEALANTS

- A. Exterior Building Sealant: Dow Corning 790 Silicone Building Sealant or approved equal. Sealant shall be same color as adjacent materials. More than one color may be required. Colors will be selected from manufacturer's standard colors.
 - 1. Sealant shall be low modulus with additional movement capabilities of 100 percent (100%) movement in extension and 50 percent (50%) movement in compression for a total of 150 percent (150%) movement.
- B. Interior Sealant: Sonneborn Sonolastic NP-2, two component color as selected by Architect or approved equal. More than 1 color may be required.
- C. Exterior Paving Sealant: Sonneborn Sonolastic SL-1, or equal.
- D. Storefront and Curtainwall Sealant: Dow Corning 795, or equal.

2.04 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

2.05 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent nonporous surfaces and formulated to promote optimum adhesion of sealants with joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
 - 3. Remove laitance and form release agents from concrete.
 - 4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant-substrate tests or prior

experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations of ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:
 - 1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 2. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.
- D. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed. Fill joints to a depth equal to 50 percent (50%) of joint width, but never more than 1/2-inch deep or less than 1/4-inch deep. Remainder of joint shall be filled with backer material.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.04 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.05 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that installations with repaired areas are indistinguishable from original work.

END OF SECTION

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SECTION 08360

OVERHEAD DOORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The Drawings and general provisions of the Contract, including GENERAL and SUPPLEMENTARY CONDITIONS, and all Division 1 Specification Sections apply to the Work specified in this Section.

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 DESCRIPTION OF WORK

- A. Furnish and install all equipment, materials and labor to make complete and ready for use the sectional overhead door listed in the drawings and described in this specification. Work specified elsewhere includes:
 - 1. Section 05500 – Miscellaneous Metals
 - 2. Section 06100 – Rough Carpentry
 - 3. Section 08712 – Door Hardware

1.04 SUBMITTALS

- A. Submit copies of shop drawings and catalog data as specified in Section 01 33 00, SUBMITTALS, and the GENERAL CONDITIONS.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Metal coiling insulated rolling door shall be Stormtite Insulated Rolling Service Door, Series 625 as manufactured by Overhead Door Corporation, or equal. Sizes to be as shown on the Door Schedule. Verify exact size in field.
1. Slat Profile: Flat, Type F-265i
 2. Slat Material: Aluminum 0.40" front slat and Aluminum 0.24" back slat, insulation to be CFC free, Foamed-In-Place Polyurethane Insulation
 3. Finish: PowderGuard Premium Powder coat finish, color to be selected by Architect from manufacturer's standard colors
 4. Bottom Bar: Extruded aluminum
 5. Guides: Steel
 6. Wind Load: 20 psf
 7. Hood: Aluminum
 8. Lock: Chain keepers on chain hoist
 9. Mounting: Face of wall
 10. Weatherseals: Bottom, interior hood baffle and exterior curtain-side guide
 11. Electric Motor Operation: Provide UL listed electric operator, size as recommended by manufacturer to move door in either direction at not less than 2/3 foot or nor more than 1 foot per second. Motor to be 120-volt. Operator controls push-button (key).

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install overhead doors in accordance with manufacturer's instructions and standards. Furnish all installation accessories required for installation and after installation adjust doors for easy operation.

END OF SECTION

SECTION 08410

ALUMINUM DOORS, WINDOWS, AND FRAMES

PART 1 GENERAL

1.01 SUMMARY

- A. Furnish all material, labor, equipment, and services necessary to install the aluminum windows and storefront, anchors, hardware, and related items indicated on the Drawings. In general, the work includes Fixed aluminum storefront frames, doors and hardware, and 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 07901 – Joint Sealants
- B. Section 08800 – Glazing

1.04 SUBMITTALS

- A. Prior to start of fabrication submit shop drawings to Architect for approval.
- B. Drawings shall indicate location of windows, opening dimensions and details of head, jamb and sill at each opening.

1.05 WARRANTY

- A. Project Warranty: Refer to "Conditions of the Contract" for project warranty provisions.

- B. Manufacturer's Product Warranty: Submit, for Owner's acceptance, manufacturer's warranty for storefront system as follows:
1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment.
 2. Manufacturer's Door Product Warranty: Submit, for Owner's acceptance, manufacturer's warranty for door/entrance system as follows:
 - a. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment. In addition, welded door corner construction shall be supported with a LIMITED LIFETIME WARRANTY for the life of the door under normal use.

See items 2.01, item C below for door construction.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All door, window and framing systems shall be Architectural Class I anodized finish (AA-M10C21A41) Color #14, Clear.
- B. Kawneer Trifab 451T, exterior framing system, or equal. Provide accessory parts, shapes and brake metal as required for a complete installation. Storefront System – 2" x 4-1/2" nominal dimension; Thermal, Front Set-Glazed, Screw Spline Fabrication.
- C. Kawneer TRIFAB 450, interior framing system, or equal. Provide accessory parts, shapes and brake metal as required for a complete installation. Storefront System – 1-3/4" x 4-1/2" nominal dimension; Non-Thermal, Front Set-Glazed, Shear Block Fabrication.
- D. Doors to be Kawneer, 350 Medium Style or Flushline doors, or equal, of sizes shown on the Drawings. Supply closers and thresholds where required. Bottoms and edges of doors shall be weather stripped with a full width metal bound, replaceable pile weather stripping.
1. Door corner construction shall consist of mechanical clip fastening, SIGMA 1-1/8" long fillet welds along top and bottom of rail extrusion at stile and rail intersection, and deep penetration plug weld at all four corners of door. **MUST BE FULL PENETRATION PLUG WELD TO LEG OF CLIP, 1-1/8" LONG FILLET WELDS ALONG TOP AND BOTTOM OF RAILS AT STILES INTERSECTION, NO TIE-ROD CONSTRUCTION OF ANY TYPE OR PARTIAL DESIGN ALLOWED.** Meeting rail to still joint fillet weld "only" is NOT ACCEPTABLE. Glazing stops shall be hook-in type with EPDM glazing gaskets reinforced with non-stretchable chord

E. Substitutions:

1. General: Refer to Substitutions Section for procedures and submission requirements.
2. Pre-Contract (Bidding Period) Substitutions: Submit written requests ten (10) days prior to bid date.
3. Substitution Documentation
 - a. Product Literature and Drawings: Submit product literature and drawings modified to suit specific project requirements and job conditions.
 - b. Certificates: Submit certificate(s) certifying substitute manufacturer (1) attesting to adherence to specification requirements for storefront system performance criteria, and (2) has been engaged in the design, manufacturer and fabrication of aluminum storefront for a period of not less than ten (25) years.
4. Samples: Provide samples of typical product sections and finish samples in manufacturer's standard sizes.
5. Substitution Acceptance: Acceptance will be in written form, either as an addendum or modification.

F. All exposed screws to be tamper proof.

G. Hardware: Furnish and install hardware as follows for each Kawneer Door: Cylinders shall be subject to change construction master, building master and grand master keys as specified in Section 08 71 00 – Door Hardware. See Hardware Schedule for remainder of hardware.

1. Continuous Geared Hinge: Kawneer Co., or equal.
2. Threshold: Nat'l. Guard Products, Inc., 513 SIA, or equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Comply with manufacturer's recommendations for the installation of aluminum doors, door frames and windows.
- B. Set units plumb, level and true to line without warp or rack of frames and doors. Anchor securely in place. Separate dissimilar metals with bituminous coatings or preformed separators.
- C. Set sill members and other members in a bed of compound to provide weather tight construction. Provide aluminum subsills where shown on Drawings.
- D. Obtain actual job site dimensions of each masonry opening and fabricate to fit with clearances indicated on the Drawings.

- E. Provide each continuous unit of framework, doors, sidelights, hardware and all accessory items as a packaged unit. Complete the fabrication, assembly and finishing before shipment to the project site to the greatest extent possible.
- F. Complete the cutting, fitting, forming, drilling and grinding of all metal work prior to cleaning, finishing, treatment and application of coatings.
- G. Weld by methods recommended by the manufacturer and AWS to avoid discoloration at welds. Grind exposed welds smooth and restore mechanical finish. Remove arises from cut edges and ease edges and corners to a radius of approximately 1/64".
- H. Conceal fasteners wherever possible. Joints shall be drawn up to an invisible or hair line crack. Exposed fasteners shall be flush with finished surface of the member.
- I. Reinforce the work, as necessary, for performance requirements and for support to the system. Provide separators which will prevent corrosion. Provide cutouts and concealed reinforcement shall be equal to 3/16" thick steel straps.

3.02 CLEANING

- A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.
- B. Protection: Protect installed product's finish surfaces from damage during construction. Protect aluminum entrances from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants. Remove and replace damaged aluminum entrances at no extra cost.

END OF SECTION

SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor and materials required and install door hardware 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 07901 – Joint Sealants
- B. Section 08410 – Aluminum Doors, Windows, and Frames

1.04 REFERENCE STANDARDS

- A. Steel Door Institute (SDI), latest edition:
 - 1. SDI 110 Recommended Selection for Standard Steel Doors, Frames, Accessories and Related Components
- B. National Fire Protection Association (NFPA), latest edition:
 - 1. NFPA 80 Standard for Fire Doors and Other Opening Protectives

1.05 SUBMITTALS

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

- B. Product data including manufacturers' technical product data for each item of door hardware.
- C. Final hardware schedule coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Submittal Sequence: Submit final schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work that is critical in the Project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by door hardware, and other information essential to the coordinated review of schedule.
 - 2. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
- D. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.06 ACCESSIBILITY

- A. All door hardware (thresholds, closers, panic devices, lever handles, etc.) must meet ADAAG. If the specified hardware does not meet the accessibility guidelines, notify the Architect with an alternate proposal of similar style and quality, conforming to the ADAAG.

1.07 QUALITY ASSURANCE

- A. Supplier Qualifications: A recognized architectural door hardware supplier that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project.
 - 1. Require supplier to meet with Engineer to finalize keying requirements and to obtain final instructions in writing.
- B. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by UL, Warnock Hersey, FM, or other testing and inspecting organization acceptable to authorities having jurisdiction for use on types and sizes of doors indicated in compliance with requirements of fire-rated door and door frame labels.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Tag each item or package separately with identification related to final hardware schedule and include basic installation instructions with each item or package.
- B. Packaging of door hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly

marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two (2) or more identical sets may be packed in the same container.

- C. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that the count is correct.
- D. Deliver individually packaged door hardware items promptly to place of installation (shop or Project site).
- E. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

PART 2 PRODUCTS

2.01 MATERIALS AND FABRICATION

- A. Manufacturer's Name Plate: Do not use manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise acceptable to Engineer.
 - 1. Manufacturer's identification will be permitted on rim of lock cylinders only.
- B. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.
- C. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.
- D. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely.
- E. Locks shall have 2-3/4-inch backset. Fronts shall be beveled 1/8 inch in 2 inches.

2.02 LOCK CYLINDERS AND KEYING

- A. Standard System: Provide new masterkey system for Project.
- B. Equip locks with manufacturer's special 6-pin tumbler cylinder with construction masterkey feature that permits voiding of construction keys without cylinder removal.

- C. Bows of keys shall be stamped with a key symbol as directed by Engineer. The key symbols, in general, will consist of three letters and two numbers, thus: WE-H12.
- D. Key Material: Provide keys of nickel silver only.
- E. Key Quantity: Furnish 3 change keys for each lock and 6 master keys.
 - 1. Furnish six (6) construction master keys
 - 2. Deliver permanent keys to Engineer
 - 3. Deliver construction keys to Contractor

PART 3 EXECUTION

3.01 INSTALLATION

- A. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by Engineer.
 - 1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Steel Door Institute.
 - 2. NWWDA Industry Standard I.S.1.7, "Hardware Locations for Wood Flush Doors"
- B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.
- C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements specified in Section 07901, Joint Sealers.

3.02 ADJUSTING, CLEANING, AND DEMONSTRATING

- A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.

3.03 HARDWARE SCHEDULE

- A. General: Provide hardware for each door to comply with requirements of Section "Door Hardware," hardware set numbers indicated in door schedule, and in the following schedule of hardware sets.
 - 1. Hardware sets indicate quantity, item, manufacturer and product designation, size, and finish or color, as applicable.
 - 2. Examine the details of items for which hardware is to be furnished and where finished shape or size of members taking hardware is such as to prevent, or make unsuitable, use of the exact types specified, suitable types having as nearly as practicable the same operation and quality as the type specified shall be furnished.
 - 3. All hardware provided and installed shall meet handicap accessibility guidelines.

3.04 DOOR HARDWARE

- A. See Allowance for Door Hardware.

END OF SECTION

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SECTION 08800

GLAZING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all material, labor, equipment and services necessary for glazing of the building as indicated on the drawings and as described in this specification.

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 08410 – Aluminum Doors, Windows and Frames

1.04 SUBMITTALS

- A. Submit manufacturer's literature on each type of glass specified.

1.05 JOB CONDITIONS

- A. Obtain glass sizes from the work at the building or from the manufacturer of frames, sash, etc., in which the glass is to be set. Responsibility for correct glass sizes rests with Glass and Glazing Subcontractor.

1.06 STANDARDS

- A. Acceptable manufacturers for glass substrate: Guardian Industries Corp., Libby-Owens-Ford Co., PPG Industries, Inc., Glass Group and Saint-Gobain/Euroglass. Acceptable fabricators for laminated units are limited to: Viracon, Inc., Interpane Glass Co., Guardian Industries Corp., HGP/Tempglass Eastern, Inc. and Cardinal IG.

- B. Manufacturer of insulating glass shall warrant that insulating glass will not, for a period of ten years from date of manufacture, develop obstruction to vision due to film formation or dust collection due to failure of hermetic seal, and that all non-conforming glass will be replaced, but not installed, without cost to Owner.
- C. AFPC V2 2701.1 "Each light shall bear the manufacturer's label designating the type and thickness of glass." AFPC V2 2701.2 "Each unit of tempered glass shall be permanently identified by the manufacturer. The identification shall be etched or ceramic fired on the glass and be visible when the unit is glazed."
- D. AFPC V2 2703.1 "Individual glazed areas in hazardous locations such as those indicated in 2703.2 shall pass the test requirements of 'Safety Standard for Architectural Glazing Materials Consumer Product Safety Commission (CPSC) 16 CFR 1201' or by comparative test shall be proven to produce at least equivalent performances."
EXCEPTIONS:
 - 1. Polished wire glass for use in fire doors, fire windows and view panels in 1-hr fire resistant walls and hazardous locations in 2703.2.1 (6) and 2703.2.1(7) shall comply with ANSI Z97.1.
 - 2. Approved plastic materials used as glazing in hazardous locations shall comply with ANSI Z97.1.
- E. AFPC V2 2703.2.1. "The following shall be considered specific hazardous locations for the purposes of glazing:
 - 1. Glazing in ingress and egress doors except wired glass in required fire doors and jalousies
 - 2. Glazing in fixed and sliding panels of sliding (patio) door assemblies and panels in swinging doors
 - 3. Glazing in storm doors
 - 4. Glazing in all unframed swinging doors
 - 5. Glazing in doors and enclosures for hot tubs, whirlpools, saunas, steam rooms, bathtubs and showers
 - 6. Glazing in any portion of a building wall enclosing these compartments where the bottom edge of the glazing is less than 60 inches above the drain inlet
 - 7. Glazing in an individual fixed or operable panel adjacent a door where the nearest vertical edge is within a 24" arc of the door in a closed position and whose bottom edge is less than 60" above the floor or walking surface
 - 8. Glazing in an individual fixed or operable panel, other than those locations described in Items 5 and 6 above, that meets all of the following conditions:
 - a. Exposed area of an individual pane greater than 9 sq. ft.
 - b. Bottom edge less than 18" above the floor

- c. Top edge greater than 36" above the floor
- d. One or more walking surfaces within 36" horizontal of plane glazing
- e. All glazing in railings regardless of area or height above a walking surface including structural baluster panels and nonstructural in-fill panels."

PART 2 PRODUCTS

2.01 MATERIALS

- A. Insulating-Glass Units: Pre-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for class CBA units and requirements specified herein.
 - 1. Provide Kind HS (heat strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in "Performance Requirements" Article.
- B. Provide Kind FT (fully tempered) where safety glass is indicated.
- C. Provide high performance low-emissivity coating on No. 2 surface. Min. performance requirements are implicit in products specified as the basis of design.
- D. 1" Tinted Insulated Unit: VITRO Architectural Glass. This glass is to be used at areas indicated on the Drawings.
 - 1. Exterior Lite: 1/4" VITRO Solarban® 70 on Solargray® Low-E #2
 - 2. Interior Lite: 1/4" Clear
 - 3. 1/2" Cavity Air (Standard)
 - 4. Performance Characteristics
 - 5. Visible Light transmittance: 32%
 - 6. Solar Heat Gain Coefficient: 0.19
 - 7. Winter U-factor/U-Value (Btu/hr-ft² -F°): 0.28
- E. 1/4" Clear Glass: VITRO Architectural Glass 1/4" clear float glass, or equal.
- F. 1/4" & 3/8" Clear Tempered Glass: VITRO Architectural Glass, 1/4" & 3/8" clear float Herculite Tongless Tempered Safety Glass, or equal.
- G. 3/16" Fire-Rated Glass: FireLite, fire-rated glass ceramic by TGP (Technical Glass Products), or equal.
- H. Setting Blocks: Neoprene, 70-90 durometer hardness.
- I. Spacers: Neoprene, 40-50 durometer hardness.
- J. Glazing Tape: Tremco, pre-shimmed 440 tape, or equal, 1/8" minimum.

- K. Sealant: Dow Corning 781, GE Silicone 1200 or other approved black acid-type silicone rubber elastomeric sealant.
- L. Silicone Glazing Sealant: Tremco Proglaze Silicone Sealant, or equal, translucent.
- M. Plate Glass Mirrors: Clear plate glass (FS DD-G-451), Type I, Class 1, quality g2, 1/4" thick with silver coating, copper protective coating and 2 mil thick paint coating, complying with CS27.
- N. Mirror Mastic: An adhesive setting compound for installation by spot application method with support only at the bottom edge.

PART 3 EXECUTION

3.01 INSTALLATION GENERAL

- A. Refer to the sections of these specifications containing references to other work which must be executed in conjunction with glass and glazing.
- B. Each glazing installation shall remain airtight and watertight under normal temperature change, wind loads and impact loads without failure or deterioration of glazing or glass.
- C. Protect glass from edge damage at all times during handling and installation.
- D. Do not attempt to cut, nip or abrade glass which is heat strengthened, tempered or coated.
- E. Remove and reset glazing beads without marring or defacing any portion of doors, windows, or beads. Clean glazing channel or framing immediately before glazing.
- F. Install setting blocks of proper size at quarter points of sill rabbet. Provide spacers, inside and out, for all glass larger than 50 united inches except at gasket glazing.
- G. Force sealant into channel to eliminate air pockets and voids and to ensure complete wetting of glass and channel surfaces. Tool exposed surfaces of sealants to provide "wash" away from glass surface. Clean and trim excess glazing material.
- H. Do not remove labels until glass and mirrors are inspected and approved by the Architect. Replace all breakage caused in executing the work or by faulty installation without cost to the Owner. Improperly set glass or glazing which does not fully meet the requirements of its grade will not be accepted. Such glass must be replaced without cost to the Owner.
- I. Clean all glass prior to final inspection.

3.02 LOCATION OF GLASS

- A. Each window, sidelight, frame, transom, and door with opening for glass shall be glazed with glass of the type indicated on the Drawings.

END OF SECTION

SECTION 09255

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 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 SUMMARY

- A. This Section includes the following:
 - 1. Non-load-bearing steel framing members for gypsum board assemblies
 - 2. Gypsum board assemblies attached to steel framing
 - 3. Cementitious backer units installed with gypsum board assemblies
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 06100 – Rough Carpentry

1.04 REFERENCES

- A. Gypsum Board Construction Terminology: Refer to ASTM C11 and GA-505 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.
- B. ASTM C 840, Standard Specification for Application and Finishing of Gypsum Board.

- C. GA-216, Gypsum Association Recommended Specification for Application and Finishing of Gypsum Board.

1.05 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of product specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum panels flat to prevent sagging.

1.07 PROJECT CONDITIONS

- A. Environmental Conditions, General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C840 requirements or gypsum board manufacturer's recommendations, whichever are more stringent.
- B. Room Temperatures: For non-adhesive attachment of gypsum board to framing, maintain not less than 40°F. For adhesive attachment and finishing of gypsum board, maintain not less than 50°F for 48 hours before application and continuously after until dry. Do not exceed 95°F when using temporary heat sources.
- C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

PART 2 PRODUCTS

2.01 STEEL FRAMING FOR WALLS AND PARTITIONS, FURREDOWNS AND CEILINGS

- A. General: Provide steel framing members complying with manufacturer's standard zinc protective coating.
- B. Steel Studs and Runners: ASTM C645, with flange edges of studs bent back 90° and doubled over to form 3/16" wide min. lip (return), and complying with the following requirements for min. thickness of base (uncoated) metal and for depth:
 - 1. Thickness: 20 ga. unless otherwise indicated. 25 ga. Studs may be used at ceiling furredowns.
 - 2. Thickness: 20 ga. for head runner, sill runner, jamb, and cripple studs at door and other openings unless noted otherwise.

3. Thickness: As indicated.
 4. Depth: 3-5/8" unless otherwise indicated.
 5. Depth: 6" where indicated.
 6. Depth: As indicated.
- C. Deflection Track: Manufacturer's top runner complying with the requirements of ASTM C645 and with 2" deep flanges for non-fire rated partitions where indicated on plans.
- D. Deflection and Firestop Track: Top runner designed to allow partition heads to expand and contract with movement of structure above while maintaining continuity of the assembly. Comply with requirements of ASTM C645 except configuration, of thickness indicated for studs and width to accommodate depth of studs indicated with flanges offset at midpoint to accommodate gypsum board thickness. For fire rated partitions:
1. Offset Configuration: Shadow-line design with offset projecting out from depth of stud.
 2. Product: Subject to compliance with requirements, a product that may be incorporated in the Work includes, but is not limited to, "Fire Trak" manufactured by Fire Trak Corp. Furnish Fire Track-Slip Clips.
- E. Steel Rigid Furring Channels: ASTM C645, hat shaped, depth and minimum thickness of base (uncoated) metal as follows:
1. Thickness: 25 ga. unless otherwise indicated.
 2. Depth: 7/8", 1-1/2", or as indicated on Drawings.
- F. Fasteners for Metal Framing: Provide fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.
- G. Drywall Control Joint: CEMCO 093 zinc control joint 7/16" deep with 1/4" opening control joint. Use where control joint is required in drywall walls and ceilings. Install at door and window heads locations susceptible to cracking.
- H. Drywall Ceiling Suspension System: Chicago Metallic Drywall Grid 640 from Rockfon. Provide fasteners, accessory pieces, wall angles and channels as required for complete installation.

2.02 GYPSUM BOARD PRODUCTS

- A. General: Provide gypsum board in widths of 48" and in maximum lengths available that will minimize end-to-end butt joints in each area indicated to receive gypsum board application.

B. Gypsum Wallboard: ASTM C1396/C1396M and as follows:

1. Type: Regular for vertical surfaces, unless otherwise indicated.
2. Type: Type X where required for fire-resistance-rated assemblies.
3. Edges: Tapered.
4. Thickness: 5/8" or as noted on the drawings.

C. Gypsum Board Base Layer(s) for Multi-layer Applications: Gypsum wallboard, ASTM C1396/C1396M. Regular 5/8" thick for vertical surfaces, unless otherwise indicated.

D. Moisture and Mold-Resistant Gypsum Board: ASTM C 1396/C1396M, with moisture and mold resistant core and paper surfaces.

1. Type: Georgia Pacific Gypsum Toughrock Mold-Guard Gypsum Board.
2. Type: X where required for fire-resistance related assemblies.
3. Edges: Tapered.
4. Thickness: 5/8" or as noted on the Drawings.
5. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

E. Impact Resistant Gypsum Board: ASTM C1629.

1. Type: Georgia Pacific Gypsum, DensArmor Plus Abuse-Resistant Panel
2. Edges: Tapered
3. Thickness: 5/8"

2.03 TRIM ACCESSORIES

A. Accessories for Interior Installation: Cornerbead, edge trim, and control joints complying with ASTM C1047. Formed steel sheet zinc coated by hot-dip process or rolled zinc.

1. Shapes indicated below by reference to Fig.1 designations in ASTM C1047:
 - a. Cornerbead on outside corners, unless otherwise indicated.
 - b. LC-bead with both face and back flanges; face flange formed to receive joint compound. Use LC-beads for edge trim, unless otherwise indicated.
 - c. One-piece control joint formed with V-shaped slot and removable strip covering slot opening.

2.04 JOINT TREATMENT MATERIALS

A. General: Provide joint treatment materials complying with ASTM C475 and the recommendations of both the manufacturers of sheet products and of joint treatment materials for each application indicated.

B. Joint Tape for Gypsum Board: Paper reinforcing tape, unless otherwise indicated. Use pressure-sensitive or staple-attached, open-weave, glass-fiber reinforcing tape with compatible joint compound where recommended by manufacturer of gypsum board and joint treatment materials for application indicated.

- C. Joint Tape for Cementitious Backer Units: As recommended by cementitious backer unit manufacturer.
- D. Drying-Type Joint Compounds for Gypsum Board: Factory-packaged vinyl-based products complying with the following requirements for formulation and intended use.
 - 1. Ready-Mixed Formulation: Factory-mixed product.
 - a. Taping compound formulated for embedding tape and for first coat over fasteners and face flanges of trim accessories.
 - b. Topping compound formulated for fill (second) and finish (third) coats.
 - c. All-purpose compound formulated for both taping and topping compounds.

2.05 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C834 and the following requirements:
- B. Acoustical Sealant for Concealed Joints: Manufacturer's standard non-drying, non-hardening, non-skinning, non-staining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound.

2.06 MISCELLANEOUS MATERIALS

- A. General: Provide auxiliary materials for gypsum board construction that comply with referenced standards and recommendations of gypsum board manufacturer.
- B. Spot Grout: ASTM C475, setting-type joint compound recommended for spot-grouting hollow metal door frames.
- C. Steel drill screws complying with ASTM C1002 for the following applications:
 - 1. Fastening gypsum board to steel members less than 0.033" thick
 - 2. Fastening gypsum board to wood members
 - 3. Fastening gypsum board to gypsum board
- D. Steel drill screws complying with ASTM C954 for fastening gypsum board to steel members from 0.033" to 0.112" thick.
- E. Steel drill screws of size and type recommended by unit manufacturer for fastening cementitious backer units.
- F. Gypsum Board Nails: ASTM C514.
- G. Asphalt-Saturated Organic Felt: ASTM D226, Type I (No. 15 asphalt felt), non-perforated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLING STEEL FRAMING, GENERAL

- A. Steel Framing Installation Standard: Install steel framing to comply with ASTM C754 and with ASTM C840 requirements that apply to framing installation.
- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with recommendations of gypsum board manufacturer or, if none available, with United States Gypsum Co.'s "Gypsum Construction Handbook."
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement. Comply with details shown on Drawings.
 - 1. Where building structure abuts ceiling perimeter or penetrates ceiling.
 - 2. Where partition framing and wall furring abut structure, except at floor.
 - a. Install deflection track top runner to attain lateral support and avoid axial loading for non-rated assemblies.
 - b. Install deflection and firestop track top runner at fire-resistance-rated assemblies where indicated. Attach jamb studs at openings to tracks using manufacturer's standard stud clip.
- D. Do not bridge building control and expansion joints with steel framing or furring members. Independently frame both sides of joints with framing or furring members as indicated.

3.03 INSTALLING STEEL FRAMING FOR WALLS AND PARTITIONS

- A. Install runners (tracks) at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction. Where studs are installed directly against exterior walls, install asphalt felt strips or foam gaskets between studs and wall.
- B. Installation Tolerances: Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8" from the plane formed by the faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings.

Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

1. Cut studs 1/2" short of full height to provide perimeter relief.
 2. For STC-rated and fire-resistance-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid structural surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed, to support gypsum board closures needed to make partitions continuous from floor to underside of solid structure.
- D. Install steel studs and furring in sizes and at spacings indicated.
1. Single-Layer Construction: Space studs 16" o.c., unless otherwise indicated.
 2. Multi-layer Construction: Space studs 24" o.c., unless otherwise indicated.
- E. Install steel studs so flanges point in the same direction and leading edge, or end of each gypsum board panel can be attached to open (unsupported) edges of stud flanges first.
- F. Frame door openings to comply with GA-219, and with applicable published recommendations of gypsum board manufacturer, unless otherwise indicated. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs. Install two studs at each jamb, unless otherwise indicated. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2" clearance from jamb stud to allow for installation of control joint.
- G. Frame openings, other than door openings, to comply with details indicated or, if none indicated, as required for door openings. Install framing below sills of openings to match framing required above door heads.

3.04 APPLYING AND FINISHING GYPSUM BOARD, GENERAL

- A. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C840 and GA-216.
- B. Install sound-attenuation blankets, where indicated, prior to installing gypsum panels unless blankets are readily installed after panels have been installed on one side.
- C. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16" of open space between panels. Do not force into place.
- D. Locate both edge or end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Avoid joints other than control joints at corners of framed openings where possible.

- E. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- F. Attach gypsum panels to framing provided at openings and cutouts.
- G. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Instead, float gypsum panels over these members using resilient channels or provide control joints to counteract wood shrinkage.
- H. Spot grout hollow metal door frames for solid-core wood doors, hollow metal doors, and doors over 32" wide. Apply spot grout at each jamb anchor clip and immediately insert gypsum panels into frames.
- I. Form control and expansion joints at locations indicated and as detailed, with space between edges of adjoining gypsum panels, as well as supporting framing behind gypsum panels. Maximum spacing between control joints shall not exceed 30'-0".
- J. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases that are braced internally.
 - 1. Except where concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4" to 3/8" wide joints to install sealant.
- K. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors, as detailed. Provide 1/4"- to 1/2" wide spaces at these locations and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- L. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's recommendations. Space screws a maximum of 12" o.c. for vertical applications.

3.05 GYPSUM BOARD APPLICATION METHODS

- A. Single-Layer Application: Install gypsum wallboard panels as follows:
 - 1. On furrdowns, apply gypsum panels prior to wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated, and provide panel lengths that will minimize end joints. Stagger abutting end joints not less than one framing member in alternate courses of board.

- B. Multi-layer Application on Partitions/Walls: Apply gypsum board indicated for base layers and gypsum wallboard face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints. Stagger joints on opposite sides of partitions.
- C. Single-Layer Fastening Methods: Apply gypsum panels to supports by fastening with screws.
- D. Multi-layer Fastening Methods: Apply base layers of gypsum panels and face layer to base layers by fastening both base layers and face layers separately to supports with screws.

3.06 INSTALLING TRIM ACCESSORIES

- A. General: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer's directions for type, length, and spacing of fasteners.
- B. Install cornerbead at external corners.
- C. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound, except where other types are indicated.
- D. Install control joints according to ASTM C840 and manufacturer's recommendations and in specific locations approved by Architect for visual effect.

3.07 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Treat gypsum board joints, interior angles, flanges of cornerbead, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.
- B. Apply joint tape at joints between gypsum boards, except where a trim accessory is indicated.
- C. Apply treatment at gypsum board joints (both directions), flanges of trim accessories, penetrations, fastener heads, surface defects and elsewhere as required to prepare work for decoration. Pre-fill open joints and rounded or beveled edges, using type of compound recommended by manufacturer.
- D. Apply joint compound in 3 coats (not including pre-fill of openings in base), and sand between last 2 coats and after last coat.
- E. For treatment of joints in glass mat, water-resistant gypsum board, comply with directions of gypsum board manufacturer.
- F. Finish cementitious backer units to comply with unit manufacturer's directions.
- G. Joints in partitions which are above ceilings shall be taped and made smoke tight.

3.08 CLEANING AND PROTECTION

- A. Promptly remove any residual joint compound from adjacent surfaces.
- B. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure gypsum board assemblies are without damage or deterioration at the time of Substantial Completion.

END OF SECTION

SECTION 09310

PORCELAIN, QUARRY, AND CERAMIC TILE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 1 Specification Sections, apply to this Section.

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 DESCRIPTION

- A. Provide porcelain, quarry, and ceramic floor, wall and base tile where shown on the drawings.

1.04 WORK SPECIFIED ELSEWHERE

- A. Section 03300 – Cast-In-Place Concrete
- B. Division 15 – Plumbing

1.05 SUBMITTALS

- A. Submit a complete list of all materials to be used together with manufacturer’s printed technical data. Submit samples of porcelain and ceramic tile to show colors and patterns selected.

1.06 STANDARDS

- A. Provide tile certified by the Tile Council of America (TCA) to equal or exceed Standard Grade requirements of ANSI A 137.1. Colors will be selected by the Architect from the manufacturer’s standard samples.

- B. Installer must examine substrate and conditions under which all work is to be installed. Notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

1.07 DELIVERY AND STORAGE

- A. Deliver materials and store on site in a dry location in original containers with seals unbroken and labels intact until time of use.
- B. Handle, store, mix and apply proprietary setting and grouting materials in compliance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Porcelain Tile (P.T.) Floor & Wall: Trinity Tile, "Cotton", 12" x 24". Colors to be selected by Architect from manufacturer's standard colors. Contact: Ryan Bunch, The Tread Collective, 479-644-3441.
- B. Ceramic Tile (C.T.) Wall: Trinity Tile, "Color Wheel", 3" x 9". Colors to be selected by Architect from manufacturer's standard colors. Contact: Ryan Bunch, The Tread Collective, 479-644-3441.
- C. Portland Cement: ASTM C 150, Type 1, Gray or White.
- D. Sand: ASTM C 144, except graded with 100% passing the No. 16 sieve.
- E. Hydrated Lime: ASTM C206 or C207 Type S.
- F. Water: Clean and potable.
- G. Dry-Set Mortar: ANSI A118.1, American Olean sanded thin set mortar, or equal.
- H. Portland Cement Mortar: ANSI A108.5.
- I. Dry-Set Grout: American Olean Dry Wall Grout, or equal.
- J. Anti-Fracture Membrane: Laticrete Blue 92 Anti-Fracture Membrane.
- K. Transitions: Schluter Systems, color/finish to be selected by Architect.
 - 1. Schluter-RENO-U, at locations where floor tile transitions to resilient flooring, carpet and/or concrete.
 - 2. Schluter-QUADEC, at edges where wall tile transitions to gypsum board or concrete block and outside corners where wall tile meets wall tile.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Comply with ANSI standard installation specifications A108.1 through A108.11 and Tile Council of America "Handbook for Ceramic Tile Installation", except as otherwise shown or specified. Maintain minimum temperature limits and installation practices as recommended by mortar and grout materials manufacturers.
- B. Comply with manufacturer's instructions for mixing and installation of proprietary materials.
- C. Neutralize and seal substrates in accordance with mortar or adhesive manufacturers.

END OF SECTION

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SECTION 09511

ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 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 SUMMARY

- A. This Section includes: Lay-In Acoustical Board Ceilings.

1.04 SUBMITTALS

- A. Product Data: For each type of product specified.
- B. Samples: For each type of product specified.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Flame spread rating for acoustical lay-in panels shall be 25 or less when tested in accordance with ASTM E-84.
- C. Ceiling installation shall comply with requirements for seismic lateral support as required by building code.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.08 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, VAC equipment, fire-suppression system, and partition assemblies.

1.09 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size units equal to 2.0 percent of amount installed.

PART 2 PRODUCTS

2.01 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- C. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.
- D. Wire Hangers, Braces, and Ties: Provide #12 gage Carbon-Steel Wire, ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

- E. Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
- F. Lay-in Acoustical Board Ceilings:
 - 1. Lay-in Acoustic Board "A":
 - a. Armstrong Dune, #1774, 24" x 24" x 5/8", Class A fire resistant. Color to be white. Grid to be Prelude 15/16" Dimensional Tee System. Wall mould shall be Armstrong 7/8" hemmed angle molding.
 - 2. Lay-in Acoustic Board "B":
 - a. Armstrong Clean Room VL-Non-perforated #868, 24" x 24" x 5/8". Color to be white. Grid to be Prelude 15/16" Exposed Tee Grid. Wall mould shall be Armstrong 7/8" hemmed angle molding.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and other conditions affecting performance of acoustical panel ceilings. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.03 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with publications referenced below per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - 1. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings-- Seismic Zones 0-2."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

2. Splay hangers only where required to miss obstructions and where structural members exceed a 4'-0" spacing; offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
 3. Install 4 hangers at each recessed fluorescent light fixture installed near each corner, installed by the ceiling Contractor.
 4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 7. Do not attach hangers to steel deck tabs.
 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 9. Space hangers not more than 48" o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8" from ends of each member.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area.
1. Screw attach moldings to substrate at intervals not more than 16" o.c. and not more than 3" from ends, leveling with ceiling suspension system to a tolerance of 1/8" in 12'. Miter corners accurately and connect securely.
 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

- F. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
- G. Where cleanouts, valves, or other operating equipment which must be serviced is located above a suspended ceiling, the panels directly below equipment shall be marked with a colored map pin near one corner of the panel.

3.04 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

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SECTION 09651

RESILIENT FLOORING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

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 DESCRIPTION

- A. Furnish all material, labor, equipment, and services necessary to install the resilient flooring as indicated in the Room Finish Schedule and on the drawings. Material shall be installed by contractors approved by the manufacturer and in strict accordance with the manufacturer's application instructions.
 - 1. Do not install flooring under or behind built-in equipment such as cabinets, furniture and the like having enclosed bases.
 - 2. Provide 1 unopened container of each color of rubber or vinyl flooring for the Owner's use in replacing damaged tile. Replacement tile shall be from same lot number and color as originally installed tile.
- B. Coordinate work so that floor coverings are the last items installed. No other trades will be allowed to work in a space once floor coverings are installed.

1.04 WORK SPECIFIED ELSEWHERE

- A. Section 09653 – Resilient Base and Accessories

1.05 DELIVERY, STORAGE

- A. Deliver materials to the job in manufacturer's original unopened containers with brand and name clearly marked. Store in original containers at not less than 70° F for at least 48 hours before installation.

1.06 QUALITY ASSURANCE

- A. The installer must examine the substrate and conditions under which the resilient flooring is to be performed. The concrete floors shall be broom clean, thoroughly dry and free of paint, varnish, wax, grease or oil. Notify the contractor in writing of any unsatisfactory conditions. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- B. This Contractor shall guarantee that all work executed under this section of the specifications will be free from defects in material and workmanship, provided any such defect is brought to the attention of the Contractor in writing within one (1) year after substantial completion of the project. Upon such notice, the Contractor shall, at his own expense, make the necessary repairs or replacements of the defective work in question. The Owner shall, however, be responsible for the removal and replacement of all fixtures and equipment attached to the surface on which the work will be done.

1.07 SUBMITTALS

- A. Submit a complete list of materials to be used together with manufacturer's printed technical data.
- B. Submit current set of samples to the Architect for selection of colors to be used.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Vinyl Plank Flooring (LVT): Mannington Commercial, The Divergent Collection – Strand, or equal. Colors to be selected from standard color line by Architect.
 - 1. Thickness: 2.5mm
 - 2. Wear Layer: 30 mil
 - 3. Dimensions: 18"x18"
- B. Leveling compounds and underlayment: as recommended or approved by flooring manufacturer.
- C. Concrete Slab Primer: Non-staining type as recommended by flooring manufacturer.

PART 3 EXECUTION

3.01 LAYOUT

- A. Concrete shall be smooth with no more than 1/8" variation from the plane within any 10'. Grind down ridges and other irregularities. Fill all cracks, holes, and depressions with latex cement underlayment.
- B. Apply concrete slab primer if recommended by flooring manufacturer prior to application of adhesive.
- C. Starting point of the layout for various rooms shall be such that no piece smaller than 2" tile occurs at walls.

3.02 INSTALLATION

- A. Do not begin work until work of other trades including painting has been completed.
- B. Maintain the temperature of the space to receive flooring at a minimum temperature of 65° F and maximum of 100° F for at least 48 hours prior to, during, and 48 hours after installation. Maintain a minimum temperature of 55° F thereafter.
- C. Lay the resilient flooring true, level and even with tight joints in strict accordance with manufacturers application instructions.
- D. Wherever flooring terminates and no division strip is provided to bring adjacent floor materials flush with tile, provide a continuous protective edge strip.

3.03 FINISHING

- A. Clean floor thoroughly with a neutral cleaner in accordance with manufacturer's recommendations.

END OF SECTION

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SECTION 09653

RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

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 DESCRIPTION

- A. The extent of resilient base is shown on the Drawings. Related work specified elsewhere includes:
 - 1. Section 03300 – Cast-In-Place Concrete
 - 2. Section 09651 – Resilient Flooring

1.04 SUBMITTALS

- A. Submit materials list and manufacturer’s technical data.
- B. Submit current set of samples to the Architect for selection of colors to be used.

1.05 PROJECT CONDITIONS

- A. Maintain minimum temperature of 65° F in spaces to receive resilient base for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. Store resilient base materials in spaces where it will be installed for at least 48 hours before beginning installation. Subsequently, maintain minimum temperature of 55° F in areas where work is completed.

- B. Install resilient base after flooring installation is complete.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Vinyl base - top set cove, 4" high, 1/8" thick, furnish in roll stock (not 48" lengths) at all locations. Color as selected by Architect. Acceptable manufacturers include Flexco, Roppe, Johnsonite and Mannington.
- B. Adhesives (Cements) - waterproof, stabilized type as recommended by manufacturer. Asphalt emulsions and other non-waterproof types not acceptable.
- C. Resilient Transitions:
 - 1. Johnsonite/Tarkett "Slimline" resilient transition at locations where resilient flooring transitions to any different flooring material – new or existing. Color to be selected by Architect.

2.02 INSPECTION

- A. The Installer must examine the substrate and the conditions under which resilient base is to be installed. Notify the Contractor in writing of any unsatisfactory conditions. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Apply resilient base to walls and other permanent fixtures in rooms where base is required. Install base in as long lengths as practicable, with corners fabricated from base material. Form external corners by heating base and bending it around the corner, with joints not less than 8" from the corner. Form internal corners by notching cove and bending base into corner to form a continuous vertical surface.
- B. Tightly bond base to backing throughout the length of each piece, with continuous contact at horizontal and vertical surfaces.

3.02 CLEANING

- A. Upon completion of resilient base installation, immediately remove any excess adhesive from base or adjacent surfaces using appropriate cleaner recommended by the resilient base manufacturer.

END OF SECTION

SECTION 09800

CORROSION-RESISTANT POLYMER LINING/EPOXY LINING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to supply and install corrosion resistant lining on all concrete surfaces as shown on the Drawings and 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. Division 3 – Concrete
- B. Division 9 – Painting

1.04 SUBMITTALS

- A. Submit, in accordance with Section 01300, complete detailed shop drawings and a coating schedule for all materials furnished under this Section including the following:
 - 1. Manufacturer's current printed recommendations and product data sheets for all coating system products supplied under this section including manufacturers printed performance criteria, surface preparation and application requirements and procedures, volatile organic compound data, and safety requirements.
 - 2. Material Safety Data Sheets (MSDS) for any materials brought on-site including all resurfacing system materials, solvents, and abrasive blast media.
 - 3. Storage requirements including temperature, humidity, and ventilation for coating system materials.

4. Manufacturer's requirements, including application and safety procedures for coating system materials.
- B. The manufacturer of the lining shall furnish an affidavit attesting to the successful use of its material as a lining for concrete structures for a minimum period of five (5) years in wastewater conditions recognized as corrosive or otherwise detrimental to concrete and certifying that submitted products are suitable for application on the surfaces to be resurfaced and for the service conditions. The affidavit shall also document verification by the manufacturer of the corrosion resistant lining system of the subcontractor's qualification as an approved installer of the specified lining materials and verify that the personnel who will perform this work have been trained to the satisfaction of the manufacturer. This affidavit shall also list the application personnel who will work on the corrosion resistant lining installation covered by this Section. The names of the tradespersons performing surface preparation, clean-up, and other miscellaneous labor functions will not have to be listed on the affidavit.
- C. The lining system shall be applied by a qualified applicator trained in handling, mixing and application of the material including the required surface cleaning and preparation. A list of references of projects using the specified lining system shall be provided to the Engineer for review.
- D. Corrosion Resistant Lining Manufacturer's written instructions and drawing details for treatment of lining materials at terminations in the structures to be lined including pipe penetrations, metal embedments, gate frames, and other terminations to be determined from the Contract Drawings. This information should also include detail treatment for the corrosion resistant lining system at all joints in the concrete.

1.05 REFERENCE STANDARDS

- A. ASTM International (ASTM), latest revision:
 1. ASTM C307 Standard Test Method for Tensile Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Grout
 2. ASTM C308 Standard Test Method for Working, Initial Setting, and Service Strength Setting Times of Chemical-Resistant Resin Mortars
 3. ASTM C413 Standard Test Method for Absorption of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Grout
 4. ASTM C579 Standard Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Grout
 5. ASTM C580 Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Grout
 6. ASTM C696 Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C with a Vitreous Silica Dilatometer

7. ASTM C905 Standard Test Methods for Apparent Density of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Grout
8. ASTM D4787 Standard Practice for Continuity Verification of Liquid Sheet Linings Applied to Concrete Substrates
9. ASTM D4262 Standard Test Method for pH of Chemically Cleaned or Acid Etched Concrete Surfaces
10. ASTM B499 Standard Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals
11. ASTM D4414 Standard Practice for Measurement - Wet Film Thickness by V Notch Gages
12. ASTM D2369 Standard Test Method for Volatile Content of Coatings
13. ASTM D4417 Field Measurement of Surface Profile of Blast Cleaned Steel, Test Methods
14. ASTM D4263 Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
15. ASTM D4138 Standard Test Methods for Measurement Dry Film Thickness of Protective Coating Systems by Destructive Means
16. ASTM D4541 Standard Method for Pull-Off Strength of Coatings using Portable Adhesion Testers
17. ASTM D4787 Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
18. ASTM D5162 Standard Practice for Discontinuity Testing of Nonconductive Protective Coating on Metallic Substrates
19. ASTM E337 Standard Practice Test Method for Measuring Humidity with a Psychrometer

B. Steel Structures Painting Council (SSPC) Specifications and Standards:

1. SSPC-SP-1 Solvent Cleaning
2. SSPC-SP-3 Power Tool Cleaning
3. SSPC-PA-3 A Guide to Safety in Paint Application
4. SSPC-VIS-1 Pictorial Surface Preparation Standards
5. SSPC-SP-5 White Metal Blast Cleaning

6. SSPC-SP-13 Surface Preparation of Concrete

C. NACE (National Association of Corrosion Engineers)

1. NACE Publication 6D-173 A Manual for Painter Safety
2. NACE Publication TPC2 Coatings and Linings for Immersion Service: Chapter 1 Safety, Chapter 2 Surface Preparation, Chapter 3 Curing, and Chapter 4 Inspection
3. NACE Publication 6F-163 Surface Preparation of Steel or Concrete Tank Interiors
4. NACE RP0892-92 Standard Recommended Practice, Lining over Concrete in Immersion Service
5. NACE RP0288-88 Standard Recommended Practice, Inspection of Linings on Steel and Concrete

- D. 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. The Contractor shall not use or retain contaminated, outdated, or diluted materials for resurfacing. All materials used shall be from new containers not previously opened.
- B. The manufacturer's requirements, including application procedures and safety procedures shall be followed in detail and strictly adhered to at all times when the work is in progress.
- C. The Contractor shall use only products of the approved manufacturer and shall use products of only one manufacturer in any one resurfacing system.
- D. The Contractor shall make available all locations and phases of the work for access by the Engineer or other personnel designated by the Engineer. The Contractor shall provide ventilation and egress to safely access the coating work.
- E. The Contractor shall conduct his/her work such that the coating system is installed as specified herein and as recommended by the coating system manufacturer. Any nonconforming coating system work shall be corrected as specified herein or as recommended by the manufacturer at no additional cost to the Owner. The Contractor shall contact the material manufacturer and Engineer at least 10 days prior to the day of coating work.
- F. The Contractor is ultimately responsible for the workmanship and quality of the lining installation. Inspections by the Lining Manufacturer, the Engineer, or others do not limit the Contractor's responsibility for the quality of the lining work.

- G. If any requirements of this specification are contradicted by a referenced standard or vice-versa, the matter shall be resolved in writing by the Engineer.
- H. The Engineer shall provide routine inspection of the lining work in accordance with Part 4 of this Section.

1.07 DELIVERY STORAGE AND HANDLING

- A. Materials shall be stored in accordance with manufacturer's recommendations in enclosed structures and shall be protected from weather and adverse temperature conditions. Flammable materials shall be stored in accordance with state and local codes. Materials exceeding storage life as defined by the manufacturer shall be removed promptly from the site.
- B. Mix all resurfacing materials in an enclosed mixing area to protect the mixing operation and materials from direct sunlight, inclement weather, freezing, or other means of damage or contamination.
- C. Deliver all materials to the site in their original, unopened containers. Each container shall bear the manufacturer's name and label.

1.08 SYSTEM DESCRIPTION

- A. Corrosion resistant lining shall be applied to all interior concrete surfaces of the biofilters including walls and floors as shown on the Drawings, the interior of all proposed manholes, the interior wet well of proposed Lift Station No. 4, and the concrete pad and curbed areas around the Aluminum Sulfate (Alum) tank.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Physical Properties
 - 1. All cured corrosion-resistant polymer/epoxy lining shall be free of cracks, pinholes or other defects adversely affecting the protective characteristics of the material. The Engineer may authorize the repair of such defects by approved methods.
 - 2. The lining shall have good impact resistance and shall have sufficient elongation to bridge existing hairline cracks in the concrete.
 - 3. The lining shall be repairable at any time during the life of the structure.

4. The corrosion-resistant polymer/epoxy lining system shall have the physical properties as given in TABLE 1:

TABLE 1 – Lining

Absorption (ASTM C413)	No greater than 0.03% in 30 days following 14 days of cure
Working Time – 70 degrees F (ASTM C308 modified)	35-50 minutes minimum
Initial Set time – 70 degrees F (ASTM C308 modified)	13 hours
Compressive Strength (ASTM C579)	4,500 psi minimum
Adhesion (ASTM D4541)	900 psi minimum
Steel Control Panel	SSPC-SP-10 Standard
Abrasion (ASTM D4060)	Less than 88 mg loss; CS17 wheel; 1,000 grams load
Density (ASTM C905)	113 pcf (1.7×10^3 Kg/M ³)
Solids by Volume	100%
Chemical Resistance	Resistant to 10% H ₂ SO ₄ for 365 days of immersion with no film degradation
Water Vapor Transmission (ASTM E96, Method E)	WVT Rate of ≤ 0.2 gms. per 100 sq. in. in 24 hours with no increase in rate following larger exposure time
Flexural Strength (ASTM C580)	4,900 psi (6.5×10^6 Kg/M ²)
Modulus of Elasticity (ASTM C580)	2.75×10^5 psi (1.8×10^8 Kg/M ²)
Tensile Strength (ASTM C307)	2,000 psi (2.7×10^6 Kg/M ²)
Thermal Coefficient of Linear Expansion (ASTM D696)	3.5×10^{-5} in/in/°F

2.02 PRODUCTS

- A. The specified products for the filling of bugholes and voids up to 1/2-inch in depth or resurface in the concrete prior to lining application shall be as follows:
1. Tnemec Series 218 Mortar Clad (1/16-inch thickness).
 2. Carboguard 510 by Carboline Company.
 3. Sauerisen Filler Compound 209.

- B. The specified products for the filling of bugholes and voids (not resurfacing) in the concrete deeper than 1/2-inch shall be as follows:
 - 1. Series 219 by Tnemec Company
 - 2. Plasite 120 Carboline Company
 - 3. Sauerisen F-120 Underlayment
- C. The specified products for the concrete lining system shall be as follows:
 - 1. Tnemec Series 436 Perma-Shield FR by Tnemec Company, Inc., North Kansas City, Missouri
 - 2. Raven 405 by Raven Lining Systems, Inc., Tulsa, Oklahoma
- D. The specified products for joint sealants shall be two part gun grade polysulfide sealants as follows:
 - 1. Sonneborne Sonalastic Polysulfide Sealant by ChemRex, Shakopee, Minnesota
 - 2. Synthacalk GC2+ by Pecora Corp., Harleysville, Pennsylvania
 - 3. Thiokol 2235M by PolySpec, Houston, Texas
- E. Abrasive Blast Media.
 - 1. Provide slag grit 10-40 utility grade or other size blast media if abrasive blast cleaning is used. Select media size for optimum removal efficiency and cutting action.
- F. The total system thickness (surface mortar plus lining) shall be 125 mils, minimum.

PART 3 EXECUTION

3.01 HOISTING, SCAFFOLDING, STAGING AND PLANKING

- A. Provide, set-up, and maintain all required scaffolds, and staging and planking, and perform all hoisting work required to complete the work of this section as indicated and specified.
- B. Scaffolds shall have solid backs and floors to prevent dropping materials to the floors or ground.

3.02 GENERAL

- A. Thinners or cleaning solvents used shall be approved by the lining manufacturer.
- B. Strictly follow the lining manufacturer's written instructions and the requirements of this specification regarding all aspects of protective lining work including: mixing, application, recoat times and curing.

C. Environmental Requirements:

1. Comply with the lining manufacturer's recommendations as to environmental conditions under which lining materials can be applied.
2. Do not apply lining materials when dust is being generated.
3. Provide all temporary lighting during the work equivalent to one 200-watt explosion proof incandescent lamp per 100-square feet of work area.

D. Protection of Equipment and Other Surfaces (Not to Receive Lining System)

1. It shall be the Contractor's responsibility to mask, cover, or otherwise protect equipment, other finishes, and surfaces not to receive the coating system from damage, i.e., scratches, breakage, contamination with abrasive blast media, or other forms of deterioration related to any step in the coating installation work. This shall be accomplished using plywood shields, polyethylene plastic wrapping, masking with duct tape, and other means suitable for achieving such protection, i.e., tarpaulins, erection of temporary wooden structures, etc.
2. Do not apply lining materials, filler/surfacers, or repair mortars over equipment name plates, tagging, or any other identification devices on piping, equipment, or other finishes.
3. Carefully protect all rotating or moving parts of all equipment such as bearings, shafts, etc. to prevent damage or ingress of any particulates detrimental to such moving equipment parts.

- E. In tanks and channels that will be covered with aluminum covers, coating shall extend 8-inches on the top surface of tank or channel walls.

3.03 CONTROL OF AMBIENT CONDITIONS IN STRUCTURES TO BE LINED

- A. Control ambient conditions in the structures to be coated, and provide protective enclosures during surface preparation, application, and curing, to meet the specified conditions. This control work shall be continued throughout the lining system installation and curing.
- B. The minimum ambient condition requirements inside the channels and structures for coating system work shall be as follows:
1. During all phases of coating system installation and curing:
 - a. Air temperature – 65°F minimum
 - b. Relative humidity – below 85%
 - c. Substrate surface temperature – 50°F minimum, and at least 10°F higher than dew point temperature

- d. No dust generation shall be allowed during this period
- C. Contractor shall provide ventilation and isolation of each channel and structure to be lined. Contractor shall provide all means necessary to exhaust noxious gases and odors, which may be present during the work.

3.04 SURFACE PREPARATION REQUIREMENTS

- A. Structures to which the lining will be applied have been exposed to wastewater for several years, (except for new concrete structures to be lined) therefore, the Contractor shall provide initial cleaning and surface preparation, as specified herein.
- B. General Surface Preparation Requirements
 - 1. Used or spent blast abrasive shall not be reused on this project.
 - 2. The compressed air used for blast cleaning shall be filtered and shall contain no condensed water and no oil. Moisture traps shall be cleaned at least once every four (4) hours or more frequently as required to prevent moisture from entering the supply air to the abrasive blasting equipment.
 - 3. Oil separators shall be installed just downstream of compressor discharge valves and at the discharge of the blast pot discharges. These shall be checked on the same frequency as the moisture traps as defined in item 2 above.
 - 4. Regulators, gauges, filters, and separators shall be in use on all of the compressor air lines to blasting nozzles at all times during this work.
 - 5. An air dryer or desiccant filter drying unit shall be installed which dries the compressed air prior to blast pot connections. This dryer shall be used and maintained for the duration of all surface preparation work.
 - 6. The abrasive blast nozzles used shall be of the venturi or other high velocity type supplied with a minimum of 100 psig air pressure and sufficient volume to obtain the blast cleaning production rates and cleanliness/specified herein.
 - 7. The Contractor shall provide ventilation for airborne particulate evacuation (meeting all pertinent safety standards) to optimize visibility for both blast cleaning and inspection for the substrate during surface preparation work.
 - 8. Ground fault interrupters shall be used on all electrical equipment used in the work.
 - 9. If between final surface preparation work and coating application, contamination of the prepared and cleaned substrates occurs, or if the prepared substrates' appearance darkens or changes color, recleaning by waterblasting, reblasting and abrasive blast cleaning shall be required until the specified degree of cleanliness is reclaimed.
 - 10. The Contractor is responsible for dust control and for protection of mechanical, electrical, and all other equipment adjacent to and surrounding the work area.

C. Degreasing

1. If inspection of the substrate prior to abrasive blast cleaning indicates the presence of grease or oil on the concrete surfaces, degrease the surfaces prior to blast cleaning. Use alkaline cleaning solutions, steam cleaning, or hot water with detergents, followed by rinsing with clean, potable water, and until all traces of degreasing/cleaning solutions have been removed. Alternate degreasing materials and methods as proposed by the Contractor will be considered and must be approved in writing by the Engineer.

D. Cleaning and Substrate Decontamination for substrates previously exposed to wastewater:

1. Prior to abrasive blast cleaning of the substrates to be coated, the Contractor shall be responsible for cleaning of the concrete and metal substrates to be coated.
2. This cleaning shall consist of high-pressure water blasting using a minimum cleaning pressure of 5,000 psi and a minimum cleaning volume of 6 gallons per minute of using clean, potable water. First, clean the concrete with potable water and bleach using 5 parts bleach to 95 parts water. Follow this by thorough cleaning/rinsing with a copious amount of potable water only.
3. This cleaning must remove all wastewater solids/residues, scum, all debris such as embedded dirt, loose coatings, and all other substances from the concrete and metal surfaces of the structures to be coated.
4. Remove all debris, wastewater constituents, and spent cleaning water from the structures to be coated by pumping and/or by vacuum cleaning. The waste and spent water used for this initial cleaning shall be conveyed by the Contractor to a location at the Treatment Plant identified by the Owner.

E. Surface Preparation of Existing Concrete Substrates

1. Abrasive blast clean or hydro blast clean all previously coated concrete surfaces to remove all existing protective coating materials degraded concrete, and to produce a sound, clean substrate free of latence, surface contaminants, loose materials, or otherwise deleterious substances. Cleaning shall be in accordance with SSPC-SP-13/NACE.
2. Cleaning of all existing concrete surfaces must produce a minimum, uniform substrate anchor pattern or profile similar to CSP 6 to 7 in accordance with ICRI 03732.
3. Should cleaning not remove degraded concrete, chipping or other abrading tools shall be used to remove the deteriorated concrete until a sound, clean substrate is achieved which is free of calcium sulfate, loose coarse or fine aggregate, latence, loose hydrated cement paste, and otherwise deleterious substances. Abrasive blast cleaning and any other means necessary shall be used to open up all air voids or "bugholes" to expose their complete perimeter. Leaving shelled over, hidden air

voids beneath the exposed concrete surface will not be acceptable. Concrete substrate must be dry prior to the application of any surface filler or coating materials.

4. Acceptable surface preparation must produce a concrete surface pH of 9.0 to 11.0 to be confirmed by surface pH testing as specified under paragraph 4.01 herein. Acceptable surface preparation must remove all concrete acid reaction materials.
5. Following inspection of the concrete surface preparation by the Contractor, and independent inspector and acceptance by the Engineer, thoroughly vacuum clean all concrete surfaces to be coated to remove all loose dust, dirt, and spent abrasive leaving a dust free, sound concrete substrate. All debris produced by blast cleaning shall be removed from the structures to be coated and disposed of at a location designated by the Owner. Inspect again and if specified conditions are met, the Engineer will accept the substrate prior to commencement of coating installation.

F. Surface Preparation of New Concrete Substrates

1. Abrasive blast clean or hydro blast clean all previously coated concrete surfaces to remove all existing protective coating materials degraded concrete, and to produce a sound, clean substrate free of laitance, surface contaminants, loose materials, or otherwise deleterious substances. Cleaning shall be in accordance with SSPC-SP-13/NACE.
2. Cleaning of new concrete surfaces must produce a minimum, uniform substrate anchor pattern or surface profile between CSP 6 and 7 in accordance with ICRI 03732.
3. Should cleaning not remove degraded concrete, chipping or other abrading tools shall be used to remove the deteriorated concrete until a sound, clean substrate is achieved which is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste, and otherwise deleterious substances. Abrasive blast cleaning and any other means necessary shall be used to open up all air voids or "bugholes" to expose their complete perimeter. Leaving shelled over, hidden air voids beneath the exposed concrete surface will not be acceptable. Concrete substrate must be dry prior to the application of any surface filler or coating materials.
4. All new concrete to be lined must have achieved a minimum of twenty-eight (28) days of cure time prior to lining application.
5. New concrete surfaces shall not have been cured using curing compounds, but rather will have been wet cured.
6. Acceptable surface preparation must produce a concrete surface pH of 9.0 to 11.0 to be confirmed by surface pH testing as specified under paragraph 4.01 herein. Acceptable surface preparation must remove all concrete acid reaction materials.
7. Following inspection of the concrete surface preparation by the Contractor, and independent inspector and acceptance by the Engineer, thoroughly vacuum clean all concrete surfaces to be coated to remove all loose dust, dirt, and spent abrasive leaving a dust free, sound concrete substrate. All debris produced by blast cleaning shall be removed from the structures to be coated and disposed of at a location

designated by the Owner. Inspect again and if specified conditions are met, the Engineer will accept the substrate prior to commencement of coating installation.

G. Surface Preparation of Bare and Coated Metal Substrates Onto Which Lining System Will Terminate

1. The approved lining system for concrete will terminate onto metal substrates at various embedments and penetrations. Abrasive blast clean all such surfaces to remove all existing coatings, paints, dirt corrosion products, and other substances that would prevent the specified coating adhesion from being achieved. All metal surfaces shall be blast cleaned to a Near White Blast in accordance with SSPC-SP-10. All metal surfaces shall be cleaned to produce a minimum surface profile of 4.0 mils which is uniform.
2. Post Blast Cleaning: Once abrasive blast cleaning has been accepted, proceed as follows:
 - a. Remove all traces of grit, dust, dirt, rust scale, friable material, loose corrosion products or embedded abrasives from substrate by vacuum cleaning prior to coating system application.
 - b. Prevent contamination of the concrete or metal surfaces after blasting from workers' fingerprints, deleterious substances on workers' clothing, or from atmospheric conditions. If, after cleaning, contamination occurs, reblast and reclean to achieve specified substrate cleanliness. Care must be taken to hold the specified degree of cleanliness on metal surfaces to prevent rust bloom prior to proceeding with application of the coating materials.

3.05 INSTALLATION OF COATING SYSTEM

- A. Unless specified elsewhere herein, strictly comply with the lining manufacturer's most recent written instructions with respect to the following:
1. Mixing of All Materials
 2. Protection and Handling of All Materials
 3. Recoat Limitation and Cure Times
 4. Minimum Ambient and Substrate Temperatures, Substrate's Degree of Dryness, Relative Humidity and Dew Point of Air
 5. Application
 6. Final Curing
 7. Use of Proper Application Equipment
- B. The protective lining must provide sealed substrates to prevent penetration of H₂S gas and liquids.

- C. Provide lining system terminations at leading edges (above or below the water line) and at all metallic interruptions to the concrete substrate, i.e. pipe supports, pipe penetrations, gates to adjacent structures, tanks, and channels, etc. All such coating system terminations shall be treated in accordance with the termination details and instructions provided by the lining manufacturer.
- D. Repair all deep voids or damaged areas of the concrete substrates to be lined using the specified trowel applied repair materials listed in Part 2.02 B. of this section. Repair all voids 1/2-inch deep or less using the specified trowel applied repair materials listed in 2.02 A. of this Section. These same materials should be used to completely resurface all existing concrete substrates to receive the lining system. This resurfacing should require an average thickness of 1/8-inch of the filler/ surfacer material specified in 2.02 A. of this Section. The application of the surfacer shall provide a uniform, "bughole" free surface to receive the 1/8" thick corrosion resistant lining.
- E. Following the proper recoat time for the filler/surfacer materials, trowel or spray apply the approved lining material evenly over the concrete surfaces as recommended and instructed by the lining manufacturer to a total dry film thickness of 125 mils or 1/8-inch above the prepared profile and above all filled air voids and bugholes in the concrete substrates. Where terminating the application of the coating system onto metal pipes and other metal surfaces, the coating material must be applied to a minimum dry film thickness of 125 mils. Depending upon the selected product, installation may require more than one application of the coating material to achieve the 125 mil total dry film thickness. To ensure a pinhole free coating surface and to remove sags or trowel marks, the wet coating shall be rolled or otherwise treated to leave a relatively smooth coating surface free of excessive trowel marks, sags or other variations in thickness. The coating material shall be forced into the surface profile or roughness of the substrate as recommended by the lining manufacturer. When multiple coats are used, the first is to be a dark color (if available) and each subsequent coat contrasts with the coat that precedes it.
- F. When the surface temperatures of the concrete substrates to be coated are rising or when these substrates are in direct sunlight, outgasing of air from the concrete will result in bubbling, pinhole formations, and/or blistering in the lining or resurfacing materials. As such, the application of the lining or surfacing materials in such locations shall be postponed until the cooler evening hours or other measures shall be taken to prevent such rising substrate temperatures. Should bubbles, pinholes, or discontinuities form in the applied materials, they shall be repaired as recommended by the lining manufacturer.
- G. Any or all sloughs, sags, ridges, runs, or other surface irregularities are to be smoothed by methods and means approved by the lining manufacturer prior to application of successive coats and prior to cure of the coating material. The completed coating shall be smooth, pinhole free, and free of seams or cold joints.
- H. The coating material shall terminate at or onto leading edges, metal embedments, pipe penetrations, and at other terminations as shown on the details provided by and as recommended by the lining manufacturer.
- I. Treatment of the coating application at expansion joints, cold joints, control joints, isolation joints, or cracks shall be installed in accordance with the drawing details or written instructions provided by the lining manufacturer.

- J. The approved joint sealants shall be installed at joints and cracks in the concrete in conjunction with the coating material in accordance with the instructions and details of the lining manufacturer and as follows.
1. All joints to receive sealant shall be cleaned, primed, backed and caulked in complete accordance with the manufacturer's instructions. Existing caulk joints and residual caulking where new caulk joints will be applied or where surfaces will be left exposed in the new work shall all be removed by grinding or other approved means to leave surfaces acceptable to receive sealant or clean as approved where surfaces will be left exposed. Provide specified backing rods for all joints or, where authorized, approved bond breaker tape.
 2. Sealant shall be applied to a square section configuration. Minimum depth of joint shall be 1/4-inch and maximum 1/2-inch. For joints greater than 1/2-inch wide provide sealant in a 2 to 1 width-to-depth ratio.
 3. The surfaces of all materials adjoining caulked joints shall be cleaned free of all smears of sealant or other soiling due to caulking operations.
 4. Joints shall be finished to a slightly concave finish as approved.

3.06 CURING OF PROTECTIVE COATING SYSTEM

- A. The finished lining shall be protected from damage during curing and shall be cured as recommended by the lining manufacturer. Ambient conditions shall be controlled during curing to ensure the minimum air temperature and minimum relative humidity as required by the lining manufacturer.

3.07 CLEAN-UP

- A. At the completion of the coating installation work, remove all equipment, surplus material, and debris from the site. The surrounding surface area, including roadways, and all other surfaces shall be restored to their pre-project condition.

PART 4 FIELD QUALITY CONTROL INSPECTION AND TESTING

4.01 RESPONSIBILITY FOR QUALITY

- A. The Engineer will provide inspection and testing of the lining work covered by this Section throughout the project. However, inspection by the Engineer or Engineer's representative or others does not limit the Contractor's responsibilities for the ultimate quality of the installed work as required by this Section and the lining manufacturer's written instructions and procedures.

4.02 FINAL INSPECTION

- A. Perform a final inspection to determine whether coating work meets the requirements of the specifications. This work shall be performed by the Engineer and the Contractor.

- B. Mark any rework required on any pinholes, holidays or any other inadequacies in the quality of the coating work. Such areas shall be recleaned and repaired by the Contractor as specified herein at no additional cost to the Owner.
- C. If the adhesion test fails a second time, the Owner/Engineer reserves the right to require the entire surface to be completely removed and reapplied at no cost to the Owner/Engineer.

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SECTION 09902

FINISH PAINTING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Furnish all material, labor, scaffolding, and equipment required to complete all work shown on the Drawings and specified herein. Work includes painting and finishing of all new exterior and interior exposed items and surfaces and some refinishing of existing surfaces as specified or noted on the Drawings.
- B. Paint all exposed surfaces except where the natural finish of the material is obviously intended and specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint these the same as adjacent similar materials or areas.
- C. It is the intent of this Section to paint items as specified herein, as indicated on the Drawings, and all other work obviously required to be finish painted unless otherwise specified. These items include but are not limited to the following: interior concrete and precast concrete surfaces where noted or scheduled; concrete masonry units; structural steel; miscellaneous metals including steel doors and frames, and steel frames for glazed openings; pipe, fittings, supports, valves, gates, operators and posts; roof fans; electrical conduit and appurtenances; interior gypsum work; interior concrete masonry unit walls; and exposed ductwork. Minor items omitted in the schedule of work shall be included in the work of this Section where they come within the general intent of the specifications as stated herein.
- D. Galvanized steel for miscellaneous metal structures including stairs, platforms, etc. shall not receive an additional field coating beyond touchup and coating repair due to cutting or damage. All galvanized steel for architectural features including lintels, jambs, flashing, etc. shall be field painted in accordance with the schedules and details on the Architectural Drawings.
- E. The following surfaces or items are not required to be painted:
 - 1. Portions of metal, other than aluminum, embedded in concrete. This does not apply to the back face of items mounted to concrete or masonry surfaces that shall be painted before erection. Aluminum to be embedded in or in contact with concrete or masonry shall be coated to prevent electrolysis,
 - 2. Galvanized structural steel, unless specified or noted otherwise,
 - 3. Stainless steels and non-ferrous metals (except copper), unless specified or noted otherwise,
 - 4. Concealed surfaces of pipe or crawl spaces,

5. Exterior cast-in-place or precast concrete surfaces, unless otherwise specified or noted elsewhere,
 6. Suspended acoustical tile ceilings,
 7. Tile,
 8. Door and other finish hardware, except door closers that are not finished,
 9. Manhole frames and covers,
 10. Fiberglass other than piping,
 11. Packing glands and other adjustable parts, and nameplates and data plates of mechanical equipment,
 12. Fencing,
 13. Chemical resistant or epoxy flooring,
 14. Abrasion resistant topping,
 15. Plumbing fixtures,
 16. Furniture,
 17. Factory prefinished architectural components,
 18. Membrane roofing,
 19. Mechanical and electrical equipment that has been factory finished as specified in Divisions 11, 13, 15 and 16,
 20. Do not paint any code required labels such as Underwriters Laboratories (UL) and Factory Mutual (FM), or any equipment identification, performance rating, name or nomenclature plates,
 21. Unless otherwise specified, concealed spaces do not require painting. This includes walls and ceilings in inaccessible spaces such as pipe chases, furred areas, duct shafts, etc.
- F. Where rooms are shown in the finish schedule to have unfinished walls and ceilings, paint metal doors and frames and other miscellaneous items in these spaces.
- G. Stainless steel and non-ferrous pipelines shall be labeled and receive color coded banding.
- H. Paint that contains mercury, asbestos or lead will not be permitted.

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 07110 – Sheet Membrane Waterproofing
- B. Section 09800 – Corrosion-Resistant Polymer Lining

1.04 WORK SPECIFIED ELSEWHERE

- A. Unless otherwise specified, shop priming of ferrous metal items is included under the various sections for structural steel, miscellaneous metal, hollow metal work, fabricated or factory built mechanical and electrical equipment or accessories.
- B. Coating requirements for fabricated or factory built mechanical and electrical equipment and accessories are included under specific sections for those items.
- C. Painting of exposed piping, conduit, ductwork, insulated piping, equipment, and other mechanical or electrical work in mechanical rooms. Coordinate painting with the Mechanical and Electrical Subcontractors.
- D. Labeling of piping and conduit.
- E. Waterproofing and dampproofing.

1.05 REFERENCE STANDARDS

- A. ASTM International (ASTM), latest edition:
 - 1. ASTM A380 Standard Practice for Cleaning, Descaling, and Passivation of Stainless-Steel Parts, Equipment, and Systems
 - 2. ASTM D4258 Standard Practice for Surface Cleaning Concrete for Coating
 - 3. ASTM D5162 Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coatings on Metallic Substrates

- B. American Water Works Association (AWWA)
- C. Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (Ten State Standards)
- D. National Science Foundation (NSF), latest edition:
 - 1. NSF 61 Drinking Water System Components – Health Effects.
 - 2. NSF 600 New Extraction Requirements of NSF International
- E. Occupational Safety and Health Act (OSHA), latest edition:
 - 1. Air Pollution Control Rules
 - 2. Color Coding
- F. Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE), latest edition:
 - 1. SSPC-SP-1 Solvent Cleaning
 - 2. SSPC-SP-2 Hand Tool Cleaning
 - 3. SSPC-SP-3 Power Tool Cleaning
 - 4. SSPC-SP-5/NACE No. 1 White Metal Blast Cleaning
 - 5. SSPC-SP-6/NACE No. 3 Commercial Blast Cleaning
 - 6. SSPC-SP-10/NACE No. 2 Near-White Metal Blast Cleaning
 - 7. SSPC-SP-11 Power Tool Cleaning to Bare Metal
 - 8. SSPC-SP-13/NACE No. 6 Surface Preparation of Concrete
 - 9. SSPC-PA2 Measurement of Dry Coating Thickness with Magnetic Gages
 - 10. NACE SP0188 Discontinuity Holiday Testing of Protective Coatings

1.06 SUBMITTALS

- A. Submit manufacturer's printed brochures showing the type of materials to be used for each painting system. Submit certification from the finish paint manufacturer that the manufacturer's materials are suitable for the intended application as shown on the Drawings and as specified herein.
- B. Submit to the Engineer for review in accordance with Section 01300, Submittals, shop drawings, working drawings, and product data including manufacturer's specifications

and data on the proposed paint systems and detailed surface preparation, application procedures and dry film thickness (DFT). Certify that the systems submitted meet all applicable volatile organic carbon regulations. Equivalent systems are to be submitted at no additional costs to meet any new regulations.

- C. Submit to the Engineer for review in accordance with Section 01300, Submittals, color cards, including standard and special colors, for initial color selections. Coordinate color samples with other Sections through the submittal process, as required by the Engineer.
- D. Submit documentation of the compatibility between prime coats and finish coats along with the date and ambient conditions for application of prime coat with an established recoat window allowed for each prime system. Submit corrective surface preparation techniques for all systems in the event that the recoat window is missed.
- E. Submit to the Engineer for review a complete Schedule of Painting Operations within 90 days after the Notice to Proceed.
 - 1. Properly notify and coordinate the fabricators' surface preparation and painting operations with these Specifications. This Schedule shall include for each surface to be painted, the brand name, the percent volume of solids, the coverage and the number of coats the Contractor proposes to use in order to achieve the specified dry film thickness, and color charts.
 - 2. When the Schedule has been approved, apply all material in strict accordance with the approved Schedule and the manufacturer's instructions.
 - 3. Wet and dry paint film gauges shall be made available to the Engineer to verify the proper application while work is in progress.
- F. Submit listing of not less than three (3) of applicator's most recent applications representing similar scope and complexity to Project requirements. List shall include information as follows:
 - 1. Project name and address,
 - 2. Name of Owner,
 - 3. Name of Contractor,
 - 4. Name of Engineer,
 - 5. Date of Completion.

1.07 QUALITY ASSURANCE

- A. Required Applicator Inspections and Documentation:
 - 1. Verify coatings and other materials are as specified,
 - 2. Verify environmental conditions are as specified,
 - 3. Verify surface preparation and coating application are as specified,

4. Verify DFT of each coat and total DFT of each coating system are as specified using wet film and dry film gauges. DFT's shall be measured in accordance with SSPC-PA2,
5. Coating Defects:
 - a. Check Coating for film characteristics or defects that would adversely affect performance of coating systems,
 - b. Check exterior finish for film characteristics or defects that adversely affect appearance,
 - c. Check for holidays on steel immersion, and concrete immersion or severe corrosive environment surfaces using a holiday detector in accordance with ASTM D5162.

B. Report:

1. Prepare inspection reports daily,
2. Submit written reports describing inspections made and actions taken to correct nonconforming work,
3. Report nonconforming work not corrected,
4. Submit copies of report to Engineer.

C. Manufacturer's Service

1. A representative of the paint manufacturer shall be available to provide on-site technical assistance, and guidance for application of the paint system as needed.

1.08 INSTALLER QUALIFICATION

- A. Engage only factory trained, approved applicators that have successfully completed applications using specified materials on projects of similar size and scope.
- B. Provide three (3) recent references indicating successful application using similar materials.
- C. Provide written approval letter from the material manufacturer.
- D. All of the contractor's jobsite personnel must be trained in the hazards associated with confined space entry. All personnel entering a confined space shall be certified for confined space entry.

1.09 PRODUCT HANDLING

- A. Deliver all materials to the job site in original, new and unopened packages and containers bearing manufacturer's name and label showing at least the following:
 - 1. Name or title of the material,
 - 2. Federal Specification number, if applicable,
 - 3. Manufacturer's name and stock number,
 - 4. Contents by volume for major constituents,
 - 5. Thinning instructions,
 - 6. Application instructions.
- B. Provide proper storage to prevent damage to, and deterioration of, paint materials.
- C. Use all means necessary to protect the materials of this section before, during, and after installation and to protect the work and materials of all other trades.
- D. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.

1.10 JOB CONDITIONS

- A. Surface temperatures: Do not apply solvent-thinned paints when the temperature of surfaces to be painted and the surrounding air temperature are below 45 degrees F, unless otherwise permitted by the manufacturer's printed instructions as approved by the Engineer.
- B. Weather conditions: Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent (85%); or to damp or wet surfaces, unless otherwise permitted by the manufacturer's printed instructions as approved by the Engineer. Applications may be continued during inclement weather within the temperature limits specified by the paint manufacturer during application and drying periods.

1.11 SAMPLES

- A. Prior to starting work on the application of paint, Engineer may require the application of paint on a sample surface. Sample surface may be up to 200 square feet with coating of the material and colors selected. Prepare sample areas of finished work in strict accordance with these specifications. Finished areas shall be adequate for the purpose of determining the quality of workmanship, and all subsequent painting shall be equal in quality to the approved samples. Experimentation with color tints shall be furnished to the satisfaction of the Engineer where standard chart colors are not satisfactory. The work may not proceed until the Engineer approves the painting sample.

1.12 SPARE MATERIAL

- A. Furnish one (1) unopened gallon can of each type and each color of paint used. Paint shall be correctly stored to protect the integrity of the paint and shall be delivered to the Owner upon project completion and prior to final acceptance. Spare material containers shall be furnished with typed labels designating where the material was applied on this contract.

1.13 PRE-PAINTING CONFERENCE

- A. Well in advance of commencement of painting operations, but after major equipment has been delivered, a pre-painting conference shall be held. All parties with an interest in the painting work shall attend, including the Contractor, the Owner, the Engineer, and the painting contractor (subcontractor) and a representative of the paint manufacturer. The Contractor shall be responsible for scheduling the meeting and contacting the participants.
- B. The conference shall include an inspection of the areas to be painted by all parties and a discussion of the conformance of each area with the specifications. Important issues such as paint compatibility, environmental conditions, climate control systems, , dry film thickness, and monitoring the number of coats that have been field applied shall be discussed and problems shall be resolved.
- C. A written record of the meeting including an attendance list shall be submitted to the Engineer.

PART 2 PRODUCTS

2.01 PAINT MATERIALS

- A. All painting materials shall be manufactured and supplied by Tnemec Company, Inc., Sherwin-Williams Company, and PPG Industries. Other manufacturers may be submitted for consideration as equals.
 - 1. No brand other than those named will be considered for approval unless the brand and type of paint proposed for each item in the following schedule is submitted in writing to the Engineer for approval within 30 days after the signing of the Notice to Proceed. Submittals shall include sufficient data describing the proposed products, substantiated by certified tests conducted at no expense to the Owner, which demonstrates equality to the paint(s) named. The type and number of tests performed shall be subject to the Engineer's approval. Color availability to match those colors specified will also be considered as an important property for equality.
 - 2. The Engineer shall be the sole authority in the determination of the selection and acceptance of equals.
- B. Provide the best quality grade of the various types of coatings as regularly manufactured by paint materials manufacturers approved by the Engineer. Materials not displaying the manufacturer's identification as a standard best-grade product will not be accepted.
- C. Provide paints that are of durable and washable quality. Do not use paint materials that will not withstand normal washing as required to remove pencil marks, ink, ordinary soil, and similar material without showing discoloration, loss of gloss, staining, or other damage.
- D. The Owner will select colors to be used in the various types of paint specified and will be the sole judge of the acceptability of the various glosses obtained from the materials proposed to be used in the work.

- E. Provide paint undercoat produced by the same manufacturer as the finish coat. Use thinners only to the limit and type recommended by the manufacturer. Insofar as practicable, use undercoat, finish coat, and thinner material as parts of a unified system of paint finish.
- F. All painting materials shall be used without adulteration and shall be mixed, thinned, and applied in strict conformance with the manufacturer's recommendations.
- G. Proper containers shall be provided for painting wastes. The containers shall be located outside of buildings and disposal shall be in accordance with pertinent codes and applicable fire regulations and shall not be on the owner's property. Paint wastes shall not be discharged to drains under any circumstances.
- H. All regulations and recommendations of the paint manufacturer shall be followed with regard to the storage and application of coatings, and the safety of workmen and the public.
- I. All coatings used on surfaces in contact with water being treated for and potable water shall be suitable for potable water contact, be NSF 61 approved, and shall meet the appropriate regulatory requirements. A certification shall be provided from the coating manufacturer attesting to such with the coating submittal.

2.02 PAINTING SCHEDULE

- A. Paint types shall be as described and defined below. The Owner will select all colors from color charts submitted by the Contractor.
- B. The following surfaces shall have the types of paint scheduled below applied at the dry film thickness in mils per coat noted. Some colors will require additional coat and thickness than that listed in order to achieve proper color coverage and shall be provided at no additional cost if necessary. A coating system has been designated for the purpose of identifying type and standard. Equivalent coating systems for the other manufacturers will be considered. Adequate information shall be submitted to the Engineer to permit a determination of the paint system being equal to that specified.

1. Ductile Iron Subject to Submergence or Splashing:

- a. Ductile Iron Surface Preparation: NAPF 500-03-04
- b. Tnemec Product:

Coat	Tnemec Product	Dry Film Thickness (mils)
Primer	Series N69/N69F HB Epoxoline	4.0 to 6.0
Finish	Series 142 Epoxoline	15.0 to 20.0

c. Sherwin-Williams Product:

Coat	Sherwin-Williams Product	Dry Film Thickness (mils)
Primer	Dura-Plate 235 MPE	4.0 to 6.0
Finish	SherGlass FF Epoxy	15.0 to 20.0

2. Ductile Iron Subject to Submergence of Splashing in Severe Service Environments:

a. Ductile Iron Surface Preparation: NAPF 500-03-04

b. Tnemec Product:

Coat	Tnemec Product	Dry Film Thickness (mils)
Primer	Series N69/N69F HB Epoxoline	4.0 to 6.0
Finish	Series 435 Perma-Shield	15.0 to 20.0

c. Sherwin-Williams Product:

Coat	Sherwin-Williams Product	Dry Film Thickness (mils)
Primer	Dura-Plate 235 MPE	4.0 to 6.0
Finish	Dura-Plate 5900	15.0 to 20.0

3. Interior Non-Submerged Ferrous Metals:

a. Steel Surface Preparation: SSPC-SP6 Commercial Blast Cleaning of Steel

b. Ductile Iron Surface Preparation: NAPF 500-03-04

c. Tnemec Product:

Coat	Tnemec Product	Dry Film Thickness (mils)
Primer	Series N69/N69F HB Epoxoline	4.0 to 6.0
Finish	Series N69/N69F HB Epoxoline	4.0 to 6.0

d. Sherwin-Williams Product:

Coat	Sherwin-Williams Product	Dry Film Thickness (mils)
Primer	Macropoxy 646	4.0 to 6.0
Finish	Macropoxy 646	4.0 to 6.0

4. Exterior Ductile Iron Pipe Not Subject to Splashing or Submergence:

a. Ductile Iron Surface Preparation: NAPF 500-03-04

b. Tnemec Product:

Coat	Tnemec Product	Dry Film Thickness (mils)
Primer	Series N69/N69F HB Epoxoline	4.0 to 6.0
Finish	Series 1094 Endura-Shield	3.0 to 5.0

c. Sherwin-Williams Product:

Coat	Sherwin-Williams Product	Dry Film Thickness (mils)
Primer	Macropoxy 646	4.0 to 6.0
Finish	Acrolon 218 HS Polyurethane	3.0 to 5.0

5. Interior exposed CMU:

- a. Surface Preparation: Have substrate clean and dry. Remove mortar splatter and level protrusions. Minimum cure time for the mortar prior to application is 28 days.

b. Tnemec Product:

Coat	Tnemec Product	Dry Film Thickness (mils)
Filler	Series 1254 Epoxoline WB	100 to 150 ft ² /gal
2 Coats	Series 69/N69F HB Epoxoline	4.0 to 6.0 total

c. Sherwin Williams Product:

Coat	Sherwin-Williams Product	Dry Film Thickness (mils)
Primer	Cement Plex 875	75 - 100 ft ² /gal
2 Coats	Pro-Industrial Waterbased Catalyzed Epoxy	3.0 to 4.0

6. Interior Gypsum Board and Plaster:

- a. Surface Preparation: Have substrate clean and dry.

b. Tnemec Product:

Coat	Tnemec Product	Dry Film Thickness (mils)
Primer	Series 151 Elasto-Grip	1.0 to 2.0
Finish	Series 113 H.B. Tneme-Tufcoat	4.0 to 6.0

c. Sherwin Williams Product:

Coat	Sherwin-Williams Product	Dry Film Thickness (mils)
Primer	ProMar 200 Zero VOC Primer	1.0 to 1.5
2 Coats	Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss	2.5 to 4.0

7. Exterior Structural Steel:

- a. Surface Preparation: SSPC-SP6 Commercial Blast Clean with a surface profile of 2.0 to 3.0 mils

b. Tnemec Product:

Coat	Tnemec Product	Dry Film Thickness (mils)
Primer	Series 394 Perimeprime	2.5 to 3.5
Base	Series N69/N69F HB Epoxoline	2.0 to 5.0
Finish	Series 1094 Endura-Shield	2.0 to 5.0

c. Sherwin-Williams Product

Coat	Sherwin-Williams Product	Dry Film Thickness (mils)
Primer	Zinc Clad 4100 Zinc-rich Epoxy	2.5 to 3.5
Base	Macropoxy 646	3.0 to 5.0
Finish	Acrolon 218 HS Polyurethane	3.0 to 6.0

- C. Primers containing lead will not be allowed.

- D. Any surfaces that are not specifically named in the Schedule and not specifically excepted shall be prepared, primed, and painted in a manner and with a material that is consistent with these specifications. The Engineer will select which of the manufacturer's products, whether indicated or not, to be used on the unnamed surfaces. No extra payment shall be allowed for this painting.

2.03 APPLICATION EQUIPMENT

- A. Only equipment recommended by the manufacturer and approved by the Engineer shall be used to apply any particular paint. Equipment shall be compatible for the paint and painting system.

2.04 COLOR CODING FOR PIPES AND EQUIPMENT

- A. Color coding shall consist of color code painting and identification of all exposed conduits, troughs, and pipelines for the transport of gases, liquids, and semi-liquids including all accessories such as valves, insulated pipe covers, fittings, junction boxes, and all operating accessories which are integral to the whole functional mechanical, pipe, and

electrical conduit system. Color coding shall comply with the recommended color coding in Ten State Standards, included as follows:

1. For Sewer Projects:

a. Raw Sludge	Brown with Black Bands
b. Sludge Recirculation Suction	Brown with Yellow Bands
c. Sludge Draw off	Brown with Orange Bands
d. Sludge Recirculation Discharge	Brown
e. Non-potable Water	Blue with Black Bands
f. Potable Water	Blue
g. Sewage	Gray
h. Compressed Air	Green
i. Plumbing Drains and Vents	Black

- B. All hangers and pipe supports shall be painted the same color and with the same paint as the pipe it supports. The system shall be painted up to but not including the flanges attached to the mechanical equipment or the flexible conduit connected to electrical motors. If more than one pipe is supported, the bracket shall be painted the same color as the nearest adjacent wall or ceiling.
- C. All systems that are an integral part of the equipment, that is originating from the equipment and returning to the same piece of equipment, shall be painted between and up to but not including, the fixed flanges or connections on the equipment.
- D. The Color Code establishes, defines, and assigns a definite color for each category of pipe. Pipelines, equipment, and other items that are not listed in the Color-Coding Schedule shall be assigned a color by the Engineer and shall be treated as an integral part of the Contract, at no additional cost to the Owner.
- E. PVC pipe shall not be painted but shall be banded in accordance with the color code. Banding shall be 2 inches wide and spaced 5 ft. on center, located at each end of the pipe title, at 2 feet from the title bands, and at all wall penetrations.
- F. All conduit shall be painted to match its background surface.

2.05 LETTERING OF TITLES

- A. Each pipe system shall be labeled with the name of the materials in each pipeline and with an arrow showing the direction of flow of liquids. Titles shall be located not more than 20 feet apart and shall also appear directly adjacent to each side of a wall that a pipeline breaches or penetrates. It shall be adjacent to valves and all pieces of equipment.
- B. Titles shall identify the contents by complete name. Identification titles shall be located as determined by the Engineer but shall be in full and unobstructed view.
- C. Titles shall be applied at eye level on machines where such is possible or the upper broadest vertical surface of low equipment. Name and identification number as shown on the drawings shall identify equipment. Titles shall be composed and justified on the left-hand side.

D. Application of titles shall be as follows:

1. The color of titles shall be black or white to best contrast with the color of the pipe or equipment and shall be stencil applied.
2. Stencil text shall be in all caps worded exactly as shown on the schedules. Titles are to be printed in a single line.
3. Equipment titles are to be 2 inches high.
4. Pipe titles are to be as follows:

<u>Outside Diameter of Pipe or Covering (inches)</u>	<u>Size of Letters (inches)</u>
3/4" to 1-1/2"	1/2"
1-1/2" to 2"	3/4"
2-1/2" to 6"	1-1/4"
8" to 10"	2-1/2"
Greater than 10"	3-1/2"

5. Arrow sizes: Where "a" is equal to 3/4 of the outside diameter of pipe or covering, the arrow shaft shall be 2 "a" long by 3/8 "a" wide. The arrowhead shall be an equilateral triangle with sides equal to "a". Maximum "a" shall be 6 inches.
6. When using direction arrow, point arrowhead away from pipe markers and in the direction of flow. If flow can be in both directions, use a double-headed directional arrow.

2.06 FABRICATED EQUIPMENT

- A. Unless otherwise indicated, all fabricated equipment requiring a coating system shall be supplied with a temporary shop primer or with a shop applied final coating system compliant with the equipment specification or this specification, in that order. Fabricators must note that shop applied final coating system thickness will be measured in the field to verify compliance.
- B. All shop primer coatings shall be removed in the field, and the equipment shall be primed and coated in accordance with the specifications.
- C. The contractor shall be responsible to take whatever steps are necessary to preserve and protect the prime or finished coating system in the field against damage from weather or other causes.
- D. Whenever fabricated equipment is required to be cleaned with a grit material, all motors, drives, bearings, gears, etc. shall be protected from the entry of grit. Any equipment found to be so contaminated shall be promptly and thoroughly cleaned.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

- A. All surfaces to be painted shall be prepared as specified herein and shall be dry and clean prior to painting.
- B. All metal welds, blisters, etc., shall be ground and sanded smooth in accordance with SSPC-SP-11. All pits and dents shall be filled and all imperfections shall be corrected to provide a smooth surface for painting. All rust, scale, grease, oil, and dirt shall be removed by the use of approved solvents, wire brushing or sanding.
- C. Concrete block surfaces shall be smooth and cleaned of all dust, efflorescence, chalk, loose mortar, dirt, grease, oil, tar, and other foreign matter, conforming to ASTM D4258.
- D. All plastic pipe surfaces shall be lightly sanded before painting.
- E. Exposed Pipe: Bituminous coated pipe shall not be used in exposed locations. Pipe, which shall be exposed after project completion, shall be primed in accordance with the requirements herein. Any bituminous-coated pipe inadvertently installed in exposed locations shall be sandblasted clean before priming and coating. Coatings to seal bituminous coatings shall not be approved. After installation, all exterior, exposed flanged joints shall have the gap between adjoining flanges sealed with a single component polysulfide sealant to prevent rust stains.
- F. Primed or Previously Painted Surfaces and Nonferrous Surfaces: All shop applied primers or temporary coatings shall be completely removed prior to the application of the final coating system. All non-ferrous metals not to be coated shall be cleaned. This cleaning shall be done in accordance with SSPC-SP-1, Solvent Cleaning.
- G. Shop-Finished Surfaces: All shop-coated surfaces shall be protected from damage and corrosion before and after installation by treating damaged areas immediately upon detection. Abraded or corroded spots on shop-coated surfaces shall be cleaned in accordance with SSPC-SP-2, Hand Tool Cleaning and then touched up with the same materials as the shop coat. All shop-coated surfaces that are faded, discolored, or which require more than minor touch-up in the opinion of the Engineer shall receive new surface preparation before being repainted. Cut edges of galvanized sheets and exposed threads and cut ends of galvanized piping, electrical conduit, and metal pipe sleeves, that are not to be finished painted, shall be "Solvent Cleaned" and primed with zinc dust-zinc oxide metal primer.
- H. Galvanized and Zinc-Copper Alloy Surfaces: These surfaces to be painted shall be "Solvent Cleaned" and treated as hereinafter specified. Such surfaces not to be painted shall be "Solvent Cleaned."
- I. Ferrous Metals: Remove all visible oil, dirt, and other soluble contaminants in accordance with SSPC-SP1. All surfaces shall be abrasive blast cleaned to a Commercial Finish removing all existing paint, rust, dirt, mill scale and foreign matter in accordance with SSPC-SP6/NACE No. 3.

- J. Aluminum embedded or in contact with concrete must be painted according to the schedule for aluminum in contact with dissimilar materials.
- K. Wood Surfaces: Prepare surfaces per the manufacturer's recommendations and prime, paint, stain or seal surfaces in accordance with the coatings schedule.
- L. Cement Panel Ceilings: Apply one coat of USG Exterior Basecoat as recommended by the manufacturer. After recommended drying time, trowel apply USG Exterior Textured finish in a 1/16-inch minimum thick, uniform layer over all basecoat surfaces.
- M. Do not proceed in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 MATERIAL PREPARATION

- A. Mix and prepare painting materials in strict accordance with the manufacturer's recommendations as approved by the Engineer.
- B. Store materials not in actual use in tightly covered containers.
- C. Maintain containers used in storage, mixing, and application of paint in a clean condition, free from foreign materials and residue.
- D. Stir all materials before application to produce a mixture of uniform density, and as required during the application of materials. Do not stir into the material any film that may form on the surface. Remove the film and, if necessary, strain the material before using.

3.03 SURFACE PREPARATION

- A. General:
 - 1. Perform all preparation and cleaning procedures in strict accordance with the paint manufacturer's recommendations as approved by the Engineer.
 - 2. Remove all removable items that are in place and are not scheduled to receive paint finish, or provide surface-applied protection prior to surface preparation and painting operations.
 - 3. Following completion of painting in each space or area, reinstall the removed items by using workmen skilled in the necessary trades.
 - 4. Clean each surface to be painted prior to applying paint or surface treatment.
 - 5. Remove oil and grease with clean cloths and cleaning solvents of low toxicity and a flash point in excess of 38° F. prior to start of mechanical cleaning.
 - 6. Schedule the cleaning and painting so that dust and other contaminants from the cleaning process will not fall onto wet, newly painted surfaces.

B. Preparation of Metal Surfaces:

1. Thoroughly clean all surfaces until they are completely free from dirt, oil and grease.
2. On galvanized surfaces, use solvent for the initial cleaning and then treat the surface thoroughly with phosphoric acid etch. Remove all etching solution before proceeding.
3. Remove shop-applied prime coats.
4. Allow drying thoroughly before application of paint.

C. Preparation of Wood Surfaces:

1. Clean all wood surfaces until they are free from dirt, oil, and all other foreign substance.
2. Smooth all finished wood surfaces exposed to view, using the proper sandpaper. Where so required, use varying degrees of coarseness in sandpaper to produce a uniformly smooth and unmarred wood surface.
3. Unless specifically approved by the Engineer, do not proceed with painting of wood surfaces until the moisture content of the wood is 12 percent (12%) or less as measured by a moisture-meter approved by the Engineer.
4. Prime, stain, or seal wood required to be job-painted immediately upon delivery to job. Prime edges, ends, face, undersides, and backsides of such wood, including cabinets, counters, etc. When transparent finish is required, use spar varnish for back priming.
5. Seal tops and bottoms of wood doors with a heavy coat of varnish or equivalent sealer immediately upon delivery to job.

D. Preparation of Stainless-Steel Surfaces:

1. All stainless-steel components and stainless-steel piping shall be thoroughly cleaned and pickled at the mill in accordance with ASTM A380. Pickling shall produce a modest etch and shall remove all embedded iron and heat tint.

E. Preparation of Cementitious Surfaces:

1. Prepare cementitious surfaces of concrete and concrete block to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze. Allow to cure as recommended by manufacturer prior to painting.
2. Determine the alkalinity and moisture content of the surfaces to be painted by performing appropriate tests. If the surfaces are found to be sufficiently alkaline to cause blistering and burning of the finish paint, correct this condition before application of paint. Do not paint over surfaces where the moisture content exceeds that permitted in the manufacturer's printed directions.

3.04 PAINT APPLICATION

A. General:

1. Slightly vary the color of succeeding coats. Do not apply additional coats until the complete coat has been inspected and approved. Only the inspected and approved coats of paint will be considered in determining the number of coats applied.
2. Sand and dust between enamel coats to remove all defects visible to the unaided eye from a distance of five feet.
3. On all removable panels and all hinged panels, paint the backsides to match the exposed sides.
4. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.
5. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint, before final installation of equipment.
6. Finish exterior doors on tops, bottoms and side edges the same as the exterior faces. Finish tops and bottoms of wood doors same as faces except final coat may be omitted.
7. Fire rated corridor partitions, smoke stop partitions, and all fire rated walls shall have signs or stenciling on the walls above the ceiling acceptable to the authority having jurisdiction such as "Fire and Smoke Barrier Protect All Openings".
8. Paint existing surfaces in locations shown to be painted as required to match the new work specified.

B. Drying:

1. Allow sufficient drying time between coats. Modify the period as recommended by the material manufacturer to suit adverse weather conditions.
2. Oil-base and oleo-resinous solvent-type paints shall be considered dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

C. Brush application:

1. Brush out and work all brush coats onto the surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, and other surface imperfections will not be acceptable.

D. Spray application:

1. Confine spray application to metal framework and similar surfaces where hand brushwork would be inferior.
2. Wherever spray application is used, apply each coat to provide the equivalent hiding of brush-applied coats. Do not double back with spray equipment for the purpose of building up film thickness of two coats in one pass unless noted otherwise in this specification.

E. Roller Application:

1. Use roller application on interior wall and ceiling finishes when recommended by the manufacturer. Apply each roller coat to provide the equivalent hiding as brush-applied coats.

F. Completed work:

1. Completed work shall match the approved samples for color, texture, and coverage. Remove, refinish, or repaint all work not in compliance with specified requirements.

3.05 PAINT

A. General Notes and Guidelines

1. When color coding is specified or directed by the Engineer, it shall consist of color code painting and identification of all exposed conduits, through lines and pipelines for the transport of gases, liquids, or semi-liquids including all accessories such as valves, insulated pipe coverings, fittings, junction boxes, bus bars, connectors, and any operating accessories which are integral to a whole functional mechanical pipe and electrical conduit systems.
2. All moving parts, drive assemblies, and covers for moving parts, which are potential hazards, shall be Safety Orange.
3. All safety equipment shall be painted in accordance with OSHA standards.
4. All inline equipment and appurtenances not assigned another color shall be painted the same base color as the piping. The pipe system shall be painted with the pipe color up to but not including the flanges attached to pumps and mechanical equipment assigned another color.
5. All conduits shall be painted to match its background surface.
6. Control panels shall be factory finished.
7. All surface colors shall be painted as selected by the Owner.

3.06 REPAIR/RESTORATION

- A. At completion of Work, touch-up and restore finishes where damaged.

B. Defects in Finished Surfaces:

1. When stain, dirt, or undercoats show through final coat, correct defects and cover with additional coats until coating is of uniform finish, color, appearance and coverage.

C. Touch-up of minor damage shall be acceptable where result is not visibly different from surrounding surfaces. Where result is visibly different, either in color, sheen, or texture, recoat the entire surface.

D. All stainless steel and pickled surfaces damaged during fabrication including welded areas shall either be mechanically cleaned or repickled or passivated in accordance with ASTM A380.

3.07 PROTECTION

- A. Protect painted areas against damage until pain system is fully cured.

3.08 ONE-YEAR ANNIVERSARY INSPECTION

- A. Owner shall set a date for a one-year inspection.
- B. Inspection will be attended by a Representative of the Owner, Engineer, and Painting Contractor.
- C. Repair deficiencies in coating systems as determined by Engineer in accordance with Coating Manufacturer's instructions.

END OF SECTION

SECTION 10000

MISCELLANEOUS EQUIPMENT

PART 1 GENERAL

1.01 DESCRIPTION

- A. Furnish and install all building specialties and related items specified under this Section making them complete and ready for use.

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. Prepare and submit shop drawings, catalog data and maintenance manuals for all building specialties items.

PART 2 PRODUCTS

2.01 ACCESS PANELS

- A. GWB Ceiling Access Panel: ACUDOR Products, Inc., DW-5058, or equal. Install in sizes and in locations shown on Drawings or as req'd.
- B. GWB Wall Access Panel: ACUDOR Products, Inc., DW-5040, or equal. Install in sizes and in locations shown on Drawings or as req'd.

2.02 METAL LETTERS

- A. ETHOS Aluminum Letters by Takeform, Inc., or equal.
 - 1. Finish/Color to be selected by Architect
 - 2. Heights as shown on Drawings
 - 3. 0.5" thickness

4. Stud mounted with standoffs

2.03 METAL CANOPIES

- A. Metal Canopy: Cantilever Aluminum Canopy, manufactured by MAPES Canopies, Lincoln, Nebraska, www.mapescanopies.com, or equal. Install per manufacturer's instructions. See Drawings for locations and dimensions.
 1. Fascia: 8" J-channel
 2. Deck: Flat Soffit
 3. Finish: To be selected by Architect from Manufacturers 2-coat Kynar Finishes.
 4. Drainage: Front Scupper – right side.

2.04 LOCKERS

- A. Turnout Gear Lockers by Republic Storage Systems, LLC, or equal.
 1. Foot Locker w/ hinged seat
 2. Upper locked compartment
 3. 24"w x 24"d x 72"h
 4. Color selected by Architect from manufacturer's standard colors.
 5. See Drawings for location and quantity.

END OF SECTION

SECTION 10155

TOILET COMPARTMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 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 SUMMARY

- A. This Section includes toilet compartments and urinal screens as follows:
 - 1. Type: High-Density Polymer (HDPE)
 - 2. Compartment Style: Floor-mounted, overhead-braced

1.04 RELATED SECTIONS

- A. Section 10280 - Toilet & Bath Accessories

1.05 SUBMITTALS

- A. Product Data: For each type and style of toilet compartment and screen specified. Include details of construction relative to materials, fabrication, and installation. Include details of anchors, hardware, and fastenings.
- B. Shop Drawings: For fabrication and installation of toilet compartment assemblies. Include plans, elevations, sections, details, and attachments to other work.

- C. Samples for Initial Selection: Manufacturer's color charts consisting of sections of actual units showing the full range of colors, textures, and patterns available for each type of compartment or screen indicated.
- D. Samples for Verification: Of each compartment or screen color and finish required, prepared on 6" square Samples of same thickness and material indicated for Work.

1.06 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. General: Provide materials that have been selected for surface flatness and smoothness. Exposed surfaces that exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are unacceptable.
- B. Basis-of-Design: General Partitions, High-Density Polymer (HDPE), floor-mounted, overhead-braced, toilet partition with stainless steel hardware and full height continuous 16 ga. stainless steel hinges and brackets, or equal. Color to be selected by Architect from manufacturer's standard colors.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, plumb, and level. Provide clearances of not more than 1/2" between pilasters and panels and not more than 1" between panels and walls. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Secure panels to walls and panels with not less than 2 stirrup brackets attached near top and bottom of panel. Locate wall brackets so holes for wall anchors occur in masonry or tile joints. Align brackets at pilasters with brackets at walls.

3.02 ADJUSTING AND CLEANING

- A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and swing doors in entrance screens to return to fully closed position.

- B. Provide final protection and maintain conditions that ensure toilet compartments and screens are without damage or deterioration at the time of Substantial Completion.

END OF SECTION

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SECTION 10522

FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division1 Specification Sections, apply to this Section.

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. General: Submit the following according to the Conditions of the Contract and Division1 Specification Sections.
- B. Product data for cabinets include rough-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type and materials, trim style, door construction, panel style, and materials.

1.04 QUALITY ASSURANCE

- A. Coordination: Verify that cabinets are sized to accommodate type and capacity of extinguishers indicated and provided by Owner under separate Contract.
- B. UL-Listed Products: Fire extinguishers shall be UL listed with UL listing mark for type, rating, and classification of extinguisher.
- C. Extinguishers shall be designed to address Class A, B, and C fires in general public areas. In Kitchen areas, extinguishers shall be designed to address a Class K fire.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguisher Cabinets: Where shown on Drawings, install J.L. Industries Cosmopolitan 1037F10 fire extinguisher cabinet, or equal. Provide one Cosmic 5E Fire Extinguisher inside each cabinet.
- B. Fire Rated Fire Extinguisher Cabinets: Where cabinet occurs in a fire rated wall, provide Cosmopolitan 1037F10 FX fire rated cabinet as manufactured by J.L. Industries.
- C. Fire Extinguisher Cabinets: Where shown on Drawings in Kitchen areas, install UL Industries 2037 F10 fire extinguisher cabinet, or equal. Provide one Saturn 15 fire extinguisher inside each cabinet.
- D. Fire extinguisher, not shown to be located in cabinets, shall be provided with wall mounting brackets. Similar to Larsen's Manufacturing Company B-2 wall bracket.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Fire extinguishers shall be mounted with handles mounted not more than 48" above finish floor.
- B. Install in locations and at mounting heights indicated or, if not indicated, at heights to comply with applicable regulations of governing authorities.

END OF SECTION

SECTION 10800

TOILET AND BATH ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

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 SUMMARY

- A. This Section includes toilet accessory items as scheduled or specified below.

1.04 RELATED SECTIONS

- A. Section 06010 – Rough Carpentry

1.05 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specifications Sections.
- B. Product data for each toilet accessory item specified, including construction details relative to materials, dimensions, gages, profiles, mounting method, specified options, and finishes.
- C. Schedule indicating types, quantities, sizes, and installation locations (by room) for each toilet accessory item to be provided for project.

1.06 QUALITY ASSURANCE

- A. Inserts and Anchorages: Furnish accessory manufacturers' standard inserts and anchoring devices that must be set in concrete or built into masonry. Coordinate delivery with other work to avoid delay.

1.07 PROJECT CONDITIONS

- A. Coordination: Coordinate accessory locations, installation, and sequencing with other work to avoid interference with and ensure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

PART 2 PRODUCTS

2.01 ACCESSORIES

- A. Grab Bars - Stainless Steel Type: Provide grab bars with wall thickness not less than 0.05" and as follows:
 - 1. Mounting: Concealed, manufacturer's standard flanges and anchorages
 - 2. Clearance: 1-1/2" clearance between wall surface and inside face of bar
 - 3. Gripping Surfaces: Smooth, satin finish
 - 4. Heavy-Duty Size: Outside diameter of 1-1/2"
 - 5. Grab bars shall be 42", 36", and/or 18" long as shown on Drawings.
- B. Mirror: Meek Mirrors M1210 Series Mirror with stainless steel angled frame. Size to be as shown on Drawings, or equal
- C. Toilet Tissue Dispenser: Bobrick B-4288, or equal
- D. Paper Towel Dispenser: Bobrick B-72974, or equal
- E. Shower Curtain Rod: Bobrick B-4207, or equal. & Shower Curtain Bobrick 204-2, or equal.
- F. Towel Pin: Bobrick B-6777, or equal.

2.02 MISCELLANEOUS ACCESSORIES

- A. Mop and Broom Holder: Rubbermaid Commercial Products 1993, or equal. Install in each Janitors Closet in location as directed by the Owner.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install toilet accessory units according to manufacturers' instructions, using fasteners appropriate to substrate as recommended by unit manufacturer. Install units plumb and level, firmly anchored in locations and at heights indicated.
- B. Install grab bars to withstand a downward load of at least 250 lbf, complying with ASTM F 446.

3.02 ADJUSTING AND CLEANING

- A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.
- B. Clean and polish all exposed surfaces strictly according to manufacturer's recommendations after removing temporary labels and protective coatings.

END OF SECTION

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SECTION 10820

LOUVERED ROOF TOP EQUIPMENT SCREENS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Fixed, extruded-aluminum louvered roof top equipment screens
- B. See Division 5 Section "Structural Metal Framing" for structural framing supporting louver 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 PERFORMANCE REQUIREMENTS

- A. Design: Design louvers, including comprehensive engineering analysis by a qualified engineer, using structural performance requirements and design criteria indicated.
- B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors.
 - 1. Wind Loads: Determine loads based on a uniform pressure of 30 lb./sq. ft. (1435 Pa), acting inward or outward.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: For equipment screens and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
- C. Samples: For each type of metal finish required.
- D. Submittal: For louvers indicated to comply with structural performance requirements and design criteria indicated.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Aluminum Extrusions: ASTM B221M, Alloy 6063-T5
- B. Aluminum Sheet: ASTM B209M, Alloy 3003 with temper as required for forming
- C. Fasteners: Use types and sizes to suit unit installation conditions:
 - 1. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.

2.02 FABRICATION, GENERAL

- A. Join concealed frame members to each other and to fixed louver blades with fillet welds concealed from view welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.03 EXTRUDED-ALUMINUM ROOF TOP EQUIPMENT SCREEN

- A. Horizontal Blade Louvered Roof Top Equipment Screen
 - 1. Basis-of-Design Product: Architectural Louvers Co. (Harray, LLC); Model V6JN4. Subject to compliance with requirements, provide the specified product or comparable product by one of the following:
 - a. Manufacturers of equivalent products submitted and approved in accordance with Section 01630 - Product Substitution Procedures
 - 2. Louver Blade Depth: 6 inches (150 mm)
 - 3. Blade Spacing: 4 inch centers
 - 4. Blade Profile: Narrow profile plain blade without center baffle
 - 5. Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm)
 - 6. Framing Support Nominal Thickness: Not less than 0.125 inch (3.2 mm)

7. Louver Performance Requirements:

- a. Free Area: Not less than 11.3 sq. ft. (1.05 sq.m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver assembly
- b. Horizontal Drag Coefficient: Not greater than 0.31 on a cross sectional profile, allowing for a 69% reduction in wind load imposed horizontally upon supporting structural framing

2.04 ALUMINUM FINISHES

- A. High-Performance Organic Finish: 3-coat fluoropolymer finish complying with AAMA2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Locate and place equipment screens level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather-tight connection.
- C. Provide perimeter reveals and openings of uniform width to allow for thermal expansion, as indicated.
- D. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory and refinish entire unit or provide new units.

END OF SECTION

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SECTION 10830

RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.01 DESCRIPTION

- A. Furnish and install all building specialties and related items specified under this Section making them complete and ready for use.

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. Prepare and submit shop drawings, catalog data and maintenance manuals for all building specialties items.
- B. Contractor shall coordinate size of units actually provided with millwork where units are to be installed.

PART 2 PRODUCTS

2.01 DISHWASHER

- A. Frigidaire Built-in Dishwasher: Model #FFBD2420US, Energy Star Certified. Size is 32-3/8"H x 24"W x 24"D, ADA Compliant, Stainless Steel finish.

2.02 MICROWAVE

- A. DANBY under-the-Cabinet Microwave: Model #DDMW007501G1. Size is 10-3/8"H x 17-7/8"W x 12-3/8"D, Stainless Steel finish.

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SECTION 11154

SUBMERSIBLE HORIZONTAL PROPELLER PUMPS

PART 1 GENERAL

1.01 SCOPE

- A. This section specifies the horizontal submersible propeller pumps for installation as indicated on the Drawings.

<u>Pump designation</u>	<u>Mixed Liquor Recycle Pump</u>	<u>Mixed Liquor Recycle Pump</u>
Number of pumps	2	2
Pump tag numbers	2101-BNR1-RP01 2102-BNR1-RP02	2201-BNR2-RP03 2202-BNR2-RP04
Pump location	West Internal Recycle Pump Station	East Internal Recycle Pump Station
Pumps from	Aeration Basin 01	Aeration Basin 02
Pumps to	BNR Basin 01	BNR Basin 02

- B. A separate pump (total 5 units) shall be supplied as a shelf spare.
- C. Each installed pumping unit shall be complete with a submersible electric motor variable frequency drive, mounting assembly for installation as indicated on the Drawings, and all other appurtenances specified or otherwise required for proper operation, including special tools.

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 Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by the Engineer. Definition of terms and other hydraulic considerations shall be as set forth in the Hydraulic Institute Standards.
- B. Each unit shall be furnished and installed complete with all anchors and supports, all mechanical equipment required for proper operation, and all additional materials or construction required by the manufacturer's design.
- C. The propeller pumps specified herein shall be designed and fabricated by a single manufacturer which shall have sole responsibility for the equipment. The manufacturer shall have pumping equipment of this design and of comparable capacity in successful operation for at least 5 years.
- 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. Power Supply
 - 1. Unless otherwise indicated, power supply to the equipment shall be 480 volts, 60 Hz, 3 phase.
- F. Identification
 - 1. 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 each pump and each motor.
- G. Spare Parts
 - 1. Spare parts shall be provided as follows:

<u>Spare Parts</u>	<u>Quantity</u>
Mechanical seals	1 per pump set
Motor Cable	1 per pump set
 - 2. Spare parts shall be suitably packaged with labels indicating the contents of each package. Spare parts shall be delivered to Owner as directed.

1.04 SUBMITTALS

- A. Drawings and Data
 - 1. Complete fabrication and assembly drawings, together with detailed specifications and data covering materials used, 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 are not limited to, the following:

a. Propeller Pumps

- 1) Name of manufacturer
- 2) Type and model
- 3) Tag Number
- 4) Pump Designation
- 5) Pump Location
- 6) Rotative speed
- 7) Type of bearings
- 8) Net weight of propeller pump and motor
- 9) Complete performance curves showing capacity versus head, minimum submergence required, pump efficiency, wire-to-water efficiency, and pump input power
- 10) Data on shop painting
- 11) Anchor bolt details
- 12) Nameplates

b. Motors

- 1) Name of manufacturer
- 2) Type and model
- 3) Type of bearings and lubrication
- 4) Rated size of motor, hp
- 5) Temperature rating
- 6) Full load rotative speed
- 7) Efficiency and power factor at full load and rated pump condition
- 8) Full load current
- 9) Locked rotor current
- 10) Data on cable
- 11) Nameplates

c. Variable Frequency Drives

- 1) As specified in the Motor Control Centers section

d. Moisture Detection System

- 1) Name of manufacturer
- 2) Type and model
- 3) Published descriptive data on each item of equipment and all accessories, indicating all specific characteristics and options

e. Seismic Design Requirements

- 1) Confirmation of compliance with the requirements of the Meteorological and Seismic Design Criteria section.

B. Operation and Maintenance Data and Manuals

PART 2 PRODUCTS

2.01 SERVICE CONDITIONS

1. The propeller pumping units will provide continuous recirculation for mixed liquor in the BNR Trains. The pumping units will recycle flow from the Aeration Basins No. 1 and 2 to the internal mixing chimneys (MC 1-2 and MC 2-2).
2. The equipment provided under this section shall be suitable for the following service conditions:

Maximum liquid temperature	80°F
Maximum solids concentration, by weight	0.5%
Seismic design requirements	As specified in the Meteorological and Seismic Design Criteria section
3. All equipment furnished shall be designed to meet all specified conditions and to operate satisfactorily at the elevation specified in the Meteorological and Seismic Design Criteria section.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

- A. The propeller pump with its appurtenances and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 100 feet. The propeller pumping units shall be provided with a mounting system including a hoist, which enables the unit to be raised, lowered, and easily removed from the basin without the need for personnel to enter the basin.
- B. The propeller water horsepower requirements, gear losses, and an ample allowance for buildup of biological solids on the propeller of the unit shall be included in determination of the brake horsepower requirements.
- C. Pumping units shall be designed for the following operating conditions, unless otherwise noted:

Number.	<i>5 (4 Duty, 1 Shelf Spare)</i>	
Pump tag numbers.	2101-BNR1-RP1 2102-BNR1-RP2 2201-BNR2-RP3 2202-BNR2-RP4	
Rated head.	3.4	ft
Capacity at rated head per pump	4,600	gpm
Operating head range for full speed continuous operation.	2.4 to 4.5	ft
Maximum nominal pump speed.	600	rpm
Minimum head at reduced speed.	2.2	

Capacity at minimum head at reduced speed.	3800	gpm
Approximate minimum pump speed.	480	rpm
Maximum motor nameplate power	10.7	hp
Efficiency at rated head, wire to water.	46	%
Basin depth	13	ft
Minimum liquid depth in basin	8	ft
Maximum propeller diameter.	24	in

- D. Overall (wire-to-water) efficiency for constant speed pumps shall include losses in the pump and motor.
- E. Overall (wire-to-water) efficiency for variable speed pumps shall include losses in the pump, motor, adjustable frequency drive, and any transformers supplied as part of the adjustable frequency drive equipment.

2.03 ACCEPTABLE MANUFACTURERS

- A. The submersible propeller pumping equipment shall be as manufactured by Flygt Corporation, Model 4660 or approved equal.

2.04 MATERIALS

- A. Pumps and accessories shall be constructed of the following materials.

Guide Bar System

Guide Bars	Stainless steel pipe, Schedule 40S, AISI Type304 or 316
Upper guide bar holders and intermediate guide bar supports	Stainless steel, AISI Type304 or 316
Lifting Cable	Stainless steel, AISI Type316.
Retaining Chain	Stainless steel, AISI Type316.
Lifting Bracket or Bridle Chain	Stainless steel, AISI Type316.

Propeller Pump

Stator housing and oil chamber housing	Stainless steel, AISI Type304 or 316 or Cast iron, ASTM A48.
Propeller Shaft	Alloy steel, hard chrome plated; or stainless steel, AISI Type316.
Propeller Shaft Mechanical Seal	Stainless steel with tungsten carbide or silicon carbide rings.
Motor Shaft Mechanical Seal	Stainless steel with tungsten carbide or silicon carbide rings.
Propeller	Same as stator housing.
Inlet Cone	Stainless steel, AISI Type304 or 316.
All Assembly Fasteners	Stainless steel, AISI Type304 or 316.
Primer and Finish Coat (Note)	

Epoxy

PPG Amercoat "Amercoat 385 Epoxy,"
Carboline "Carboguard 890," ICI Devoe Devran
"224HS," Tnemec "Series N69 Hi-Build
Epoxoline II," or Sherwin-Williams "Macropoxy
646."

- B. Note: The manufacturer's coating recommended for the specified service that is equivalent to the specified coating will be acceptable.
- C. Where stainless steel components are welded, the stainless steel shall be AISI Type 304L or 316L.
- D. All stainless steel shall be pickled in accordance with ASTM A380 at the mill before being shipped. 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 for a ferroxyl test to detect the presence of residual embedded iron. All pickled surfaces contaminated or damaged during fabrication including welded areas shall be repickled or passivated in accordance with ASTM A380 as needed to remove all traces of iron contamination and heat tint. 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.
- E. 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 each pump and each motor.

2.05 CONSTRUCTION

A. Propeller Pump

- 1. Each propeller pump shall be the direct-driven, close-coupled, submersible type. All components of the unit, including motor and gear box, shall be designed for the specified requirements of pump service and shall be capable of continuous underwater operation. In addition, all components of the unit, including motor and gear box, shall be capable of continuous operation in air, completely unsubmerged, for 2 hours.
- 2. A sliding bar guide bracket shall be an integral part of the pumping unit. The entire weight of the pump unit shall be guided by a single bracket which shall be capable of handling all thrust created by the pump.
- 3. Cast components shall have smooth surfaces devoid of blow holes and other irregularities.
- 4. Each pumping unit shall be equipped with an integral inlet cone and use a wall mounting plate or pipe adapter as indicated on the Drawings. The design of the inlet cone shall ensure good hydraulic efficiency.

B. Propeller

1. The propeller shall consist of two or three blades, each integrated on a shaft for mounting in a hub. The blades shall be dynamically balanced and of non-clogging backward curve design.

C. Oil Chamber Housing

1. The oil chamber shall contain an inspection plug, drain plug, and vent plug.

D. Mechanical Seals

1. Each pump shall be provided with a lapped end face type mechanical seal (propeller shaft) and two lip seals (gear box for gear-driven mixers), running in oil reservoirs for cooling and lubrication. The mechanical seal between the propeller and propeller shaft oil chamber shall contain one stationary and one positively driven rotating face ring running in an oil reservoir for cooling and lubrication. The seals between the shaft and gear box, and gear box and motor chamber shall be of the lip style. All seal springs shall be isolated from the pumped liquid.
2. Four seals separating the various parts as specified herein will also be acceptable. The outer seal in the propeller hub shall be either a viton or nitrile rubber lip seal, sealing propeller shaft and grease chamber from the mixed media running on a replaceable stainless-steel bushing. The two inner seals on the propeller shaft shall be either viton or nitrile rubber lip seals insulating the propeller shaft grease chamber from the gearbox oil chamber. The fourth seal shall be a mechanical seal running in the oil for cooling and lubrication. It shall be mounted on the motor shaft to insulate the gear box oil chamber from the dry motor stator housing.
3. The seals shall require neither maintenance nor adjustment, but shall be easy to check, relap, and replace. Neither shaft seals lacking positively driven rotating members nor conventional double mechanical seals which use a common single or double spring and require a pressure differential to offset external pressure and effect sealing will be acceptable.

E. Sealing of Mating Surfaces

1. All mating surfaces shall be machined and fitted with nitrile rubber O-rings where watertight sealing is required. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces. The use of elliptical O-rings, gaskets, or seals requiring a specific fastener torque value to obtain and maintain gasket or seal compression and watertightness will not be acceptable. The use of secondary sealing compounds, gasket cement, grease, or other devices to obtain watertight joints will not be acceptable.

F. Pump Mounting Assembly

1. Each pumping unit shall be furnished with a vertical guide rail system and wall mounting plate. Two 2-inch, 316 stainless steel, Schedule 40S pipes shall be provided to guide the pump during installation and removal. Guide rail holders of 316 stainless steel shall be furnished and installed. Upper guide bar holders shall be

furnished and installed to connect the top of the guide bar system to the structure as depicted on the Drawings. Lower guide rail holders shall be furnished and installed to connect the bottom of the guide bar system to the bottom slab or to the flange of the discharge pipe.

2. The mounting plate for pumping units shall function as a quick disconnect discharge connection for the pumping unit. The plate shall be suitable for mounting to a pipe, as indicated on the Drawings. The pumping unit shall interlock with the mounting plate to form a metal-to-metal seal between the pump and the discharge connection. No gaskets, O-rings, or other sealing arrangements shall be required to seal the discharge connection. The pumping unit shall not require any bolts, nuts, or fasteners to mount to the discharge connection.

G. Bolts and Nuts

1. Field assembly bolts and nuts and anchor bolts and nuts shall be provided for each item of equipment. Anti-seize compound shall be applied to the threads of all stainless-steel bolts before assembly.

2.06 BALANCE AND VIBRATION

- 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 resonance at normal operating speeds is avoided. At any operating speed, the ratio of rotation speed to the critical speed of the unit or components thereof shall be less than 0.8 or more than 1.3.

2.07 FABRICATION AND MANUFACTURE

A. Welding

1. All welded joints shall be sealed watertight with continuous welds.

B. Edge Grinding

1. Sharp projections of cut or sheared edges of ferrous metals shall be ground to a radius as necessary to ensure satisfactory paint adherence.

C. Surface Preparation

1. All welds shall be thoroughly cleaned and ground smooth in preparation for painting. All ferrous metal surfaces, except motors, speed reducers, and stainless steel, shall be solvent cleaned in accordance with SSPC-SP1 before shop primer is applied.

D. Shop Painting

1. All iron and steel parts, except for stainless steel parts, which will be in contact with liquid or submerged after installation shall be shop cleaned in accordance with the coating manufacturer's recommendations and painted with an epoxy coating system. The coating shall have a dry film thickness of at least 10mils and shall

consist of a prime (first) coat and finish coats. At least one quart of the finish coat material shall be furnished with each mixer for field touch-up painting.

2. See Finish Painting for other shop painting requirements.

2.08 DRIVE UNITS

A. Electric Motors

1. Each propeller pump shall be driven by a submersible, electric motor manufactured and furnished by the pump manufacturer. Motor nameplate rating shall exceed the maximum power required by the pump over the operating range. Each motor shall be rated for the power supply provided to the pump and shall have a service factor of 1.10. The stator housing shall be an air-filled, watertight casing. A cooling jacket shall encase the motor housing for each pump where needed to maintain adequate cooling. The cooling jacket shall require no external source of cooling water. Motor insulation shall be moisture resistant, Class F, 155°C. Each motor shall be NEMA Design B for continuous duty at 40°C ambient temperature and designed for at least 10 starts per hour. Stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C.
2. The motor bearings shall be antifriction, permanently lubricated type. The bearings shall have a minimum calculated ABMA L₁₀ Life Rating of 40,000 hours when operating at maximum operating point. Maximum shaft run out at the mechanical seals shall not exceed 2mils at any point in the operating range.
3. The water seal design for cable entry shall not require a specific fastener torque to ensure a watertight and submersible seal. The use of epoxies, silicones, or other secondary sealing systems will not be acceptable. The cable entry junction box and motor shall be separated by a stator lead sealing gland or terminal board. The junction box shall isolate the motor interior from moisture gaining access through the top of the stator housing.
4. Each pump shall be provided with a separate or combined submersible power cable and submersible control cable. The power cable shall contain a ground conductor and one conductor per power phase. All submersible cables shall have a legend or code permanently embossed on the cable indicating the cable is suitable for submersible use. Cable sizing shall conform to NEC requirements. The cable lengths shall be sufficient to extend to the junction boxes specified below plus an extra 10feet. Each cable shall be provided with stainless steel Kellems grips and stainless-steel support brackets to help prevent damage to the cable insulation.
5. Motors shall be specifically selected for service with an adjustable frequency type speed controller and shall be derated to compensate for harmonic heating effects and reduced self-cooling capability at low-speed operation so that the motor does not exceed Class B temperature rise when operating in the installed condition at load with power received from the adjustable frequency drive. All motors driven by adjustable frequency drives shall be supplied with full phase insulation on the end turns and shall meet the requirements of NEMA MG 1, Part 31. In addition to the requirements of NEMA MG1, Part 31, motors shall be designed to be continually pulsed at the motor terminals with a voltage of 1600volts ac.

B. Variable Frequency Drives

1. The variable frequency drives are provided by Division 16 in the Motor Control Centers section. The manufacturer shall provide the pump motor nameplate information to coordinate VFD sizing.

2.09 MOTOR CONTROLS

A. Junction Box

1. Each pump shall be provided with a junction box for power and control cable termination. The junction box shall be mounted as indicated on the Drawings. The power and control cables to the pump shall be terminated in the junction box. A Kellems grip or other suitable strain relief device shall be provided on each submersible cable to prevent excess strain between the submersible cable and the junction box.
2. The junction box shall be as specified in the Raceways and Boxes section.

B. Moisture Detection System

1. Each submersible pump housing shall be provided with a moisture detection system complete with all sensors, control power transformers if required, and relays. The moisture detection system shall be rated for a 120-volt ac supply voltage. If the system operates on a voltage other than 120-volt ac, the manufacturer shall provide the necessary control power transformer. The moisture detection system shall provide one normally open dry output contact rated 5amps at 120volts ac. The contact shall close when moisture is detected in the submersible pump motor housing or motor pre-chamber as recommended by the equipment manufacturer. All moisture detection system components shall be furnished by the submersible pump supplier and components not integral to the pump shall be shipped loose for installation into the motor controller enclosure.

C. Temperature Detection System

1. Each motor shall be protected by one motor temperature switch embedded in each phase winding. Each switch shall be designed to operate at 125°C (±5°C). Each switch shall be normally closed automatic reset type rated 5amps at 120Vac. The switches shall be wired in series with end leads wired to terminals within the motor housing.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Each pumping unit shall be installed in accordance with the Special Provisions section.
- B. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. Anchor bolts shall be set in accordance with the manufacturer's recommendations and setting plans.

3.02 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 the Equipment Testing and Start-Up section 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.

3.03 TRAINING

- A. The equipment manufacturer shall furnish the services of a representative that is competent and experienced in operation and maintenance of the equipment, who is directly employed by the manufacturer, to instruct Owner's personnel in the proper operation and maintenance of the equipment.
- B. Contractor shall include the following minimum training provided by the manufacturer's representative. This does not include travel hours or expenses.
 1. Number of Shifts: 2
 2. Minimum Hours of Training per Shift: 4
 3. Minimum Total Hours of Training: 8
- C. Operations Training
 1. Classroom instruction covering the theory of operation, site specific operation of the equipment and optimization of the submersible propeller mixer operation shall be provided. All costs for these services shall be included in the contract price.
- D. Maintenance Training
 1. Hands-on training in separate sessions for mechanical maintenance and electrical and instrumentation maintenance shall be provided. Sessions shall run following the operations training. All costs for these services shall be included in the contract price.
- E. Maintenance Assistance
 1. Assistance to Owner during the first year of operation when a unit shall be disassembled for inspection, cleaning, and/or maintenance shall be provided. The

schedule for this service will be set by the Owner and coordinated with the manufacturer. All costs for these services shall be included in the contract price.

- F. Training shall be in accordance with the Demonstration and Training specification.

END OF SECTION

SECTION 11207

PARSHALL FLUME

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required, and install a Parshall Flume 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. Section 01600 – Materials, Transportation and Handling
- C. Section 03300 – Cast-In-Place Concrete
- D. Section 13330 – Instrumentation Products

1.04 REFERENCE STANDARDS

- A. ASTM International (ASTM), latest edition:
 - 1. ASTM D 256 Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
 - 2. ASTM D 638 Standard Test Method for Tensile Properties of Plastics
 - 3. ASTM D 790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

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

1.05 SYSTEM DESCRIPTION

- A. The Parshall Flume specified herein is intended to be of standard types for use in measuring flow.
- B. Contractor is responsible for compatibility between Parshall Flume materials, pipe attachments, and appurtenances.

1.06 SUBMITTALS

- A. See Section 01300, Submittals for submittal procedures.
- B. Product Data: Provide test results of fiberglass reinforced plastic laminate.
- C. Provide shop drawings showing the following information:
 1. Critical dimensions, jointing and connections, fasteners and anchors,
 2. Materials of construction,
 3. Sizes, spacing, and locations of structural members, connections, attachments, openings, fasteners, and loads.
- D. Manufacturer's installation instructions

1.07 QUALITY ASSURANCE

- A. The supplier shall be responsible for the provisions of all test requirements specified in ASTM D256, ASTM D638, ASTM D790, or ASTM D2853.
- B. The Engineer or representative of the Owner may inspect the Parshall flume after delivery and it will be subject to rejection if it fails to meet any of the Specification requirements or if damage or mishandling of the Parshall flume is evident.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 01600, Materials, Transport, and Handling.
- B. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- C. Store products indoors and protect from construction traffic and damage.
- D. If any defective item is discovered after it has been installed, it shall be removed and replaced at the Contractor's own expense.

1.09 COORDINATION

- 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 adjoining items of work in this Section before commencement of items herein specified.

1.10 FIELD MEASUREMENTS

- A. Take field measurements at the site to verify or supplement indicated dimensions and to ensure proper coordination of all other construction items.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Provide products manufactured by Warminster Fiberglass Company, PLASTI-FAB Inc., Engineered Fiberglass Composites, or approved equal.

2.02 PARSHALL FLUMES

- A. Parshall Flume shall meet or exceed the following design standards:
 - 1. Tensile strength (ASTM D 638): 14,000 psi
 - 2. Flexural strength (ASTM D 790): 25,000 psi
 - 3. Flexural modulus (ASTM D 790): 1,000,000 psi
 - 4. Impact, Notched, Izod (ASTM D 256): 10 ft-lb/in
 - 5. Barcol hardness (resin-rich surface) (ASTM D 2583): 40, minimum, average
 - 6. Temperature limit: 150 degrees F
 - 7. Chemical resistance: Comply with ANSI/AWWA F101, Type II classification
- B. The contractor shall supply and install a 36-inch throat width Parshall Flume as shown on the drawings. The flume shall be capable of measuring flows from 300 GPM to 22,500 GPM.
- C. Parshall Flume shall feature a one-piece fiberglass reinforced polyester (FRP) design with integral stiffening ribs to make unit self-supporting and eliminate external bracing. Provide temporary internal bracing during installation to prevent warp or twisting of the Parshall flume.
- D. Accessories:
 - 1. Mounting bracket for radar level sensor
 - 2. Staff gauge graduated in gallons-per-minute (GPM) attached to inside wall of flume

PART 3 EXECUTION

3.01 INSTALLATION OF PARSHALL FLUME

- A. Install products in accordance with manufacturer's instructions.
- B. Ensure that products are installed plumb and true, free of warp or twist, within tolerances specified by the manufacturer and as indicated in the contract documents.
- C. Set flume at proper elevation in accordance with drawings.
- D. Set floor of flume at inlet end level with flow and across flow, set sidewalls plumb, and set top flanges level on each side.
- E. Fasten flume securely to prevent flotation or twisting during placement of concrete.
- F. Place concrete along sides and bottom of flume to ensure complete filling without voids and displacement of flume. Stage placement in alternating lifts, 1/3 height on each side of flume.
- G. Clean surfaces in accordance with manufacturer's instructions.

END OF SECTION

SECTION 11215

VERTICAL TURBINE PUMPS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to install, complete, field test, and make ready for operation, vertical turbine pump and motor as shown on the Drawings and as specified herein.
- B. Equipment furnished under this section shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless specific exceptions are noted by the Engineer.
- C. 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. Also included shall be supervisory services during installation and field testing of each unit and instructing the regular operating personnel in the proper care, operation, and maintenance of the 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 01171 – Electric Motors
- B. Section 01300 – Submittals
- C. Section 01782 – Operation and Maintenance Data

- D. Division 9 – Painting
- E. Division 15 – Mechanical
- F. Division 16 - Electrical

1.04 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, Submittals, shop drawings and product data. Submittals shall include the following:
 - 1. Certified dimensional drawings of each item of equipment and auxiliary apparatus to be furnished.
 - 2. Certified foundation, pump support, and anchor bolt plans and details; minimally including anchor bolt installation method, bolt length, and minimum embedment depth.
 - 3. Schematic electrical wiring diagram and other data as required for complete pump installation.
 - 4. Literature and drawings describing the equipment in sufficient detail, including parts list and materials of construction, to indicate full conformance with the detailed specifications.
 - 5. Total weight of pumping unit.
- B. Design Data
 - 1. Manufacturer's certified rating curves, to satisfy the specified design conditions, showing pump characteristics of discharge, anticipated field head, brake horsepower, bowl efficiency and guaranteed net positive suction head required (NPSHR). Curves shall show the full recommended range of performance and include shut-off head. This information shall be prepared specifically for the pump proposed. Catalog sheets showing a family of curves will not be acceptable.
- C. Test Reports
 - 1. Certified motor test data.
 - 2. Tabulated data for the drive motors including rated Hp, full load rpm, power factor and efficiency curves at 1/2, 3/4 and full load, service factor and kW input, including when the pump is at its design point. Submit a certified statement from the motor manufacturer that the motors are capable of continuous operation on the power supply without affecting their design life for bearings or windings.
 - 3. A schedule of the date of shop testing and delivery of the equipment to the job site.
 - 4. Description of pump factory test procedures and equipment.

5. Reed Critical Frequency Analysis Report to demonstrate conformance with combined system natural frequency separation requirements specified herein. The report shall include bump test data for the proposed motor to document the motor's actual Reed Critical Frequency value. Any requests for variation from these requirements shall be clearly documented in the pump manufacturer's submittal.

D. Operation and Maintenance Data

1. Complete operating and maintenance instructions shall be furnished for all equipment included under this Section as provided in Section 01782, Operation and Maintenance Data. The maintenance instructions shall include troubleshooting data and full preventative maintenance schedules and complete spare parts lists with ordering information.

1.05 REFERENCE STANDARDS

- A. Design, manufacturing, and assembly of elements of the equipment specified herein shall be in accordance with, the following:
 1. American Gear Manufacturers Association (AGMA)
 2. American Institute of Steel Construction (AISC)
 3. American Iron and Steel Institute (AISI)
 4. American Society of Mechanical Engineers (ASME)
 5. American National Standards Institute (ANSI)
 6. ASTM International (ASTM)
 7. American Water Works Association (AWWA)
 8. American Welding Society (AWS)
 9. Anti-Friction Bearing Manufacturers Association (AFBMA)
 10. Hydraulic Institute Standards for Centrifugal, Rotary and Reciprocating Pumps; Hydraulic Institute, Vertical Pump Standards; and Hydraulic Institute Test Standards, Vertical Pumps 2.6
 11. Institute of Electrical and Electronics Engineers (IEEE)
 12. National Electrical Code (NEC)
 13. National Electrical Manufacturers Association (NEMA)
 14. Occupational Safety and Health Administration (OSHA)
 15. The Society for Protective Coatings (SSPC)
 16. Underwriters Laboratories (UL)
- B. Where reference is made to one of the above standards, the revision in effect at the time of Contract signing shall apply.

1.06 QUALITY ASSURANCE

- A. To assure unity of responsibility, the motors, and supporting sole plates be furnished and coordinated by the pump manufacturer. The Contractor and manufacturer shall assume responsibility for the satisfactory installation and operation of the entire pumping system including pumps, motors, etc. as specified.
- B. The equipment covered by this Section is intended to be standard pumping equipment of proven ability as manufactured by a company having extensive experience in the production of such equipment similar to the applications stated in Paragraphs 1.01 and

1.06. Units specified herein shall be furnished by a single manufacturer. The equipment furnished shall be designed, constructed, and installed to operate satisfactorily when installed as shown on the Drawings.

- C. Pumps shall be manufactured, and field tested in accordance with the Hydraulic Institute Standards for vertical turbine pumps, except where otherwise specified herein.
- D. The pump manufacturer shall be fully responsible for the design, arrangement, and operation of all connected rotating components, including supporting sole plate(s), if any, of the assembled pumping unit mounted on a fabricated steel base plate, to ensure that neither harmful nor damaging vibrations occur at any speed within the specified operating range.

1.07 SYSTEM DESCRIPTION

- A. The Final Effluent (FE) vertical turbine pump(s) shall pump water from the proposed Effluent Pump Station to Town Branch Creek for discharge, and the Plant Water (PW) vertical turbine pump(s) shall pump water from the proposed Effluent Pump Station to designated facilities for utilization in the treatment process. The pumped liquid is fully treated wastewater from the Bentonville Water Resource Recovery Facility. The pump manufacturer shall provide a complete vertical turbine pump assembly, including seals, line shafts, couplings, lubrication systems, etc., with proven ability to operate under the specified system conditions. The pumps shall be operated and controlled by VFD as specified in the manufacturer's recommendations.

1.08 DELIVERY STORAGE AND HANDLING

- A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the unit and equipment are ready for operation.
- B. All equipment and parts must be properly protected against any damage during shipment. Store equipment in accordance with manufacturer's recommendations.
- C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- D. The finished surfaces of all exposed flanges shall be protected by wooden or equivalent blank flanges, strongly built, and securely bolted thereto.
- E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- F. No shipment shall be made until approved by the Engineer in writing.
- G. For protection of bearings during shipment and installation, the bearing shall be properly processed. Anti-friction bearings shall be protected in accordance with the bearing manufacturer's recommendations against formation of rust during a long period of storage while awaiting completion of installation and start-up of the machine in which they are used.

1.09 MAINTENANCE

- A. Furnish all special tools and test equipment required for the proper servicing of all equipment. All such tools and test equipment shall be furnished in a suitable steel tool chest complete with lock and duplicate keys.
- B. Spare parts shall be suitably 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.
- C. Furnish the following spare parts for each size pump;
 - 1. One (1) impeller of each size
 - 2. One (1) seal and set of wear rings and bearings for each size and type of pump
 - 3. One (1) lineshaft sleeve and coupling for each size and type of pump

1.10 WARRANTY

- A. Written warranties shall be provided to the Owner on all equipment specified in this Section. Warranties shall provide that, in the event of failure of any parts or equipment during the warranty period due to defective materials or workmanship, such parts or equipment will promptly be replaced and installed by the Contractor at no additional cost to the Owner. Warranty to extend 24 months from Substantial Completion and acceptance by the Owner.

PART 2 PRODUCTS

2.01 GENERAL

- A. The pumping units for the FE Pump(s) and the PW Pump(s) shall each be supplied by one manufacturer and shall be complete including pumps, motors, controls, and appurtenances such as, but not limited to, couplings, guards, and gauges.
- B. The pumps, motors, and controls shall be designed and built for 24-hour continuous service at any and all points within the required range of operation, without overheating, without cavitation, and without excessive vibration or strain beyond the limits established by the Hydraulic Institute standards. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially constructed to meet the specified requirements and system description defined in Paragraph 1.06 herein. Ample room and facilities shall be provided for inspection, repairs, and adjustment.
- C. Each major piece of equipment shall be furnished with a stainless-steel nameplate (with embossed data) securely mounted to the body of the equipment. As a minimum, the nameplate for the pumps shall include the manufacturer's name and model number, serial number, rated flow capacity, head, speed, and all other pertinent data. As a minimum, nameplates for motors shall include the manufacturer's name and model number, serial number, horsepower, speed, input voltage, amps, number of cycles and power and service factors.
- D. Pump line shafts and couplings shall be field replaceable.

2.02 CONDITIONS OF OPERATION

- A. The FE pumps shall be manufactured by Patterson, SIMFLO or Peerless. The PW pumps shall be manufactured by Trillium or Peerless.
- B. The FE pump(s) shall be designed for the conditions of service tabulated as follows.

Service:	Dry Weather	Wet Weather
Number of Pumps:	3	3
Maximum speed (rpm)	1,800	1,200
Minimum pump discharge nozzle diameter (inches):	12	16
<u>Primary Operating Condition</u>		
Capacity at maximum speed (gpm):	2,350	6,950
TDH at maximum speed (feet):	25.1	25.4
Minimum operating efficiency (percent):	80	85

- C. The PW pump(s) shall be designed for the conditions of service tabulated as follows.

Service:	Plant Water
Number of Pumps:	2
Maximum speed (rpm)	3,600
Minimum pump discharge nozzle diameter (inches):	4
<u>Primary Operating Condition</u>	
Capacity at maximum speed (gpm):	300
TDH at maximum speed (feet):	220.6
Minimum operating efficiency (percent):	77.3
<u>Secondary Operating Condition</u>	
Capacity at reduced speed (gpm):	150
TDH at reduced speed (feet):	178.2

- D. Where anticipated Total Dynamic Head (TDH) is referred to below in conjunction with the specified discharge requirements, it shall be understood to consist of the discharge pressure at the nozzle in feet plus the velocity head at that point, plus the difference in elevation between the discharge gauge and the suction well water level. The efficiency of the pump shall be understood to be based upon the bowl efficiency.

2.03 PUMP CONSTRUCTION

- A. All necessary bolts and hardware for the pump assembly, motor, and foundation shall be corrosion resistant and selected by the pump manufacturer based on the specified operating conditions.
- B. Pump assembly components and materials of construction, minimally including the pump bowl, suction bell, impeller, impeller shaft, line shaft, and couplings materials, shall be selected by the pump manufacturer unless specifically defined by the Engineer. The manufacturer's selections shall be the most suitable for this application based on the specified operating conditions when the material or component options are available.

- C. Discharge columns shall be steel of flanged and bolted construction in lengths not exceeding 10 feet. All flange hardware shall be corrosion resistant and selected by the pump manufacturer based on the specified operating conditions. The minimum wall thickness of the discharge column shall be as specified by the pump manufacturer.
- D. Discharge head with integral base plate shall be fabricated steel with 150-pound ANSI flanged end. The head shall provide for added rigidity to reduce harmonics of variable speed drives.
- E. The combined natural frequency of the system (including the pump, discharge head, soleplate, motor, and its supporting structure) shall maintain a minimum +/-20% separation margin for applications with a maximum operating speed of 1,200 RPM or greater and +25/-20% for applications with a maximum speed of 900 RPM and lower. These separation margins shall apply to all points of operation along the designed operating speed range of the pump. Any variances from these separation margins proposed by the pump manufacturer shall be included in the pump submittal. The manufacturer shall provide certification of the limitations of critical speed for the shaft.

2.04 PUMP DRIVE SYSTEM

- A. Each pump shall be driven by a hollow shaft non reversing ratchet squirrel cage induction electric motor with speed (range) as specified under Paragraph 2.02 above, and with total enclosed fan-cooled enclosure.
- B. The vertical pump motor shall be NEMA premium efficiency and rated for operation with a Variable Frequency Drive (VFD) over a speed range of 20-60 Hz for variable torque load curves.
- C. The pump motor shall be supplied with an internal space heater, 120VAC, 60Hz, at sufficient wattage to prevent condensation while the motor is not in use. Upon receiving the motor on site, the Contractor shall connect temporary 120VAC power to the motor if stored outdoors.

2.05 SHOP TESTS

- A. The Engineer shall have the right to witness the factory tests and inspect any equipment to be furnished under this Section prior to their shipment from place of manufacture.
- B. Each bowl assembly shall be factory tested with a Standard Performance Test as described in Hydraulic Institute Test Standards, Vertical Pumps 2.6 for vertical turbine pumps and all test data submitted for approval by the Engineer prior to shipment. Certified copies of the calculated pump performance curves shall be submitted including anticipated head, capacity, bowl efficiency, total brake horsepower, NPSH, and required submergence. A minimum of five (5) points, including shutoff, shall be taken for each test with at least one point being as near as possible to the specified conditions.
- C. The discharge head and bowl assembly of each pump shall be hydrostatically tested in full compliance with the Hydraulic Institute Test Standards, Vertical Pumps 2.6.
- D. Pump motor tests as shall be submitted for approval by the Engineer prior to shipment.

2.06 SURFACE PREPARATION

- A. Each piece of equipment in the pumping system including pump, support system, column piping, and motor shall be prepared finish painted as specified in Division 9.
- B. All interior and exterior wetted surfaces of pump columns and discharge elbows and the exterior of the bowl assemblies shall be cleaned of all rust and mill scale and supplied with a protective coating.

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordinate with other trades, equipment, and systems to the fullest extent possible.
- B. Take all necessary measurements in the field to determine the exact dimensions for all work and the required sizes of all equipment under this Contract. All pertinent data and dimensions shall be verified.

3.02 INSTALLATION

- A. Installation shall be in strict accordance with the manufacturer's instructions. Anchor bolts shall be set in accordance with the pump manufacturer's recommendations and setting plans.
- B. Qualified supervisory services, including manufacturers' engineering representatives, shall be provided for a minimum of two (2) days at each pump station to ensure that the work is done in a manner fully approved by the respective equipment manufacturer. The pump manufacturer's representative shall specifically supervise the installation and alignment of the pump with the driver, the grouting, the alignment of the connecting piping, and the installation of the field installed packing. If there are difficulties in the startup or operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner. Services of the manufacturer's representatives and training shall be provided when the first pump is started, with follow-up visits upon start-up of each subsequent pump.
- C. Connection of piping to pumps shall be done in the presence of the Engineer. All piping connections to the pump shall be done without bending and/or twisting the piping to mate with the pump flange connections.
- D. A certificate from the equipment manufacturer shall be submitted stating that the installation of their equipment is satisfactory, that the equipment is ready for operation, and that the Owner's operating personnel have been suitably instructed in the operation, lubrication, and care of each unit.

3.03 FIELD TESTS

- A. Field testing of the pumps shall be conducted after the manufacturer's representative has certified that the pumps have been installed in accordance with manufacturer's recommendations.

- B. Field testing shall consist of the operation of the pumps by the Owner, after installation and issuance of an installation certificate by the manufacturer, for a period of three (3) days before determining that the pumps are operating as specified. The Owner will pay for the electricity used during this period. All other costs for field tests shall be included in the Contract Price.
- C. The limits of vibration as set forth in the Hydraulic Institute standards shall govern. The manufacturer's representative shall measure and report vibration of the assembly through the full range of pump operation speeds.
- D. The Owner will accept the pumps after both factory and field testing is successfully completed.
- E. Any component parts which are damaged as a result of testing or which fail to meet the requirements specified shall be replaced, reinstalled, and retested at the Contractor's expense.

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SECTION 11225

SPIRAL SCRAPER CLARIFIER

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Specification covers the general requirements for the design, fabrication, and assembly one (1) proposed spiral clarifier mechanism and the modification of two (2) existing spiral clarifier mechanisms. The Owner has two (2) existing spiral scraper clarifiers manufactured by Walker Process currently in service in Secondary Clarifier No. 1 (SC-01) and Secondary Clarifier No. 2 (SC-02). The Contractor shall provide all labor and materials required for the installation of the new spiral scraper clarifier mechanism in Secondary Clarifier No. 3 (SC-03) and the modification of the two (2) existing spiral clarifiers mechanisms in SC-01 and SC-02 as specified herein.
- B. Work and Components Included (But Not Limited To):
 - 1. The Equipment Manufacturer shall furnish the items listed below for secondary clarifiers SC-01 and SC-02:
 - a. Galvanized Influent well extension and McKinney Baffle
 - b. All associated hardware and anchor bolts
 - 2. The Equipment Manufacturer shall furnish the items listed below for secondary clarifier SC-03:
 - a. Drive mechanism complete with a gearmotor reduction unit, micro-switch torque overload devices and shear pin
 - b. Center support pier
 - c. Center pier anchor bolt template
 - d. Center cage, truss arms and tie chord A-frames with clevis assemblies
 - e. Access bridge including center platform, aluminum walkway, aluminum hand-railing and toe plate
 - f. One (1) surface skimmer assembly which include two scum blades and a hinged skimmer assembly
 - g. One (1) scum trough with flushing device
 - h. Galvanized energy dissipating inlet (EDI) baffle system and supports
 - i. Galvanized McKinney Baffle

- j. Flocculation feedwell and supports
 - k. Sludge collection manifold with custom adapter designed by clarifier manufacture to direct RAS from manifold into RAS pipe at clarifier center
 - l. Stainless steel effluent weir plate, scum baffle, scum trough
 - m. All associated hardware and anchor bolts
- 3. Like items of equipment specified herein shall be the end products of one manufacturer in order to achieve standardization for operation, maintenance, spare parts, and manufacturer's service.
 - 4. Density current baffles and Launder Covers shall be supplied as specified in Section 11226, Glass Fiber Reinforced Plastic Fabrications.
 - 5. 316 stainless steel Weir Plates, Scum Baffles, and Scum Troughs for SC-1 and SC-2 shall be supplied in accordance with the requirements in this section.

1.02 MATERIAL 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 01600 – Materials, Transportation and Handling
- C. Section 01782 – Operation and Maintenance Data
- D. Section 01783 – Product Warranties
- E. Section 01810 – Equipment Testing and Start-Up
- F. Section 11226 – Glass Fiber Reinforced Plastic Fabrications

G. Section 13320 – SCADA Control Panels

H. Division 15 – Plumbing

I. Division 16 – Electrical

1.04 REFERENCE STANDARDS

A. Design, manufacturing, and assembly of elements of the equipment specified herein shall be in accordance with, the following:

1. American Gear Manufacturers Association (AGMA)
2. American Institute of Steel Construction (AISC)
3. American Iron and Steel Institute (AISI)
4. American Society of Mechanical Engineers (ASME)
5. American National Standards Institute (ANSI)
6. ASTM International (ASTM)
7. American Water Works Association (AWWA)
8. American Welding Society (AWS)
9. Anti-Friction Bearing Manufacturers Association (AFBMA)
10. Institute of Electrical and Electronics Engineers (IEEE)
11. National Electrical Code (NEC)
12. National Electrical Manufacturers Association (NEMA)
13. Occupational Safety and Health Administration (OSHA)
14. Recommended Standards for Wastewater Facilities (Ten States Standards)
15. The Society for Protective Coatings (SSPC)
16. Underwriters Laboratories (UL)

B. Where reference is made to one of the above standards, the revision in effect at the time of Contract signing shall apply.

1.05 SYSTEM DESCRIPTION

- A. All equipment and material shall be selected and designed by the manufacturer as appropriate for its intended use under these service conditions. Wastewater will enter Secondary Clarifiers SC-01, SC-02, and SC-03 from the Aeration Basins through a flow splitting structure. Service conditions shall be as follows:

Description	Process Conditions
Type of wastewater treatment	Final clarification of mixed liquor from Aeration Basins
Wastewater temperature range	35°F to 70°F
Chemicals to be added	Aluminum Sulfate
Influent pH range	6.0 TO 9.0
Water quality data	MLSS range 1,200 to 4,500 mg/L
Sludge volume index (SVI) range	80-132
Equipment exposed to temperatures that could produce icing	Yes

- B. Clarifying equipment shall perform the following integrated functions:

1. Dissipate inlet energy and prevent localized currents
2. Separate settleable solids from the effluent
3. Evenly withdraw the clarified effluent
4. Transport and thicken settled solids
5. Prevent dilution of the settled solids at the withdrawal point
6. Remove scum from the liquid surface in the basin

- C. Equipment shall be for circular spiral scraper cage drive clarifiers. The equipment for each basin shall include a center drive unit and torque control, aluminum walkway and platform with aluminum handrail, stationary center influent column supporting the drive, energy dissipating inlet (EDI), center hydraulic flocculating feedwell, rotating drive cage, rake arms with spiral blades, anchor bolts, scum skimmers, scum beach, and all other appurtenances necessary or shown on the Drawings.

1.06 SUBMITTALS

- A. Drawings and Data. Complete assembly and installation drawings, together with detailed specifications and data covering materials, power drive assemblies, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the Submittals section. Drawings shall indicate all dimensions and structural member sizes and shall be certified by an officer of the company manufacturing the equipment that the design is in compliance with all local laws and codes for the location where the equipment will be installed. Data and specifications for each unit shall include, but shall not be limited to, the following:

1. Torque rating
2. Maximum (breakdown) torque

3. Arm tip speed
4. Weight
5. Shop painting
6. Structural and Mechanical drawings
7. Sludge Collection Details
8. Electric motor data in accordance with the submittal requirements of the Electric Motors section
9. Variable frequency drive equipment in accordance with the submittal requirements of Specification Section 16480, Motor Control Centers.
10. Electrical control equipment
11. Type, specifications, AGMA rating, details, input and output speeds, exact gear ratios, and service factor (24-hour continuous service) of gear reducers
12. Description of overload device
13. Wiring diagram and electrical schematic
14. Functional description of internal and external instrumentation and controls to be supplied including list of parameters monitored, controlled, or alarmed
15. Bearing type, size, hardness, and manufacturer
16. Gear box type, size, manufacturer, torque ratings, input Hp, duty classification, shaft diameter, coupling information, service factors, and mounting bracket information
17. Scum trough flush valve details
18. Certification of the anchor bolt design calculations by a registered professional engineer
19. Certification of the AGMA driving rating calculations by a registered professional engineer
20. Certification of the bearing life calculations by a registered professional engineer
21. Control Panels
22. Dimension and Layout Details
23. Wiring Diagrams and control schematics
24. Materials of construction for panels and all associated hardware, including NEMA rating

- 25. Detailed list of panel components
- 26. Catalog cut sheets on all components

B. Operating and Maintenance Data

- 1. Operating and maintenance instructions shall be furnished to the Engineer as provided in Section 01782, Operation and Maintenance Data. The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists and descriptions that are required to instruct operating and maintenance personnel unfamiliar with such equipment.
- 2. Manufacturer shall supply a minimum of three (3) copies of a single Operation and Maintenance Manual specifically suited to the complete clarification system on or before delivery of the equipment to the jobsite.

C. The Contract, if awarded, will be on the basis of material and equipment specified without consideration of alternate equipment. In the event an alternate is allowed, the Contract price will be adjusted accordingly by a change order.

- 1. By submitting a bid, the Contractor agrees and understands that Contract award will be made on the basis of the specified equipment.
- 2. If an alternate is found to be not acceptable, the Contractor shall be responsible for supplying the equipment specified.

D. Descriptive information shall include the following:

- 1. List of ten (10) installations of equipment in successful operation of the design in all essential regards as specified.
- 2. Written certification that the proposed drive meets AGMA standards. Drive mechanism calculations prepared by a registered professional engineer and shall be submitted for approval along with published torque value of the proposed drive.
- 3. Complete assembly drawing of the collector components and List of Materials giving:
 - a. Type of material used for each component
 - b. Dimension, thicknesses, and weights of each component

1.07 QUALITY ASSURANCE.

A. Manufacturer's Experience

- 1. The equipment Manufacturer shall have not less than 15 successful years of experience in the design, construction and operation of the type specified at ten (10) different plants.

2. The Engineer may require evidence, in the form of operating records, from these plants to substantiate any claims concerning the ability of the equipment to perform as required.
- B. **Welding Qualifications.** All welding procedures and welding operators shall be qualified by an independent testing laboratory in accordance with the applicable provisions of Section D1.1 of the American Welding Society Code. All procedure and operator qualifications shall be in written form and subject to the Engineer's review. Accurate records of operator and procedure qualifications shall be maintained by Contractor and made available to the Engineer upon request.
- C. **Welder Certification.** Prior to the start of the work, the 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 the Engineer.
- D. **Balance.** 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 resonance at normal operating speeds is avoided. In any case, the vibration displacement (peak-to-peak) as measured at any point on the machine shall not exceed 2.0 mils. 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.
- E. **Alterations.** Any alterations to the structure, piping, supports, anchors, accessories, or appurtenances indicated on the Drawings that are required for installation and operation, regardless of type or manufacturer, shall be made by and at the sole expense of the equipment manufacturer. All costs in connection with any modifications shall be considered as included in the bid and contract based thereon. All changes and modifications shall be acceptable to the Engineer.

1.08 GUARANTEE AND WARRANTY

- A. The equipment supplier shall warrant the clarifier equipment against defects in manufacturing and materials for period not less than 12 months from date of substantial completion. If any part of the equipment should fail during the warranty period, it shall be repaired or replaced at no cost to the Owner.
- B. The clarifiers are anticipated to be placed into service with three (3) separate startup events. Warranty may commence on separate dates for individual items of equipment, but no items of equipment shall have a warranty period of less than 12 months from the date that item of equipment is placed into service.
- C. The manufacturer is responsible for providing equipment storage instructions prior to equipment delivery. Equipment warranty will not be lessened due to damage during storage should those requirements be satisfied.
- D. All warranties shall comply with Specification Section 01783, Product Warranties.

1.09 MAINTENANCE

- A. Special tools, if required for normal operation and maintenance, shall be furnished with the equipment by the manufacturer.
- B. The following spare parts and accessories shall be furnished for each drive unit furnished. The spare parts shall be furnished in substantial wooden boxes with identifying labels and delivered to the Owner as directed:

Spare Part	Quantity
Shear pins	One (1) Set
Bearings and seals	One (1) Set
Torque box switches	One (1) Set

- C. Spare parts shall be delivered to the Owner on the day of equipment startup in the presence of the Engineer and equipment manufacturer's representative.

PART 2 DESIGN

2.01 MANUFACTURERS

- A. The OWNER and ENGINEER believe the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this section.

- 1. Walker Process

2.02 EQUIPMENT

- A. General

- 1. Furnish and deliver spiral sludge collector for installation in one (1) proposed concrete settling tank:
 - a. Tank diameter is 90 feet with outboard concrete effluent launder
 - b. Tank side water depth is 12 feet
 - c. Floor slope is 1-inch per 1-foot
- 2. Clarifier Mechanism
 - a. Provide a center pier supported, center feed design with peripheral overflow
 - b. Provide a center drive mechanism that supports a walkway, maintenance platform and rotating structural steel cage
 - c. The cage shall support two (2) structural truss arms, each equipped with a single and continuous spiral plow blade. The blade shall span from the center pier to the peripheral wall

- d. One (1) surface skimmer assembly which includes two scum blades and hinged skimmer assembly. Scum blade assemblies shall be designed to properly function with proposed weirs and scum baffle
 - e. Plows shall move settled solids into a supplied sludge manifold. Manufacturer designed adapter shall be supplied to transfer RAS from manifold into existing central RAS pipe
 - f. Fabricated steel structures shall be shipped in the largest sub-assemblies permitted by carrier regulations, properly match-marked and identified for ease of field erection
3. Clarifier Mechanism Design – Hydraulics (Per Clarifier). Note that minimum and average flow are based on only two (2) clarifiers operating, and peak flows are based on all three (3) clarifiers in operation.
- a. Effluent Flow

i. Minimum flow (MGD)	0.7
ii. Average flow (MGD)	4.0
iii. Peak flow (MGD)	4.5
 - b. Return Activated Sludge (RAS) Flow

i. Minimum flow (MGD)	1.8
ii. Average flow (MGD)	6.0
iii. Peak flow (MGD)	9.1
 - c. Waste Activated Sludge (WAS) Flow

i. Average flow (GPD)	28,030
ii. Peak flow (GPD)	105,270
4. Clarifier Mechanism Design – Equipment
- a. Dimensions

i. Internal Diameter, feet	90
ii. Side-water Depth, feet	12
iii. Floor Slope, inch/inch	1/12
 - b. Center Column

i. Minimum inside diameter, inches	36
ii. Number of ports in center column	4
iii. Center column port area, min each	2.5 ft ²
iv. Top of center column port	4" above average WSL

c. Energy Dissipating Inlet (EDI)

i. Minimum Diameter, feet	7
ii. Minimum Depth, feet	4
iii. Number of Ports	6
iv. Max Port Velocity, ft/s	1.5

d. Flocculation Well

i. Minimum Diameter, feet	20
ii. Number of Scum Ports	4

e. Horizontal Baffle (McKinney Baffle)

i. Total Diameter, feet	33
ii. Minimum height below feedwell	2 ft.- 8 inches

f. Skimmer and Scum Trough

i. Number of skimmer arms	2
ii. Trough minimum length, feet	5' 0"

5. Clarifier Design – Drive Mechanism

a. Minimum Ball Race Diameter, inches	46.5

b. Drive Requirements

i. Drive Output Speed, RPM	Adjustable
ii. Collector tip speed , approx.	14fpm
iii. Minimum continuous rated torque	30 ft-kips
iv. Alarm Torque	100% Continuous Rated Torque
v. Motor Cut-Off	125% Continuous Rated Torque
vi. Momentary Peak	200% Continuous Rated Torque
vii. Shear Pin	< 200% Continuous Rated Torque

- c. The rated torque of all components of the collector drive unit shall equal or exceed the torque equivalent to the nameplate horsepower of the drive motors.

- d. All motor driven components shall be designed and constructed so that the maximum noise level measured at 3 feet from the installed equipment drives and motors does not exceed 80 dBA.

B. Clarifier Design – Materials

1. Fabrication: The materials of construction for all components in contact with liquid, including center pier, center well extension (existing mechanisms only), McKinney baffle, sludge ring, collector, and scum skimmer components shall be hot dipped galvanized carbon steel. Scum baffles, weir plates, and scum trough shall be 316 stainless-steel. Welded joints shall be sealed watertight with continuous welds.

Bolts shall be provided at connections to facilitate field assembly. Faying surfaces of bolted joints shall be shop coated.

2. Edge Grinding: All cut or sheared edges shall be ground smooth to a 1/8-inch minimum radius for all material 1/4-inch thickness and larger. For material thickness less than 1/4-inch all cut or sheared edges shall be ground smooth to a radius equal to half (1/2) the material thickness. Grinding of rolled edges on standard shapes with a minimum radius of 1/16-inch will not be required.
3. Surface Preparation: In preparation for galvanizing, all ferrous metal surfaces shall have all welds ground smooth and free of all defects in accordance with NACE Standard SPO178, Appendix C, Designation C, and sharp edges ground smooth, if not previously prepared in the shop. Instead of blending of the weld with the base metal as specified by the NACE standard, it will be acceptable to furnish a welded joint that has a smooth transition of the weld to the base metal. All welds shall be ground smooth to ensure satisfactory adhesion of the galvanization.
4. Stainless Steel: All stainless steel shall be pickled in accordance with ASTM A380 at the mill before being shipped. 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 contaminated or damaged during fabrication including welded areas shall be re-pickled or passivated in accordance with ASTM A380 as needed to remove all traces of iron contamination and heat tint. 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.
5. Final Finish: All Iron and metal surfaces of the equipment shall be hot dip galvanized by the manufacturer. Cold galvanization is not acceptable. The center drive equipment, electric motors, speed reducers, and other drive components shall be completely protected during blasting operations.
6. Preparation and painting of the stainless-steel components shall be as specified in the Protective Coatings section.

C. Bolts & Nuts

1. The bolts, nuts, and washers shall be suitable for field assembly, and be provided for each item of equipment.
2. All field assembly bolts, nuts, and washers in submerged locations shall be stainless steel. A washer shall be installed under each nut.
 - a. Assembly Bolts and Nuts:
 - i. Stainless Steel Bolts ASTM F593, Alloy Group 2
 - ii. Stainless Steel Nuts ASTM F594, Alloy Group 2

b. Flat Washers:

- i. ANSI B18.22.1; of the same material as the bolts and nuts.

3. Anchor bolts shall comply with the Anchorage in Concrete and Masonry section.
4. Anti-seize compound will be applied to the threads of all stainless-steel bolts before assembly.

D. Structural Design

1. Unless indicated otherwise, all structural members, plates, or shapes shall be a minimum of 1/4-inch thickness. The ratio of unbraced 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 (for angles about the Z axis). For simple spans, deflection shall be less than or equal to 1/360 for the total load. For cantilever spans, deflection shall be less than or equal to 1/240 for total load. In addition, all structural members and connections shall be designed so that the unit stresses will be less than 90 percent (90%) AISC yield stresses when subject to a loading of two (2) times the minimum rated torque. The preceding deflection criteria does not have to be satisfied at loading of twice (2X) the maximum calculated running torque.
2. The design of the equipment shall consider surface preparation and painting requirements and shall comply with the recommendations of the SSPC. Inaccessible welds and welding of angles back-to-back shall be avoided.
3. Submerged carbon steel or stainless-steel components shall not be fabricated from sections with a hollow cross-section, such as pipe or tubular sections; only bars, plates, angles, channels, and other rolled sections shall be used. Walkway, feedwell, and floccwell baffle support beams shall not be submerged.
4. Sharp corners of cut or sheared edges will be dulled with one pass of a power grinder to create a smooth edge.
5. All welding shall conform to American Welding Society Standard AWS D1.1. Structural support members shall be shop welded for bolted field assembly.

E. Drive Mechanism

1. Drive Units. Drive units shall be selected, designed, and rated in accordance with AGMA standards, and the criteria specified herein. Where AGMA standards and the criteria specified herein are in conflict, the values that will result in the most conservative design for long life and minimum maintenance shall be selected. Drive units shall be of weatherproof design.
2. Each drive unit shall be adjustable speed as specified herein and shall be anchored to the turntable base. Each drive unit shall consist of a worm gear reduction unit connected by a roller chain, V belt drive, or directly connected to a speed reducer and drive motor. Two drive units shall be supplied for dual pinion drives. Drive units having a pinion mounted directly on the motor shaft will not be acceptable. Shell

worms will not be acceptable. Plain or sleeve type bearings will not be acceptable. All bearings shall have a minimum L10 life of 20 years, based on the continuous torque rating.

3. The sludge collection drive unit motor shall be in accordance with the Electric Motors section, except that sealed bearings may be provided if they have an ABMA L10 rating of at least 100,000 hours. The motor shall be furnished with a motor space heater.
4. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor. Drive units shall be designed for 24 hours continuous service.
5. Overload Mechanism. The drive of the rotating scraper assemblies shall be equipped with an indicating torque overload mechanism with a NEMA 4X stainless steel housing and shall be actuated by the movement of the worm shaft in the intermediate wormgear speed reducer as well as two (2) independently adjustable, electrically isolated contacts. The overload mechanism shall be factory adjusted. The "Alarm" (High Torque Alarm) contact shall open to operate specified alarm devices when the load reaches approximately 100 percent (100%) of the minimum rated torque of the drive unit. The "Stop" (High Torque Alarm) contact shall close to unlatch a relay to stop the motor at approximately 120 percent (120%) of the minimum rated torque. The overload mechanism shall be adjusted and set at the factory. The torque indication and alarm contact shall be mechanically or electrically actuated. The torque overload contact shall be mechanically actuated.
6. A shear pin shall be provided as additional overload protection to prevent 140 percent (140%) of the minimum rated torque from being applied to the drive mechanism. A third independently adjustable, electrically operated contact shall not be provided as a substitute for the additional overload protection.
7. Gearmotors. Gearmotors shall conform to ANSI/AGMA 6013-B16, "Standard for Industrial Enclosed Gear Drives," and shall have a service factor of 1.4 based upon the specified continuous running torque. The use of gearmotors sharing an integral housing, or cut gears into the motor output shaft, or that require removal of lubricant from the gear reducer to change out the motor, will not be acceptable.
8. Gear Reducers. Each gear reducer shall be a totally enclosed unit and shall be oil or grease lubricated with anti-friction bearings throughout and shall be AGMA rated.
9. Spur, helical, herringbone, and bevel type gear reducers shall be rated as specified in ANSI/AGMA 2000-A88 or Accuracy Level 11 in conformance with ANSI/AGMA 2015-1-A01 or the current standard, with minimum service factor of 2.0 based on the motor nameplate horsepower of the drive motor. Worm gear reducers shall be rated as specified in ASTM B271, AMS 4862F, and ANSI/AGMA 2004-C08. or the current standard, with a service factor of at least 1.75 based on the nameplate horsepower of the drive motor. Shaft mounted and flange mounted gear reducers shall be rated AGMA Class III. Each gear reducer shall be designed and manufactured in compliance with applicable AGMA standards, except the L10 bearing life shall be 20 years.

10. The thermal horsepower rating of each unit shall equal or exceed the nameplate horsepower of the drive motor. During continuous operation, the maximum sump oil temperature shall not rise more than 100 degrees Fahrenheit (100°F) above the ambient air temperature in the vicinity of the unit and shall not exceed 200 degrees Fahrenheit (200°F).
11. Each grease lubricated bearing shall be installed in a bearing housing designed to facilitate periodic re-greasing of the bearing by means of a manually operated grease gun. Each bearing housing shall be designed to evenly distribute new grease, to properly dispose of old grease, and to prevent over greasing of the bearing. At the manufacturer's option, permanently sealed, grease lubricated bearings meeting the specified L10 bearing life of 20 years may be provided. An internal or external oil pump and appurtenances shall be provided if required to properly lubricate oil lubricated bearings. A dipstick or a sight glass arranged to permit visual inspection of lubricant level shall be provided on each unit.
12. Gear reducers which require the removal of parts or the periodic disassembly of the unit for cleaning and manual re-greasing of bearings will not be acceptable.
13. Certification shall be furnished by the gear reducer manufacturer indicating that the intended application of each unit has been reviewed in detail by the manufacturer and that the unit provided is fully compatible with the conditions of installation and service.
14. Adjustable Speed Drive. An adjustable speed drive for each sludge collector shall be provided in accordance with the control equipment paragraph of this section.

F. Lubrication

1. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.
2. Lubricants of the types recommended by the equipment manufacturer shall be provided in sufficient quantities to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of the equipment by Owner.
3. Gear reducer gears and bearings shall be oil or grease lubricated. Gears and lubricated bearings shall run in oil or shall be provided with a positive means of continuous lubrication. Seals shall be provided around shafts to prevent leakage of oil. Splash lubrication is not acceptable. Due to the potential low speed gear rotation, a positive means of lubrication shall be provided.
4. Roller chain shall be self-lubricating type with oil-impregnated, sintered steel bushings or O ring type with lubricant factory installed in the pin bushing contact areas and sealed in place by means of elastomeric O rings on each pin between the roller link plate and pin link plate.
5. Lubrication systems shall be so designed that they are protected against contamination and the lubricants cannot contaminate the water being treated. Each

lubrication system shall be provided with an external, visual method of checking lubricant level, without removing parts or fittings. A dipstick or sight glass arranged to permit visual inspection of the lubricant level shall be provided on each unit.

6. Lubrication shall be accomplished by means of convenient and readily accessible oil fill and drain plugs or grease fittings that do not require the removal of parts or dismantling of equipment. Oil drain and fill openings shall be easily accessible from the operating platform, convenient for collection of oil in 18-inch-high containers from the platform, without removing the unit or equipment platform from its normal installed position. Alternatively, systems that allow oil to be easily drained and filled from the equipment platform which utilize a portable pump to remove the oil to containers on the equipment platform may be used if acceptable to Engineer.
- G. Equipment Bases: Cast iron or welded steel baseplates shall be provided for the equipment.
- H. Flocculation Feedwell
1. The flocculation feedwell fabricated from 3/16" steel plate sections supported from the drive cage or bridge extensions
 2. Incorporate steel stiffeners at the top and bottom to maintain shape and rigidity
 3. Feedwell shall be of adequate size to diffuse the flow into the tank at a uniform flow through velocity
 4. Ports shall be cut into the flocculation feedwell to permit entrapped scum to escape
 5. Ports shall be baffled to prevent short circuiting to the weirs
 6. For the diameter of the proposed flocculation feedwell, straight segmented pieces are not allowed
- I. Center Pier
1. Center Influent Column and Support. Each mechanism shall be supported on a cylindrical steel center pier/influent diffuser, through which influent flow enters the basin. The center pier shall be of sufficient height to accommodate level installation of the access walkway and to support the turntable above the water level. The center pier shall support all loads from the rotating mechanism, including torque as well as the equipment platform, access walkway, energy dissipating inlet, and hydraulic flocculating feedwell baffle wall. The minimum diameter of the center pier shall be as specified herein, and the shell thickness shall be at least 1/4-inch. The cross-sectional area of the center pier influent ports shall be as large as practicable, without compromising the structural integrity, to reduce the influent flow velocities through the influent ports to the minimum possible.
 2. The bottom of the center column ports shall be at least 3 feet above the bottom of the feedwell baffle wall. Influent ports and other openings in the center pier shall be suitably reinforced.

3. The anchor bolt connection between the center pier and the concrete structure shall be designed to resist all loadings, including the maximum torque that may be applied by the drive mechanism. The center pier shall be plumbed and leveled using removable shims and wedges. The use of leveling nuts on the anchor bolts will not be permitted. A watertight connection shall be provided between the center pier and the bottom of the basin. All details of the connection shall be indicated on the submittal drawings.
4. A 3-inch flanged outlet shall be provided on the center pier just above the bottom baseplate for draining the center column. A blind flange and bolts, nuts, and washers shall be provided for the flanged outlet. The flanged outlet shall project a minimal distance from the pier wall.

J. Energy Dissipating Inlet (EDI)

1. A rotating circular energy dissipating inlet with bottom shall be supported by the cage and be designed to diffuse the liquid into the center feedwell in a tangential direction. The EDI shall be designed to positively prevent sludge from depositing within the EDI and shall include bottom drain holes. The rotating EDI shall be designed with a full bottom extending to within 1-inch of the center column. The gap between the center pier and EDI shall be bridged with a neoprene seal. It shall include an upper rim angle for stiffness. Multiple tangential diffuser gates shall be provided to induce a tangential flow velocity between the EDI and feedwell and specifically preclude any vertical currents. The vertical wall of the gates shall be curved at a constant radius and shall not restrict the flow. The tangential baffle shall extend past the gate openings at least the same distance as the opening width. The gates shall have a fixed bottom to prevent vertical currents as the flow exits the EDI.

K. Horizontal Baffle (McKinney Baffle Style)

1. A rotating circular horizontal baffle shall be supported by the cage and rake arm trusses and be designed to direct incoming flow in the horizontal direction such that the exit velocity between the top of the baffle and the bottom of the feedwell is between 0.15 and 0.25 ft/s into the settling area of the basin at the peak flow rate plus maximum RAS flow through the basin. The horizontal baffle shall have a maximum gap of one (1) inch around the circumference of the center column to ensure limited current and velocities at the center column horizontal baffle interface. The gap shall be sealed with a flexible material proposed by the manufacturer and approved by the Engineer. The horizontal baffle shall incorporate a minimum of 30 degree (30°) sloped segment nearest the center column before turning horizontal to prevent solids buildup around the column. The sloped segment shall not exceed 20 percent (20%) of the horizontal baffle diameter.
2. The horizontal baffle shall be fabricated of suitably reinforced galvanized plate not less than 1/4-inch thick. Horizontal baffle plates shall be connected by full length welded construction.

L. Center Mechanism

1. The center mechanism shall consist of the drive unit, gearing, and the supporting structure for the sludge collecting equipment.

2. **Sludge Collection Turntable Assembly:** The sludge collecting equipment shall be driven by a turntable assembly that consists of a large diameter main bearing and drive unit. The main bearing shall consist of annular bearing raceways near the outer circumference which shall rotate on alloy steel balls and shall be a strip liner bearing as specified herein. Main bearings shall have an ABMA L10 life rating of at least 200,000 hours and shall be designed to carry all vertical loads and torque loads plus an additional allowance of 25 percent (25%) of the weight of the rotating equipment. A ring gear shall be provided on the turntable. Ring gears shall be cast integrally with the turntable or bolted in place. Where specified herein, a balanced dual pinion drive shall be provided for the ring gear. The turntable and ring gear shall be cast iron, ductile iron, or steel. Ring gears shall be rated according to AGMA Standard 2001-C95 or the current standard for operation at the required continuous torque rating for a minimum life of 200,000 hours. The valved oil bath drain shall be easily accessible from the center platform. The drain shall terminate in a turned down elbow and shall be suitable to support a container to receive waste oil.
3. **Strip Liner Bearing Ball Races:** Strip liner turntables shall rotate on alloy steel balls. Ball races for each main bearing shall be hardened to at least 39-43 Rc or provided with renewable hard steel liner strips. The balls shall run in an oil bath and shall be protected by a synthetic flexible seal and dust shield. A cast iron, ductile iron, or steel ring gear shall be provided on each turntable. Ring gears shall be cast integrally with the turntable or bolted in place.
4. **Race Bearings:** The ball bearing assembly shall be mounted in an ASTM A48 Class 40 cast iron housing. The housing shall be cast as a single piece to provide a leak proof enclosure. Fabricated housings will not be acceptable. Seals or gaskets located below the oil level will not be acceptable. The base of the housing shall be mounted on the top flange of the stationary center column and designed to support the internal spur gear, the rotating clarifier mechanism, and one end of the access walkway. The housing shall be complete with seals, oil level dipstick, oil fill, and valve oil and condensation drains.
5. **Rotating Scraper Assemblies:** The center mechanism shall be equipped with two (2) rotating scraper arms attached to and supported from a center cage. The center cage shall be of steel box truss construction. The cage top shall be bolted to the main gear which shall rotate the cage with the attached arms and energy dissipating horizontal baffle. The center cage shall be reinforced top and bottom for proper distribution of loads to supports and shall have adequate strength and rigidity to support and rotate the scraper arms under maximum load, with an adequate factor of safety. Scraper arms shall be fabricated from structural steel members using triangular or box truss construction. Longitudinal members of the triangular trusses shall be fabricated from bent plates at least 1/4-inch thick and minimum leg width of 2 inches. Longitudinal members of box trusses shall be fabricated from bent plates or rolled structural members at least 1/4-inch thick and minimum leg width of 2 inches. Trussed arms shall be designed without tie rods.
6. The rotating arms shall be equipped with blades of the spiral type to move settled sludge to the collection point. Each arm shall collect sludge over the full area of the basin bottom. The height of each spiral blade shall have a constant taper over the length of the blade. Each blade shall have adjustable stainless steel squeegees at

the bottom edge. Squeegees shall be fastened to rake blades with stainless steel fasteners. The blades arms shall be fabricated from rolled structural angles or sections having a minimum thickness of 1/4" and designed to meet AISC specifications.

7. The scraper arms shall conform to the slope of the basin bottom. The clearance between the basin bottom and the blades shall not exceed 1 1/2 inches at any point.
8. Sludge Withdrawal Mechanism: The manufacturer shall provide a sludge collection drum to pull sludge from the clarifier into the sludge draw-off point. The collection drum shall be designed to rotate with the center cage and prevent short-circuiting of the influent to the underflow. Ports shall be located in front of the rotating spiral rake blade. The ports shall be sized to collect thickened sludge from the bottom most dense sludge layer to maximize underflow solids concentration without plugging. Appropriate seals shall be provided as necessary to prevent the passage of liquid between the mechanism, tank, and center column.
9. Scum Skimmers: The basin shall be equipped with baffles and devices that collect floating scum and flush it into a trough for removal. Skimming equipment shall be designed to operate with the circumferential scum baffle indicated on the Drawings and shall consist of skimmer and wiper assembly, extended length peripheral scum trough, and discharge pipe.
10. The basin shall be equipped with two skimming arms. Each skimmer shall collect scum the full length of the peripheral scum trough to the scum baffle. The skimming arm shall form an angle of at least 2 degrees (2°) with the center line of the rake arm, and the entire weight of the arm shall be supported by the rotating machine.
11. The wiper blade shall be at least 6-inches wide, extending approximately 3 inches above and 3 inches below the water level. The wiper shall have adjustable aluminum arms with adjustable neoprene edges and shall rake scum up the approach ramp of the scum trough and automatically discharge it into the trough. Each skimmer shall also have full radius steel deflector blades extending tangentially from the influent well to the skimmer to assist in scum removal. The wiper assembly shall be supported at the outer end in its travel over the scum trough. The scum trough shall include an integral 2-1/2-inch exit side lip with an adjustable approach ramp extending 2 feet from the center of the trough. The ramp crest shall be at least 1 inch above the top of the weir. The scum baffle, which normally projects 2 inches above the top of the weir as indicated on the Drawings, shall be extended to 8 inches above the top of the weir at the scum ramp and at least 12 inches beyond each end of the ramp. In addition, the depth of the scum baffle shall be increased by 10 inches from 12 feet ahead of the leading edge of the ramp to 8 feet beyond the trailing edge of the ramp.
12. The scum trough shall have diagonal 316-stainless steel support bars spaced at no more than 6 inches apart to prevent birds from entering the trough. The scum trough shall be manufactured of 316 stainless-steel, and shall be provided with a cam operated valve which shall flush the trough with basin water at each pass of the skimmer. The operation of the valve shall satisfactorily flush the scum trough. Valve opening and duration of flushing shall be adjustable.

13. The size and arrangement of the discharge pipe from the scum trough shall be as indicated on the Drawings.

M. ACCESS WALKWAYS

1. Each clarifier shall include a basin walkway supported by beams and trusses spanning from the basin effluent launder wall to the center column.
2. Each turntable top shall have a platform above the center column for convenient access to the center drive mechanism. The platform shall be wide enough to provide a clear space of at least 3 feet on all sides of the equipment. The platform shall be accessed from the basin wall by the access walkway which shall extend from the basin effluent launder wall to the platform. The equipment platform shall have the same floor elevation as the access walkway and shall be floored with 1/4-inch aluminum checkered plate.
3. The access walkway shall be at least 36 inches wide. The walkway shall be floored with 1 1/2-inch aluminum grating and shall be diagonally braced against lateral movement. A kickplate at least 4 inches high shall be provided around the entire walkway, including the equipment platform. The walkway shall be so designed and constructed such that deflection will not exceed 1/360 of the span length considering all dead loads plus a live load of 100 pounds-per-linear-foot. Walkways of the underhung truss type are not acceptable.
4. Grating and checkered plate shall be fabricated and attached to the structure in accordance with the Grating and the Structural Steel and Miscellaneous Metals sections.
5. As shown on the Drawings, an access stairway with treads matching the walkway floor shall be provided at the basin wall end of each walkway. Materials of construction shall match the walkway.
6. Railing system shall conform with the local code requirements for nonpublic use.
7. Three rail railings 3' 6" high shall be provided along each side of each beam-supported walkway and stair, and around the equipment platform. Railings shall be aluminum as specified in the Handrailing, Guard railing, and Ladders section. Walkway trusses may serve as railings, provided the top chord is 3' 6" above the walkway surface and the space between members does not exceed 4 inches for public use, and 12 inches for nonpublic use. Otherwise, railings shall be mounted on each side, 3' 6" above the surface. A rectangular aluminum mounting plate for electrical equipment shall be provided on the equipment platform railing. The bolts and hardware used to install the mounting plates shall be stainless steel.
8. Walkways shall be provided with the necessary brackets for supporting the electrical conduits, hose wash stations, and spray waterlines indicated on the Drawings.

2.03 SURFACE PREPARATION AND FINISHING

- A. The clarifier mechanism including access bridge shall be hot dipped galvanized. Refer to Specification Section 09902, Finish Painting for all other required coatings.

2.04 ELECTRICAL CONNECTIONS AND WIRING

- A. Control panels, wiring, conduits, and instrumentation will be provided by the Electrical Contractor under Division 16 – Electrical.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with the Equipment Installation section and as specified herein.
 - 1. Weir plates shall be adjusted to a level position after installation to provide uniform overflow rate at all points. The blades on each scraper shall be adjusted to the contour of the basin floor. All stainless-steel bolts shall be tightened with a torque wrench. Torque values for all stainless-steel bolts shall be in accordance with the manufacturer's recommendations. The recommended values shall prevent under shearing and/or seizing of stainless-steel bolts.
 - 2. To ensure that each sludge collecting mechanism is functioning properly, it shall be run at least four (4) hours before flow is admitted to the basin.

3.02 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 the Equipment Start-Up and Testing 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.

3.03 FIELD OR PERFORMANCE TESTING

- A. Field or performance testing shall be in accordance with the Equipment Testing and Start-Up section and as specified herein.
 - 1. The authorized representative of the manufacturer shall perform the following checks after installation of the clarifier drive is complete:
 - a. Alignment and Installation
 - i. Check alignment of the drive and driven sprockets

- ii. Check chain for proper tension
- iii. Ensure proper fit of chain guard
- iv. Measure the stop block clearance and lower drive housing
- v. Review and confirm the correct motor, gear reducer, and drive chain have been installed on the clarifier drive per the defined mechanism design
- vi. Confirm installation of the proper shear pin
- vii. Bump motor to confirm correct rotation

b. Lubrication

- i. Check the drive mechanism for the correct lubrication levels
- ii. Service all lubrication points and grease fittings
- iii. Check the air vents in the gear reducers

c. Micro-switches

- i. The torque protection micro-switches must be connected per the diagram on the drive drawing
- ii. The shut-down switch must be connected: a manual reset must be wired in the circuit when the motor shut-off switch is activated
- iii. Set alarm and motor shut-off torque overload gap per the drive drawing

2. Clarifier Mechanism

- a. The authorized representative of the manufacturer shall perform the following checks after installation of the clarifier mechanism is complete:
 - i. Confirm proper installation of all field bolt material.
 - ii. Check the bridge and platform for proper level installation.
 - iii. Ensure proper spacing has been installed on the bridge expansion end to allow for sufficient room to expand and contract.
 - iv. Run the mechanism and check the horizontal plane at four (4) points on the wall (90° apart) for tanks up to 80-feet in diameter, eight (8) points (45° apart) for large tanks. Always recheck starting point.
 - v. Check manifold runs concentric to center pier.
 - vi. Check the slope of the header at fluidizing blade.
 - vii. Confirm that the upper and lower manifold seals are installed properly.
 - viii. Check the elevation and scum beach level relative to the maximum water surface.
 - ix. Perform alignment check of the header and truss arms.
 - x. Proper tracking and alignment of skimmer assembly with water elevation and scum trough.
- b. Field Load Test: Contractor shall perform a load test on the sludge collection equipment in accordance with the recommendations of the equipment manufacturer. The mechanism shall be loaded until there is sufficient torque created on the drive to trip the alarm unit at 100 percent (100%) of the rated torque and continue loading until the "Stop" contact is activated at 120 percent (120%) of the minimum rated torque. The equipment manufacturer shall provide Contractor with detailed instructions on where and how to connect the loads to the arms and shall have a service representative present during the test.

3.04 TRAINING

- A. The manufacturer's representative shall provide training of Owner's personnel as described below. All costs for training services shall be included in the Contract Price.
 - 1. Manufacturer to provide eight (8) trips and 12 days total of on-site field service.
 - 2. One (1) day shall be dedicated installation inspection. After installation, a final inspection shall be conducted followed by a general training seminar and operation assistance.

END OF SECTION

SECTION 11226

GLASS FIBER REINFORCED PLASTIC FABRICATIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Specification includes fiberglass reinforced plastic (FRP) density current baffles and launder covers for clarifiers, thickeners, or other applications as shown on the contract drawings.
- B. This Specification covers the general requirements for the design, fabrication, and assembly of FRP density current baffles and launder covers for two (2) existing secondary clarifiers, SC-01 and SC-02, and one (1) proposed secondary clarifier, SC-03. The Contractor shall provide all labor and materials required for the installation of the density current baffles and launder covers as specified herein.

1.02 MATERIAL 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 01600 – Materials, Transportation and Handling
- C. Section 01783 – Product Warranties
- D. Section 11225 – Spiral Scraper Clarifier

1.04 REFERENCE STANDARDS

- A. International Organization for Standardization (ISO), latest edition:
 - 1. ISO 9001: Quality Management Systems Requirements
- B. ASTM International (ASTM), latest edition:
 - 1. ASTM D 256: Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
 - 2. ASTM D 570: Standard Test Method for Water Absorption of Plastics
 - 3. ASTM D 638: Standard Test Method for Tensile Properties of Plastics
 - 4. ASTM D 790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - 5. ASTM D2583: Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
- C. American Water Works Association (AWWA), latest edition:
 - 1. AWWA F101: Contact-Molded, Fiberglass-Reinforced Plastic Wash-Water Troughs and Launderers

1.05 SUBMITTALS

- A. The following shall be submitted in accordance with Section 01300, Submittals:
 - 1. Shop Drawings containing the following information:
 - a. Dimensions
 - b. Job specific layout
 - c. Sectional assembly
 - d. Locations and identification mark
 - e. Accessories, attachments, transition pieces
 - f. Connection details
 - 2. Manufacturer's catalog data showing:
 - a. Dimensions, spacing, and construction details
 - b. Materials of construction
 - c. Description
 - 3. Certificates
 - a. Submit Manufacturer's certification that all materials furnished are in compliance with the applicable requirements of this specification

4. Manufacturer's Instructions

- a. Submit complete information and instructions relating to storage, handling, installation, and inspection of all equipment related to this section.

1.06 QUALITY ASSURANCE

- A. The material covered by these specifications shall be furnished by a reputable and qualified manufacturer of proven ability that is regularly engaged in the manufacture and installation of FRP products.
- B. Fabricator shall be experienced in successfully producing FRP products specified for this project, with sufficient production capacity to produce required units without causing delay in the work.
- C. Fabricator shall provide a list of five (5) installations of comparable size in operation for at least three (3) years.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. All FRP components shall be shop fabricated and assembled into the largest practical size suitable for shipping.
- B. The parts and assemblies that are shipped unassembled shall be packaged and tagged in a manner that will protect the equipment from damage and facilitate the final assembly in the field.
- C. All FRP materials shall be stored before, during, and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping or damage of any kind to the materials.

1.08 SEQUENCING

- 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 adjoining items of work in this Section before commencement of items herein specified.
- B. Ensure that density current baffles and launder covers are installed such that two (2) secondary clarifiers are in service at all times.

1.09 WARRANTY

- A. Warranty provisions are included in Section 01783, Product Warranties.

1.10 FIELD MEASUREMENTS

- A. Contractor shall take field measurements at the site to verify or supplement indicated dimensions and to ensure proper coordination of all other construction items.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide products manufactured by NEFCO, MFG Construction and Water Products Company, Enduro Composites, Waterman, or approved equal.
- B. Manufacturer and supplier to supply a performance bond.
- C. Manufacturer of products shall be ISO 9001 certified.
- D. All FRP products shall be manufactured entirely in the United States.
- E. Supplier of FRP material shall be the manufacturer and the FRP material.

2.02 DENSITY CURRENT BAFFLES

- A. Product Material shall be Fiberglass reinforced isophthalic polyester resin contact-molded composite laminate; the surfaces shall have a gel-coat resin finish, gel-coat to contain the ultraviolet inhibitor. All cut edges shall be sealed with polyester resin.
- B. Baffle thickness to be determined by the depth of the baffle.
 - 1. Glass Type E with silane finish
 - 2. Adequate contact molding pressure ensures complete resin wet-out of glass fibers
 - 3. Fiberglass fiber weight, nominal 25 percent
- C. Physical Properties:
 - 1. Tensile Strength (ASTM D-638): 18,500 psi
 - 2. Flexural Strength (ASTM D-790): 27,900 psi
 - 3. Flexural Modulus (ASTM D-790): 1,080,000 psi
 - 4. Izod, Notched (ASTM D-256): 15.4 ft-lb/in
 - 5. Barcol Hardness, ASTM D2583: 40
 - 6. Water Absorption, ASTM D 570: .13 percent
 - 7. Meets ANSI/AWWA F101 property requirements
 - 8. Baffle panels should not exceed 12'-0" in length.
- D. Baffle panels shall include integral molded 3/8-inch top edge mounting flange 6 inches in height with pre-drilled holes to accommodate anchors for mounting to tank walls or bolts for mounting to metal trough.
- E. Baffle panels shall include integral molded 90-degree bottom flange 3 inches in height and the full length of the baffle panel.
- F. Baffle face shall slope 45 degrees from circular tank vertical wall or at an angle determined by specific project requirements.
- G. Baffle panels shall be straight for rectangular tanks and curved for round tanks, curved according to the tank radius shown on drawings.

- H. Manufacturer shall supply pre-drilled holes on one panel side for field drilling of holes through pre-drilled holes into adjoining baffle panel for final “shiplap” connection.
- I. All cut edges and drilled holes shall be resin coated with manufacturer’s sealant.
- J. Baffles with integral molded end supports are not acceptable.
- K. Mounting Fasteners shall be provided by the baffle manufacturer and be Type 316 stainless steel.
- L. Baffles shall be designed to include a vent to prevent the buildup of gasses below the baffle.

2.04 LAUNDER COVERS

- A. Fiberglass reinforced plastic launder covers shall be furnished and installed on the secondary clarifiers as specified herein and in accordance with the details indicated on the Drawings. The covers shall be non-gasketed and shall include fiberglass reinforced plastic hatches, complete with cover, hinges, lifting and locking handles, and mounting frame and all other accessories as required and as recommended by the launder cover manufacturer.
- B. Launder cover panels and fiberglass accessories shall be minimum 1/4 inch thick and shall be fabricated to the shapes indicated on the Drawings and molded to the curvature of the basins. Manufacturer shall field certify all dimensions to ensure the correct fit of all components of the covers. The cover shall extend over the launder, weir, and scum baffle, but shall not be supported by the weir or scum baffle.
- C. The cover panels shall be provided with hinges to allow access to the launder and weir. Cover panel hinges shall be near the effluent weir wall and the direction of opening shall be toward the wall as indicated on the Drawings. Contractor shall provide cover panels alternating between a lifting ring and set latch assembly as indicated on the Drawings. Hatches for removable covers shall be hinged to provide access to the weir for inspection purposes. The hatch hinges shall be located such that the direction of opening is toward the center of the basin and for other applications hinges shall be located to provide easy access for inspection and cleaning purposes.
- D. The launder covers shall be segmented, and each segment shall weigh not more than 75 pounds, to allow ease of handling and installation. Each end of alternating cover segments shall be recessed to receive the adjacent panel. Cover design shall provide for expansion and contractions due to climatic changes without damage.
- E. The color of the covers, hatches, and fiberglass accessories shall be selected by the Owner from the manufacturer’s standard colors and shall be opaque.
- F. Covers shall be mechanically anchored and sealed to concrete surface with adhesive sealant as specified in the Caulking sections. Hinged covers and hatches shall have a stainless-steel hold-open device to prevent cover or hatch from blowing open or closing on itself. Cover and hatches shall be secured with hand-operable stainless-steel latches that require no special tools.

- G. Covers and hatches shall have a factory applied UV resistant surface. Each cover panel shall be provided with stainless steel lifting rings or handles suitable for lifting with a handle-mounted hook. Two handle-mounted hooks shall be provided for each separate installation.
- H. Mounting flanges, brackets, and supports shall be fabricated of Type 316 stainless steel. All hardware and hinges shall be of Type 316 stainless steel. Mounting flanges, brackets, and supports shall not obstruct the liquid flow at any location. Mounting arrangement shall be as recommended by the launder cover manufacturer.
- I. Covers, hatches, and fiberglass accessories shall be fabricated in accordance with ANSI/AWWA F102-07. The manufacturer shall accept responsibility for the complete design, engineering, and function of the launder cover system. Design shall be completed by an engineer licensed in the state of Arkansas. Manufacturer shall field certify all dimensions to ensure the correct fit of all components of the covers.
- J. Where the circumference of the effluent launder is interrupted by a bridge support or other obstacle, a fixed panel(s) shall be installed over the launder beneath the support such that the surface of the cover is continuous around the entire tank.
- K. Support applied downward vertical or gravity loadings
- L. Meet required snow load of 30 psf, wind load of 14 psf, point load 250 lb
- M. Covers shall be designed to be safely opened from the perimeter of the clarifier. The covers are not intended to support walking.
- N. The launder cover laminate shall meet the following minimum physical and mechanical requirements:
 - 1. Tensile Strength (ASTM D-638): 18,500 psi
 - 2. Flexural Strength (ASTM D-790): 27,900 psi
 - 3. Flexural Modulus (ASTM D-790): 1,080,000 psi
 - 4. Izod, Notched (ASTM D-256): 15.4 ft-lb/in
 - 5. Barcol Hardness, ASTM D2583: 40
 - 6. Water Absorption, ASTM D 570: 0.13 percent
 - 7. Maximum Deflection: L/180 for any member
- F. Resin - The resin shall be a commercial grade isophthalic polyester thermosetting resin, which has either been evaluated in a laminate, or which has been determined to be acceptable for use in a wastewater treatment plant environment.
- G. Fillers - The resin shall contain no fillers. Thixotropic agents for viscosity control are acceptable. Colorants which have been determined by at least five years previous service to be acceptable for the service condition are acceptable. The standard color for the launder cover shall be marine white unless otherwise specified. Ultraviolet stabilizers are required in all launder cover laminates. Catalysts, accelerators and/or promoters shall be added to provide complete cure of the laminate and must meet the physical properties as indicated.

- H. Ultraviolet Resistance - Ultraviolet resistance is required in all laminates exposed to ultraviolet light, whether it be in the form of pigmentation or ultraviolet absorbers.
- I. Reinforcement - E glass with silane finish.
- J. The content of the finished laminate shall be adequate to produce mechanical and physical properties conforming to Section 2.3, Table 1.
- K. Other Reinforcement – Additional reinforcement in the form of foam, stainless steel, plastic laminate, or other reinforcement for high stress areas shall be completely encapsulated within the laminate. Care shall be taken to insure that these areas of the launder cover laminate are not designated as attachment points or drilled for any purpose.
- L. Laminate Construction
 - 1. 'A' surface shall be a gelcoat surface.
 - 2. Structural layers shall consist of plies of chopped strand mat with a maximum of 2 ounces per square foot. Adequate contact molding pressure ensures complete resin wet-out of glass fibers.
 - 3. 'B' surface shall be a gelcoat surface.
 - 4. Finished launder cover shall be a minimum of 25 percent (25%) fiber reinforced with a minimum thickness of not less than 1/4-inch.
- M. Materials used in the manufacture of the FRP launder covers shall be new stock of the best quality and shall be free from all defects and imperfections that might affect the performance of the finished product.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Baffle panel and launder cover dimensions shall require verification and project site conditions must be suitable for installation. Unsatisfactory site conditions must be corrected before product installation.

3.02 STORAGE

- A. Should it be necessary to store product prior to installation, precautions should be taken to prevent cracking, twisting, warping, distortion, bending, breaking, chipping or damage of any kind to the materials.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, approved shop drawings and in true and proper alignment.

- B. Adjust baffle panels and launder covers per contract documents or as directed by the Engineer.
- C. When necessary to adjust lengths of baffle panels or launder covers due to field conditions and when approved by the Engineer, seal cut, or machined edges thus exposed with manufacturers supplied sealant. Excessive cutting will not be acceptable.
- D. Field cutting of launder covers is allowed if necessary. All field cut edges and field drilled holes shall be sealed per the manufacturer's instructions.
- E. Ensure that launder covers and supports are installed plumb and true, free of warp or twist, within the tolerances specified by the manufacturer and as shown on the drawings.

3.04 ADJUST AND CLEAN

- A. Surfaces to be cleaned according to manufacturer's instructions.
- B. Remove excess materials of construction and trash to leave site in a clean condition for subsequent operation.

END OF SECTION

SECTION 11243

PILE CLOTH MEDIA FILTER

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, equipment, tools, materials, and appurtenances required for the installation of the pile cloth media filter as shown on the Plans and as specified herein.
- B. Electric motors shall be furnished as part of the work of this Section and shall conform to all applicable portions of Section 01171, Electric Motors.
- C. Coordinate with the System Integrator (SI) regarding all required ethernet communications with the SCADA 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 RELATED SECTIONS

- A. Section 01171 – Electric Motors
- B. Section 01300 – Submittals
- C. Section 01782 – Operation and Maintenance Data
- D. Division 9 – Painting
- E. Section 13310 – SCADA Automation Products
- F. Section 13320 – SCADA Control Panels
- G. Section 13330 – SCADA Instrumentation Products

H. Section 13340 – SCADA Networking Products

I. Section 13421 – Electromagnetic Flow Meter

J. Section 15100 – Valves and Appurtenances

K. Section 15140 – Pipe Hangers and Supports

L. Section 15160 – Electric Actuators

M. Division 16 – Electrical

1.04 REFERENCE STANDARDS

A. Comply as a minimum with applicable provisions and recommendations of the following:

1. American Bearing Manufacturers Association (ABMA), latest edition
2. ASTM International (ASTM), latest edition:
 - a. ASTM D5035 Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
3. American Welding Society (AWS), latest edition:
 - a. AWS D1.6 Structural Welding Code – Stainless Steel
4. Anti-Friction Bearing Manufacturer Association (AFBMA), latest edition
5. Environmental Protection Agency (EPA), latest edition:
 - a. EPA 40 CFR Part 136 Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act
6. Institute of Electrical and Electronic Engineers (IEEE), latest edition
7. National Electric Code (NEC), latest edition
8. National Electrical Manufacturers Association (NEMA), latest edition

1.05 SUBMITTALS

- A. Submit, in accordance with Section 01300, Submittals, copies of all materials required to establish compliance with this Section. Submittals shall include the following:
1. Certified shop and erection drawings showing all important details of construction, dimensions, and anchor bolt locations
 2. Media area calculations

3. Design Hydraulic loading rate and Hydraulic loading rate calculations
 4. Design Solids loading rate and Solids loading rate calculations
 5. Hydraulic profile through the filter showing the following:
 - a. Influent weir length
 - b. Influent weir elevation
 - c. Influent weir nappe at design and peak flow
 - d. Effluent weir length
 - e. Effluent weir elevation
 - f. Effluent weir nappe at design and peak flow
 6. Performance Testing data
 7. Backwash Pump hydraulic calculations
 8. Descriptive literature, bulletins and/or catalogs of the equipment
 9. The total weight of the equipment, including the weight of the single largest item or component and lifting points
 10. A complete total bill of materials for all equipment
 11. A list of the manufacturer's recommended spare parts. Include gaskets, packing, etc., on the list
 12. Recommended summer and winter grade of lubricants along with alternative references to equal products of other manufacturers
 13. Complete data on motor and power factor correction capacitors (if required) in accordance with Section 01171, Electric Motors
 14. Complete description of surface preparation and shop prime painting
 15. Manufacturer's Warranty
 16. Manufacturer's Installation Drawings
 17. Complete master wiring diagrams, elementary or control schematics, physical dimensional or elevation drawings and system single line drawings specific to this Contract. Standard preprinted sheets or drawings simply marked to indicate applicability to this Contract will not be acceptable
 18. Submittal information shall include detailed information indicating wiring connection points for all external devices and controls as specified herein.
 19. Complete description of the control panel required components
- B. In the event that it is impossible to conform to certain details of this Section, describe completely all non-conforming aspects.

C. Operating and Maintenance Data

1. Operating and maintenance instructions shall be furnished to the Engineer as provided in Section 01782, Operation and Maintenance Data. The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions that are required to instruct operating and maintenance personnel unfamiliar with such equipment.
2. A factory representative who has a complete knowledge of the proper operation and maintenance shall be provided as specified herein. Qualifications of factory representative shall be submitted for approval. Manday requirements listed are exclusive of travel time and do not relieve the Contractor of obligation to provide sufficient service to place equipment in satisfactory operation.
 - a. During installation, assist in location of anchor bolts; setting, leveling, and field erection of equipment; coordination of piping, electrical, and miscellaneous utility connections: two (2) 8-hour days
 - b. Start-up, testing and calibration: three (3) 8-hour days
 - c. Operation, maintenance, startup, shutdown, troubleshooting, lubrication, and safety instruction: one (1) 8-hour day
 - d. Service inspections during first two (2) years of operation, for use at Owner's request, and exclusive of repair, malfunction, or other troubleshooting service calls: one (1) 8-hour day (not anticipated as consecutive)
 - e. The selected manufacturer shall also provide a free troubleshooting help line for the life of the plant

D. Process Control Strategy Submittal

1. The process control schemes shall be developed in a ladder logic diagram or functional block (logic) diagram presentation based on information from the Specifications. Included with each diagram shall be:
 - a. Brief Scope of the Control Function
 - b. Listing of all scanned inputs to the control function
 - c. A short narrative of the control strategy
 - d. Any assumptions made in developing the program
 - e. Listing of all inputs and outputs (i.e., AI, DI, AO, DO) from the control function
 - f. Cross reference list of all I/O showing to which I/O modules or software modules they are linked

- g. Listing of all operator inputs/outputs to and from the control function. Any special LCD displays, related to the function shall be illustrated. A description of the operation of any panels shall be described as it relates to the control function
 - h. Failure contingencies shall be described in detail
 - 2. This submittal shall cover all the associated ladder logic developed under this Contract required to implement the control functions specified.
- E. Manufacturer's Certificate: Certify that all equipment and materials provided are AIS compliant, as necessary.

1.06 QUALITY ASSURANCE

- A. In order to assure uniform quality, ease of maintenance and minimal parts storage, it is the intent of these Specifications that a single manufacturer shall supply all equipment called for under this Section. The equipment manufacturer shall, in addition to the Contractor, assume the responsibility for proper installation and functioning of the equipment.
- B. The Manufacturer shall have at least 20 successful installations of the specified type of equipment at different locations in the United States. At least five (5) installations must have been in services for a minimum of five (5) years. The Engineer may require evidence, in the form of operating records, from these installations to substantiate any claims concerning the ability of the equipment to perform as required.
- C. The equipment shall be designed, constructed, and installed in accordance with the best practices and methods and shall by
- D. Field measurements shall be taken at the site to verify, or supplement indicated dimensions and to ensure proper coordination of all other construction items.
- E. The equipment manufacturer's shop welds, welding procedures, welders and welding operators shall be qualified and certified in accordance with the requirements of the latest edition of AWS D1.6 "Structural Welding Code – Stainless Steel" published by the American Welding Society.
- F. The manufacturer shall furnish performance test results documenting that the system has achieved the specified performance requirements.

1.07 WARRANTY

- A. The equipment supplier shall warrant the equipment against defects in manufacturing and materials for period not less than one (1) years from date of substantial completion, or eighteen (18) months from date of delivery, whichever shall occur first. If any part of the equipment should fail during the warranty period, it shall be repaired or replaced at no cost to the Owner.
- B. The manufacturer is responsible for providing equipment storage instructions prior to equipment delivery. Equipment warranty will not be lessened due to damage during storage should those requirements be satisfied.

1.08 MAINTENANCE

- A. Special tools, if required for normal operation and maintenance, shall be furnished with the equipment by the manufacturer.
- B. Provide the following spare parts if applicable:
 - 1. One (1) 6" backwash valve actuator
 - 2. One (1) 4" valve actuator
 - 3. Four (4) replacement cloths of four (4) filter elements/discs
 - 4. Two (2) proximity switches
 - 5. Two (2) sets of springs for the backwash system
 - 6. One (1) complete set of gaskets, o-rings, etc. for each pump
 - 7. One (1) set of wear rings for each pump
 - 8. One (1) spare impeller
 - 9. One (1) set of bearings for each pump
 - 10. One (1) set of mechanical seals for each pump
 - 11. One (1) set of belts for each pump for each pump
 - 12. One (1) wear plate for each pump
 - 13. One (1) shaft coupling or set of belts for each pump
- C. Spare parts shall be delivered to the Owner on the day of equipment startup in the presence of the Engineer and equipment manufacturer's representative.

PART 2 PRODUCTS

2.01 GENERAL

- A. The pile cloth media filtration system shall be designed based on the following operating parameters:
 - 1. Total Average Daily Flow: 8 MGD
 - 2. Total Max Month Flow: 10.9 MGD
 - 3. Total Peak Hourly Wet Weather Flow: 30.0 MGD
 - 4. Number of Units: 4
 - 5. Filters shall be designed to treat the max daily flow with one (1) unit out of service (Dual Use Mode)
 - 6. Effective Filtration Area Per Unit (Minimum): 1,152 ft²
 - 7. Average Daily Filtration Rate (Maximum): 1.61 gpm/ft²
 - 8. Max Month Filtration Rate (Maximum): 2.19 gpm/ft²
 - 9. Peak Hour Filtration Rate (Maximum): 6.03 gpm/ft²
 - 10. Maximum Influent TSS Concentration: 30.0 mg/L

- 11. Average Filter Effluent TSS Concentration: 5.0 mg/L
- 12. Maximum Allowable Headloss through the filter: 12 inches
- 13. Each filter shall be installed in a concrete basin
- B. Unless otherwise specified, the power supply to the equipment will be 480 volts, 60 Hz, 3-phase, 3-wire. Where control voltage lower than the power supply voltage is required, a suitable control power transformer shall be furnished.
- C. All motors, pumps, and bearings shall be designed for continuous duty and long operating life outdoors under a canopy in a high humidity atmosphere.

2.02 MANUFACTURER

- A. This Section calls attention to certain features but does not purport to cover all details of construction of the equipment. Furnish and install the equipment complete in all details and ready for operation. All equipment shall be provided by a single manufacturer.
- B. The equipment shall be designed, constructed, and installed in accordance with the best practices and methods and shall be the Iso-Disc® Model IDDF-9D96S-C by Alfa-Laval. Alternatives will not be accepted.

2.03 PILE CLOTH MEDIA FILTER

- A. Iso-Disc® Cloth Media Filter:
 - 1. Each unit will be supplied as a complete operable system, except as noted, and will include the following:
 - a. Basin mounting brackets and hardware installation
 - b. Filter Tank Effluent Discharge Manifold
 - 1) Each filter shall have an effluent discharge manifold shall be constructed of Type 304 stainless steel and include nine (9) 6" x 12" effluent nozzles that discharge onto the effluent channel from each individual disk.
 - c. Filter Basins
 - 1) The filter basins shall be constructed of concrete, by others.
 - 2) Each filter basin shall have an adjustable downward sliding weir gate, 10'-0" wide x 3'-0" tall. These gates are to be supplied and installed by others.
 - 3) Each filter basin shall incorporate nine rectangular effluent nozzles connected to a filtrate trough designed to remove the entire flow of the filter basin from each individual disk.

- 4) Each filter basin shall incorporate five (5) 6" backwash nozzles connected to a backwash mechanism (washbox carriage) within the filter basin. The backwash mechanism shall be constructed of 304 stainless steel.
- 5) Each filter basin shall include a perforated 304 stainless steel drain pipe designed to evenly remove settled sludge from the filter cell.
- 6) Each filter basin shall included a scum trough adjacent to the overflow weir and connected to the backwash pump.
- 7) Each filter shall include grease fitting extension lines to allow for lubrication of all equipment from the adjacent operating platform. The extension lines shall be attached to the handrail and include labels for each line.

d. Filter Backwash Shoes

- 1) The filtration system in each filter shall incorporate a series of 4-inch backwash shoes connected to a backwash mechanism (washbox carriage) within the tank. The backwash mechanism shall be constructed of Type 304 stainless steel.

e. Filter Assembly

- 1) The filter frame shall be comprised of structural steel shapes designed for the intended use and be of adequate strength to withstand all loads during shipping and operations.
- 2) The filter assembly shall include a robust framework with Type 304 stainless steel structural steel sections with a minimum thickness of 1/4 inch. The framework shall be adequate to provide mounting and structural support for the drive mechanism, backwash carriage and multiple filter elements.
- 3) The filter basin assembly will be supplied complete with an integrated 304 stainless steel effluent trough into which each individual filter element will discharge. Each element and the trough will have corresponding rectangular openings. An EPDM rubber sleeve shall connect the element and the discharge trough to provide a watertight seal and be covered with a 304 SS shield for UV protection.
- 4) Five (5) 6-inch electrically actuated butterfly valves shall be installed at each of five (5) backwash connections. The wafer style butterfly valves will be mounted between the piping manifold flange and the tank flanged connections. The individual valves will be removable for maintenance with minimal effort and without having to remove piping.
- 5) One (1) 4-inch electrically actuated plug valve is to be installed at each of the two (2) the sludge withdrawal manifold connections on the filter basin. Each plug valve will be flanged and will be removable for maintenance with minimal effort and without having to remove piping.

- 6) One (1) 4-inch electrically actuated plug valve is to be installed at the scum trough connection. The plug valve will be flanged and will be removable for maintenance with minimal effort and without having to remove piping.
 - 7) All piping for connection of the backwash valves and sludge withdrawal valve to the suction of the backwash pump shall be 6" Sch. 80 Type 304 Stainless Steel and shall be supplied by the filter manufacturer. All piping from the backwash valve manifold discharge flange to the backwash pump(s) shall be supplied by the installing contractor.
 - 8) The backwash carriage assembly on the filter unit will be complete with ten (10) backwash shoes that will fit tightly against the filter cloth on the filter elements. The shoes located between the elements shall each remove solids from two filter media surfaces. The shoes located externally will each remove solids from the surface of one filter media surface. The shoes will have hose connections to the backwash nozzles. The backwash carriage and backwash shoes shall be constructed of 304 stainless steel. A 4-inch 304 stainless steel sludge withdrawal piping manifold shall be installed in the bottom of the tank. The manifold shall draw settled solids from the entire tank bottom when suction is applied by the backwash pump.
- f. Filter Media:
- 1) Each filter element will be fitted with two filter cloths. They shall be attached using 304 stainless steel battens that are secured to the element face with corrosion resistant fasteners.
 - 2) The filter media shall be a knit fabric. The fabric shall be a knit type with a polyester backing coated with acrylic latex. Cloths shall be of microfiber pile construction having a nominal filtration rating of 5 microns and shall be designed specifically for primary filtration applications. Granular media and screens having structured identical openings shall not be allowed. The pile cloth shall be free chlorine resistant cloth.
 - 3) The cloth media shall have an active filter depth of 3 to 5 mm to provide additional collisions between solids particles and the media within the media depth, resulting in capture of solids across a broader particle range. The cloth depth shall also provide storage of captured solids, reducing backwash volumes while maintaining an operational headloss. Woven mesh or microscreen type media with no filtration depth are not acceptable.
 - 4) Individual pile fibers shall be held in place by a support backing integral to the media. To facilitate proper flow of backwash water through the cloth, the medium's back side shall be of open construction consisting of 10% open area at least 50 times larger than the nominal filtration media in any direction. Media that uses sewn in support structures, which have the potential to prevent free flow through the media, shall not be allowed.
 - 5) Cloth media breaking strength and elongation shall be tested in accordance with ASTM Standard D5035 2R-E method by an ISO certified laboratory specializing in textile testing. Breaking strength shall be in excess of 200 lbf

(890 N) in the warp and the weft direction. Elongation shall be less than 10% at 60 lbf (270 N) in the warp and the weft direction. Test reports shall be provided with submittals to demonstrate compliance with this requirement.

- 6) The maximum distance between cloth restraints must not exceed 36 inches.

g. Filter Element Assembly

- 1) The filter element frames shall be constructed from Type 304 stainless steel and plastics as an integral unit completely welded and supported for all operating and installation loads.
- 2) Each element shall have media support structure incorporated and it shall be designed to secure the grid in place and minimize wear to the media.
- 3) Each element shall be complete with two (2) filter media surfaces.
- 4) Each element shall have an integral effluent manifold adequately sized for the application and designed to allow easy removal and replacement of the element assembly.
- 5) Each element shall be attached to the effluent trough independently to allow element isolation. The disk filter design shall insure the ability to sample filtrate from each element independently.
- 6) Plugs shall be supplied for installation into the effluent trough wall connection to allow disk removal and prevent unfiltered water discharge allowing continued filter operation with one or more elements removed.

h. Support Frame

- 1) Each element shall be secured in place in the filter frame. The element supports shall be designed to withstand all loads of the disk and cleaning mechanism. Element restraints shall be easily accessible for removal from the top of the tank.

i. Backwash Carriage Assembly

- 1) Each filter unit shall incorporate a linear backwashing system that will operate by passing the cleaning shoes over the filter media to remove accumulated solids by suction. The backwash carriage will also act as the transmission conduit for the backwash water being drawn by the backwash pump located externally to the filter tank.
- 2) The backwash carriage shall be constructed from Type 304 stainless steel.
- 3) The backwash carriage shall be complete with a drive mechanism that will allow the suction shoes to be operated over 100% of the available area of filtration media.

- 4) The backwash carriage shall be designed as to not inhibit the removal of filter elements for routine service or maintenance.
- 5) The cleaning face of the backwash shoes shall be designed to maintain a linear position which is parallel to the element face and maintain a tolerance from the surface of the filter media to allow free release of entrapped solids.

j. Drive Mechanism

- 1) The drive assembly shall be designed to cycle the backwash carriage during the backwash cycle.
- 2) Power for the drive system shall be provided by a 2 hp, 480V/3-phase/60Hz right angle gearmotor.
- 3) A reversing motor starter shall be used to allow the backwash carriage to move across the filter media surface in either direction.
- 4) Four (4) bevel gearboxes are driven by the right angle gearmotor and rotate four (4) jackscrews to cause the washbox carriage to raise or lower based on jackscrew direction of rotation. Jackscrews are 1-1/4" diameter with 1/4 pitch Stub Acme threads.
- 5) Four (4) ultrahigh molecular weight polyethylene drive nuts are installed in the backwash carriage that cause raising and lowering as the jackscrews are rotated.
- 6) Two (2) inductive proximity sensors monitor the position of the washbox carriage. The sensors are located above the water level and monitor the position of a flag that moves upward and downward with the wash carriage. The flag allows the operator to have a visual indication of the carriage position.

k. Backwash Pumps

- 1) The backwash pump for each filter shall serve that filter independently and shall be cast iron, single stage end suction, solids handling, centrifugal pump designed for domestic wastewater applications. The pump will be equipped with a maximum 10 hp, open drip proof, 480V/3-phase/60Hz drive motor. Pumps shall be Gorman-Rupp Model T4A or approved equal.
- 2) Pump and motor shall be installed on a painted steel base with integrated discharge elbow.
- 3) The pump shall be sized to provide adequate suction for cleaning up to four (4) media surfaces simultaneously as determined by the filter manufacturer.
- 4) Duty point is 400 GPM at design head conditions.
- 5) Pump shall handle a minimum of 1-inch spherical solids.

- 6) Pump shall have 4-inch suction and 4-inch discharge connections.
 - 7) One (1) 4-inch manual plug or ball valve shall be provided by the filter manufacturer for discharge line isolation for each backwash pump.
 - 8) One (1) 4-inch manual plug or ball valve shall be provided for suction line isolation for each backwash pump.
 - 9) A stainless-steel vacuum gauge and vacuum transducer shall be provided in the pump suction header and a stainless-steel pressure gauge and pressure transducer shall be provided in the pump discharge header to allow monitoring and fine tuning of the pump operating conditions. The vacuum and pressure transducers shall be connected to the Filter Control Panels.
- I. Automatic Backwash Control Valves (5 per filter)
- 1) The 6-inch backwash valves shall be Electrically Actuated Butterfly Valves.
 - 2) Valves shall be 115 VAC operated and controlled automatically from the control panel.
 - 3) Valves shall have manual override and position indicator (dry contacts for open and close indication).
 - 4) Valve actuators shall be housed in a NEMA 4X enclosure and incorporate an internal brake, thermal overload monitor and heater.
 - 5) Valves shall move from fully closed to fully open in 30 seconds.
- m. Automatic Sludge Withdrawal Control Valves (2 per filter) and Scum Withdrawal Valve (1 per filter)
- 1) The 4-inch valves shall be an electrically actuated plug valve.
 - 2) Valves shall be 115 VAC operated and controlled automatically from the control panel.
 - 3) Valves shall have manual override and position indicator (dry contacts for open and close indication).
 - 4) Valve actuators shall be housed in a NEMA 4X enclosure and incorporate an internal brake, thermal overload monitor and heater.
 - 5) Valves shall move from fully closed to fully open in 21 seconds.
- n. Backwash Pump Manual Discharge Control Valve
- 1) One (1) 4-inch manual plug or ball valve is to be provided in the discharge line from the pump.

- 2) Valve shall be rated for 150 psi.
 - 3) Valve shall have stainless steel shaft and shall be blow-out proof.
 - 4) Valve shall be a wafer body design, fully supported flange bolt holes, and full bodied with V-notch EPDM liner.
- o. Backwash Pump Manual Isolation Valve
- 1) One (1) 4-inch inch manual plug or ball valve is to be provided for the pump suction piping.
 - 2) Valve shall be rated for 150 psi.
 - 3) Valve shall have stainless steel shaft and shall be blow-out proof.
 - 4) Valve shall be a body design, fully supported flange bolt holes, and full bodied with V-notch EPDM liner.
- p. Control Panel
- 1) A filter control panel will be supplied and installed with each filter tank. Wiring of filter mounted components including the backwash valves, the sludge withdrawal valve, backwash carriage drive unit and tank level monitoring devices shall be complete to the control panel by the installing electrical contractor. The wiring from the filter mounted control panel to or from external points of connection will be by the installing electrical contractor as well. Each disk filter control panel will include but not be limited to the following components:
 - a) NEMA 4X, 304 SS, enclosure with single handle latch
 - b) PLC (Allen-Bradley MicroLogix - 1400) for system operation
 - c) Human-Machine Interface
 - d) Control power and valve power transformer shall be included. Transformer to be mounted on the panel exterior for superior heat dissipation
 - e) IEC motor starters to be included for a backwash carriage drive and a VFD for each backwash pump. The backwash carriage drive starter shall be rated for 2 hp and shall be of the reversing type. The backwash pump starters shall be rated for 10 hp
 - f) The panel front shall be complete with selector switches for the backwash valves, sludge withdrawal valves, scum valve, backwash pumps and backwash carriage drive

- g) Equipment status indications will be displayed on the HMI
 - h) Emergency stop and alarm silence pushbuttons located on panel front
 - i) Alarm Horn on panel exterior
 - j) Door mounted circuit breaker
 - k) Magnetic circuit breakers
 - l) 20-amp quadruple receptacle
 - m) Relays for control as required
 - n) One (1) pressure transducer for monitoring filter water level
 - o) Cabinet Air Conditioner
- 2) The backwash cycle is independently initiated by a level control transmitter located in each filter tank, by a timer setting or by manual operator initiation. The filter drive unit and the backwash pump are activated, and electrically actuated valves open in sequence to accomplish backwashing of the filter. Both level controlled and timer backwash operating modes can be active at any given time.
- 3) One (1) submersible pressure transmitter will be supplied in each filter tank. The transmitter will provide the primary level measurement feedback for the control system.
- 4) Resistance probes will be installed in the filter tanks as shown on the submittal drawings. The probes will provide for high-high and low-low level indication to the control system. They are included to act as back-up to the pressure (level transmitter). High-high level will cause an alarm and initiate a backwash. Low-low level will cause an alarm, terminate the backwash cycle if in progress or inhibit backwash if not. Low-low will protect the pump against dry run. The probes also provide for continued filter operation in the case of level transmitter failure.
- 5) The panel operational sequence shall include a sludge withdrawal cycle timer. This timer shall be pre-set and field adjustable. Sludge withdrawal can also be programmed by the operator to occur after a setpoint selected number of backwash cycles.
- 6) All operating parameters shall be setpoint adjustable. The operator will select the backwash start level setpoint. The operator shall select the backwash stop level setpoint. Under constant flow conditions the backwash cycle will begin with valve number one and sequence through all valves until all media surfaces have had the backwash shoe make one complete pass

over them. If the flow is low or intermittent the backwash process may take the tank level to the stop backwash level at which time the cycle will end to protect the pump from dry run. The backwash system will be reset at that point and will start at the beginning of the cycle next time the start backwash level has been reached.

q. Field Service/Startup

- 7) Three (3) trips, total of (9) eight-hour days onsite for startup and training

2.04 COORDINATION

- A. Filtration system shall be furnished by the filter manufacturer who shall coordinate the items of equipment, appurtenant systems, interconnecting piping, and controls to ensure the compatibility and proper operation of all items.
- B. The filter manufacturer shall prepare system installation drawings, panel layouts, and other data required for complete system description and installation. The filter manufacturer shall verify that each system component is compatible with all other components of the system, that all pipe materials and sizes are appropriate, and that all devices necessary for a properly functioning filtration system have been provided. The Contractor shall prepare interconnecting diagrams.
- C. Contractor's review of drawings submitted prior to the final determination of related equipment shall not relieve Contractor from installing a system in full compliance with the specific requirements of the related equipment.

2.05 SPECIFICATION PRECEDENCE:

- A. The specifications for equipment and controls under this section supersede specifications for equipment and controls specified elsewhere in the contract documents and drawings. Third-party components such as gear reducers, pumps, motors, valves, and actuators shall be provided with recommended manufacturers paint system, rated for anticipated service conditions in a wastewater application. Detailed information shall be submitted for each coating system to verify that it is appropriate for the application.

2.06 WARRANTY

- A. The Manufacturer shall provide a written warranty against defects in materials and workmanship. Manufacturer shall warrant the goods provided by the Manufacturer to be free from defects in materials and workmanship under design conditions and normal use for a period of one (1) year from the date of successful start-up. The Manufacturer acknowledges that the extended storage period planned for this project will not void, shorten, or diminish any warranty provisions if the equipment is stored per the Manufacturer's written instructions. The warranty for the components associated with each of the four (4) individual filter systems shall commence upon successful start-up of that system. This warranty shall not apply to any goods or part which has been altered, applied, operated, or installed contrary to the Manufacturer's written instructions provided in the manufacturer's O&M manual or subject to misuse, attack/degradation by a chemical not commonly present in wastewater, negligence, or accident.

2.07 MANUFACTURING QUALIFICATIONS

- A. The filter supplier shall have experience in the design and manufacture of cloth media filters for a minimum of five (5) years and shall be able to demonstrate a minimum of 50 installations within the United States in municipal wastewater applications with cloth media.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install the pile cloth media filtration system in accordance with the manufacturer's recommendations.

3.02 FIELD QUALITY CONTROL

- A. 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. In each case, the manufacturer's representative shall be present when the equipment is placed in operation in accordance with 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.
- B. 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.
- C. All costs for these services shall be included in the contract price.

3.03 PROCESS PERFORMANCE GUARANTEE AND TESTING

- A. The cloth filter system shall be guaranteed to produce a filter effluent in accordance with the Performance and Design Requirements specified herein at both average and peak hour loading rates with three (3) filter units in operation. To assess compliance with the specified effluent requirements, performance testing shall be conducted.
- B. Additionally, the guarantee shall apply under the following conditions:
 - 1. The filter is installed, operated, and maintained in accordance with instructions included in manufacturer's O&M Manual
 - 2. The equipment has been paid for in accordance with contract terms
 - 3. Performance data for the filter system shall be provided upon request not more frequently than quarterly unless to investigate any non-performance notifications
 - 4. The process performance guarantee shall be in effect for thirty-six (36) months from the date the filter system is certified by the Engineer as being substantially complete

5. Should the filter system not meet the guaranteed performance:
 - a. The guarantee shall be considered invalid if the influent parameters do not conform to the Performance and Design Requirements paragraph.
 - b. In the event that the influent parameters are within the limits specified under the Performance and Design Requirements paragraph, the Owner shall provide written notice of same to the manufacturer and the manufacturer shall have up to 30 days to modify the filters as necessary to achieve the guaranteed performance.
 - c. Performance data for the filter system shall be provided upon request to investigate any non-performance notifications.
6. This guarantee shall no longer be applicable or valid if any product, including any software program, supplied by the manufacturer is modified or altered without the written approval of manufacturer.
7. In the event of continued failure of the equipment to produce the guaranteed effluent characteristics, the manufacturer shall modify the filter(s) as necessary to achieve the guaranteed performance. The maximum cumulative liability to the manufacturer for the modification or supply of additional equipment shall be limited to a cumulative total of 100% of the original purchase price of the equipment. This liability will be backed by a performance bond for 100% of the original purchase price of the equipment. With the exception of its own reasonable administrative and personnel costs, Owner shall not incur any costs associated with inspection, diagnosis, attempt, repair, or modification necessary to achieve the guaranteed performance. In the event that Owner determines or anticipates that it will incur such cost, Owner shall provide the manufacturer with written notice and the costs shall be reimbursable by the manufacturer upon Owner's submission of written documentation of reimbursable expenditures.
8. If the manufacturer is unable to produce the process performance guaranteed results through system modification after a period not to exceed twelve (12) months after the manufacturer receives the written notice referenced in paragraph 5.b of this Guarantee, the manufacturer will:
 - a. Refund 100% of the original purchase price of the equipment within the shorter of 30 calendar days after (1) a determination that the manufacturer is unable to produce the process performance guaranteed or (2) the anniversary of twelve (12) months from the date that the manufacturer received the written notice referenced in paragraph 5.b of this Guarantee. This liability will be backed by a performance bond for 100% of the original purchase price
 - b. At its sole cost, completely remove the equipment from Owner's property with the shorter of 30 calendar days after (1) a determination that the manufacturer is unable to produce the process performance guaranteed or (2) the anniversary of twelve (12) months from the date that the manufacturer received the written notice referenced in paragraph 5.b of this Guarantee.

3.04 MECHANICAL TESTING

- A. A mechanical test shall be conducted by the Contractor under supervision of the filter manufacturer's representative after the equipment start up is complete. Contractor shall furnish all labor, materials, and equipment required for the test.
- B. Each filter shall be operated in filtering mode and shall undergo a backwash cycle. In addition, recovery of the system from a failure of a backwash sequence shall be demonstrated. The testing of each filter shall include testing of all electrically and manually actuated valves.
- C. Any malfunctions or defects appearing during the tests shall be corrected and additional testing performed, as directed by the Engineer and filter manufacturer's representative, to demonstrate satisfactory operation.
- D. Three (3) copies of the report shall be submitted to Engineer within 30 days after completion of the specified tests.

3.05 FIELD PERFORMANCE TESTING

- A. Engineer's acceptance of the mechanical test results is required before field performance testing can begin. Performance test shall be conducted for a minimum of five days and shall demonstrate the system performs in accordance with the requirements specified herein. Testing shall not be conducted during periods of treatment process upset. Testing shall be conducted for two days at a peak day flow hydraulic loading rate and three days at an average day flow hydraulic loading rate. Hydraulic loading rate (gpm/sf) shall be determined using the effluent flow rate divided by the number of filters in service divided by the effective submerged filtration area of each filter.
- B. The performance test shall be supervised by an authorized representative of the filter manufacturer familiar with operation of the equipment furnished and having experience in conducting tests of the type specified. Qualified personnel shall operate the filtration equipment, record the data, make the required calculations, and prepare the test report. Sampling and sample analysis shall be provided by the Contractor through a laboratory certified in the state where the Project is located. The Engineer will witness the tests. In case of conflict, interpretations and calculations made by Engineer will govern.
- C. Partial payment for performance testing will be allowed upon satisfactory completion of tests at both hydraulic loading rates and acceptance by Engineer. Contractor shall list field testing as a separate item in the Schedule of Values or cost loaded Progress Schedule, in order to claim partial payment.
- D. Contractor shall notify Engineer and Owner 4 weeks before the testing date and shall submit a test protocol to the Engineer detailing test procedures, analyses to be performed, name of laboratory completing the analysis, and testing schedule.

3.06 TEST PROCEDURES

- A. Twenty-four (24) discrete samples shall be taken each day of testing on both the combined filter influent and effluent. All samples shall be stored in a refrigerated compartment at 4 degrees C prior to analyses. The influent sample shall be withdrawn

from mid-depth of the filter influent box. The effluent sample shall be withdrawn from mid-depth of the filter effluent channel prior to disinfection. Each sample, whether influent or effluent shall be tested for total suspended solids (TSS) and turbidity. Sampling and field quality control procedures shall be in accordance with the requirements of EPA 40 CFR Part 136.

- B. The data to be obtained in each test shall include:
1. Backwash rate based on actual pump rate
 2. Backwash duration
 3. Hydraulic loading rate (gpm/sf)
 4. Maximum solids loading rate (ppd/sf)
 5. Total suspended solids removal (pounds per day)
 6. Backwash frequency (backwash/day)
 7. Total forward flow (calculated)
- C. The performance requirements of the filtration process will be met when the system produces an effluent within the specified limits 100 percent of the time for the specified duration and hydraulic loading of the test. A test report summarizing the data collected during the performance test shall be provided to the Engineer no later than 3 weeks after the final sample for the performance test was collected.

3.07 MODIFICATIONS

- A. If the cloth filter system fails the performance test, the Contractor shall determine the cause of the test failure. If the Contractor finds, and Owner and Engineer concur, that the cause of the test failure, was due to filter influent loading above the specified maximum values, the Contractor shall be reimbursed for the cost and expenses incurred in identifying the problem. However, if the cause for failure of the test was due to faulty equipment or factors under the control of the Contractor, the Contractor will be required to make modifications to the filter system at no additional cost to Owner.
- B. If modifications to the disk cloth filter system are necessary to meet the performance requirements, the Contractor shall rectify the problem in a manner acceptable to the Owner and Engineer and shall repeat the performance test until the performance requirements have been met.
- C. The maximum cumulative liability to the Contractor for the modifications or supply of additional equipment shall be limited to 100% of the cost of the equipment supplied.

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SECTION 11260

UV DISINFECTION SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This section covers the general design requirements, materials and product data, installation, startup, and commissioning for an open channel UV disinfection system. Additional requirements for equipment and performance testing are specified in the following sections:
 - 1. Equipment Start-up and Testing
 - 2. Training
 - 3. Fabricated Stainless Steel Weir Gates
 - 4. Division 13 Specifications as applicable
 - 5. Electrically Actuated Valves
 - 6. Electrical
- B. The UV System Supplier (UVSS) shall provide all parts, equipment, materials, components, installation, and performance testing required for a complete and functional system.
- C. The UVSS shall coordinate requirements for system installation with the Contractor and Engineer including the following:
 - 1. Channel dimensions
 - 2. UV system headloss
 - 3. Performance testing requirements
 - 4. UV system installation instruction
 - 5. UV control system integration into the Plant Control System
- D. The UVSS shall submit the specified information to the Engineer for the design of the facilities associated with the supply of the UV system.
- E. The UV system shall be designed for outdoor installation.
- F. The UV system shall be an open channel, gravity flow system utilizing inclined, low pressure, high intensity lamps. The UV system shall include the following principal components:
 - 1. UV lamp modules with quartz sleeves
 - 2. Lamp assemblies on removable modules
 - 3. Low pressure high output lamps
 - 4. Automatic quartz sleeve cleaning system
 - 5. UV channel level control as required
 - 6. Online UV intensity detection system
 - 7. Ballast and/or transformers to operate UV lamps
 - 8. Power Distribution Center

9. Interconnecting power and data cables between UV modules and UV power/control equipment
10. System instrumentation and controls including programmable logic controller
11. Hooks for removal of the UV modules from the channels by overhead crane for maintenance
12. UV eye shields and personnel safety equipment
13. Accessories
14. Spare parts
15. Special tools, whether specifically mentioned in this section or not, as required for a complete system
16. Control panel(s)

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 and the associated sections shall be fabricated, assembled, erected, placed in proper operating condition, and tested in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment provided by the UVSS.
- B. Definitions
 1. The following terms are used in this section and associated sections:
 - a. UV Dose – The total radiant energy incident from all directions onto an infinitesimally small sphere of area dA, divided by dA, for a given contact time in seconds. The unit of UV dose shall be millijoules per square centimeter (mJ/cm²) and shall be calculated as follows:
$$D = I \times t$$
 - b. Where: D = UV Dose, mW-s/cm² (mJ/cm²)
I = average intensity or irradiance, mW/cm²
t = average exposure time, s

UV Transmittance (UVT) – The transmittance of ultraviolet light at a wavelength of 254 nm through the water across a pathlength of 1 cm. UV transmittance shall be calculated from UV absorbance (A) at 254 nm by the following equation:

$$\text{Percent transmittance} = 100 \times 10^{-A}$$

- c. Intensity or Irradiance – The total radiant power incident from all directions onto an infinitesimally small sphere of cross-sectional area dA, divided by dA. The units of intensity shall be milliwatts per square centimeter (mW/cm²).
- d. Validated Reactor – A reactor that has been validated under the following conditions.
 - 1) The validated flow range contains the design flow range per reactor as stated in this section.
 - 2) The validated UVT range contains the operational UV transmittance range as stated in this section.
 - 3) The validated dose range contains the operational germicidal UV dose range as stated in this section.
- e. Equivalent Dose – The maximum dose necessary for a full-scale UV system to achieve a level of inactivation of a specific organism equivalent to the level of inactivation for the same organism achieved in a laboratory using a collimated beam apparatus with a low-pressure lamp producing UV energy at a wavelength of 254 nm to test a water sample collected at the same time.
- f. Low Pressure High Output (LPHO) Lamp – A lamp with input power equal to two to three times the input power of a LP lamp, primarily at 254 nm, with a pressure of approximately 0.2 psi.
- g. Guaranteed Life – The manufacturer's warranted life of the lamp, sleeve, ballast, and sensor.
- h. Expected Lamp Life – The manufacturer's estimated life of the lamp based on the operating conditions described in this section.
- i. Prorated Start Time – The time beginning after at least 20 percent (20%) of the guaranteed life has lapsed.
- j. Guaranteed Maximum Total System Energy Use – A calculated value based on UVSS data reflecting energy use in kilowatt-hours per year.
- k. Guaranteed Maximum Head Loss – The head loss in inches of water column allowed through the UV channel with all restrictions, including fouling, influent gate, and level control gate at peak flow rate.
- l. Gallon – U.S. gallon.

2. General Equipment Stipulations

- a. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements differ in this specification from those in the General Equipment Stipulations section, the requirements specified herein shall take precedence.

C. Power Supply

1. The UV system shall be rated for a 480 volt, 3 phase, 4 wire, 60 hertz power supply. The UVSS where required, shall provide isolation/step-down transformers to the power/wire/utilization voltage as required by the system furnished.
2. The UV cleaning system if not integrated into the UV module, shall be rated for a 480-volt 3 phase 4 wire power supply and a 120 volt 1 phase, 2 wire plus ground power supply if required for the main control system
3. The UV System electrical panels are not provided with electrical disconnects. Each electrical power supply should be provided with a separate disconnects, to be supplied under the electrical contract.
4. Identification: Equipment specified herein and in associated sections shall be identified in accordance with the Equipment and Valve Identification section.

1.04 QUALITY ASSURANCE.

A. Qualification Requirements

1. The UVSS shall be regularly engaged in the manufacture of UV systems and shall have at least five Low Pressure High Intensity (LPHI) systems of 60 mgd or greater capacity, installed and operating in the United States.
2. The UVSS shall have evidence of qualification and at least ten (10) years of operational experience of experience in manufacturing and delivering open channel UV disinfection systems using low pressure high output amalgam lamps.
3. All equipment furnished under this specification shall be new and shall be the standard product of a supplier who is regularly engaged in the supply of the equipment to be furnished.

B. Performance Requirements Guarantee.

1. The performance of the UV system in accordance with the requirements specified herein shall be guaranteed by the UVSS.
2. The UV validated dose produced by the system shall be in accordance with the specified requirements and shall be verified by a bioassay conducted according to either NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Reuse Water (2012) or Ultraviolet Disinfection Guidance Manual (2006) procedures.

3. Cost of any additional validation work required to meet the requirements of this specification shall be at UVSS cost.

1.05 EQUIPMENT BASIS OF DESIGN.

- A. This specification section describes a complete operational system to be furnished by a single responsible equipment manufacturer. The equipment described herein is based on products manufactured by Wedeco a Xylem Brand and Trojan Technologies. The equipment supplied by the Contractor shall, in the sole opinion of the Engineer, minimally satisfy the intended functionality, quality, operability, and maintainability of the design basis system.
- B. Prequalification of Alternate Equipment. The Contractor may submit unnamed manufacturer's equipment for consideration as an alternative to the equipment specified as the Design Basis. An addendum may be issued at least five days before the bid date naming alternate suppliers that conform to the specifications and are approved to bid equipment for the project. To qualify alternate equipment, the contractor shall provide the following information to the Engineer at least ten (10) business days prior to the bid date:
 1. Drawings, specifications, and product literature with adequate detail to determine that what is proposed will meet the requirements of the plans and specifications. This design pre-submittal shall be complete and shall include as a minimum, the following:
 - a. Detailed layout drawings
 - b. Detailed component specifications and catalog cut sheets
 - c. Process P&ID drawing
 - d. Detailed list of variations required from original design, referencing appropriate sections of the specifications and locations on the drawings
 - e. History of the process offered, including pilot data and experience
 - f. Installation list including actual scale-up data from pilot testing to full scale plant operation, also including plant contact names and telephone numbers
 2. A list of 20 installations of similar type and size with plant addresses and telephone numbers. The Engineer and Owner may contact these installation sites to determine experience. The alternate equipment supplier shall also provide a list of total open channel ultraviolet disinfection for wastewater system plants.
 3. Evidence of manufacturing capability including a description of facilities, the number and professional qualifications of personnel, and quality control practices. The alternate equipment supplier shall identify major outside fabricators for the purpose of determining experience.
 4. A complete listing of changes which will be required in the contract plans and specifications to accommodate the alternate equipment.
- C. Alternate bidders shall guarantee, in writing, signed by an officer of the company that the equipment offered will provide comparable or superior features, performance quality, and materials of construction as the equipment specified. Prior approval of the alternate equipment shall not constitute final approval of specific equipment, but rather constitute

only approval of the respective equipment manufacturers to provide price quotations based on equipment meeting the specifications.

- D. The cost of any changes incidental to installation of the alternate equipment such as electrical wiring, relocation of piping, engineering design or supervision, as built drawings, etc., shall be borne by the contractor with no additional expense to the Owner.
- E. Quality Assurance
 - 1. The products covered by this specification are intended to be the standard equipment, as modified by these specifications, of proven ability, and as manufactured by a single manufacturer, having at least ten (10) years of experience in the production of such equipment. Ultraviolet disinfection system shall be manufactured by Wedeco a Xylem Company, Trojan Technologies, or pre- approved equal.
 - 2. Should equipment which differs from these specifications be offered and determined to be equal to that specified, such equipment will only be determined to be acceptable on the basis that any revisions in the design and/or construction of the building, piping, appurtenance equipment, electrical work, controls, etc., required to accommodate such a substitution is made at no cost to the Owner and is approved by the Engineer.

1.06 SUBMITTALS

- A. UV system supplier shall submit for review, engineering data, including the quantities provided for headloss, power consumption, and disinfection ability in accordance with the requirements of the Submittals section. These data will be verified during the performance testing of the system and prior to the acceptance of the equipment by the Owner. Any exceptions or deviations to these specifications shall be listed and fully described in the submittal. The Engineer's final decision regarding the acceptance or denial of any deviations or exceptions shall be just cause for the rejection of the proposed equipment and require that the UVSS provide the disinfection equipment as specified herein.
- B. Engineering Data
 - 1. Complete fabrication, assembly, foundation, and installation drawings, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted. Data and specifications shall include the following:
 - a. Complete description in sufficient detail to permit an item-by-item comparison with the Specification.
 - b. Dimensions and installation requirements of all required elements.
 - c. P&IDs of the system, detailing the equipment supplied by the UVSS and showing equipment to be provided by others that will interface with the system. The UVSS shall identify tag numbering for the units and the system that is coordinated with the Owner's established tag numbering scheme.

- d. Descriptive information, including catalog cuts and UVSS's specifications for major components. Information shall include weight and dimensions of major equipment and materials.
- e. Bill of Materials after shop drawings are accepted, for all tagged devices and components supplied with the UV System including component original part numbers identifying each furnished component. For all tagged devices supplied, the UVSS shall develop a "Cross Reference Schedule" that matches the Tag to the appropriate equipment manual. The equipment schedule shall include the pertinent information associated with the equipment including tag number, description, functional name location, component equipment model, part number, size, materials, accessories and range. The Cross-Reference Schedule shall be provided in the form of a Microsoft Excel spreadsheet or AutoCAD drawing.
- f. Electrical schematics, wiring diagrams and plan layouts. Drawings shall provide details for all field-wiring requirements between the UV system control panels and externally mounted equipment. An electronic copy of the PLC input/output listings in an Excel spreadsheet shall also be submitted to the Owner for programming of the HMI application.
- g. Detailed narrative information on how the UV system will operate.
- h. Listing of three (3) multi-channel installation references in North America, who are users of similar systems with similar hydraulic capacity and effluent quality requirements, as indicated in the design requirements, using the lamp technology being provided, which are designed, assembled, and furnished by the UV system supplier. These systems must have been in operation for 36 months. Contact names, phone numbers, addresses, and brief project descriptions shall be included.
- i. The most recent complete bioassay report utilizing procedures recommended by either: USEPA, IUVA, or NWRI, prepared and certified by an independent third party. The report shall have been prepared within the past three (3) years. If the report is over three years old, spot checked bio assay data shall be submitted to confirm the results of the original report on the final installed system as part of the performance test. The report shall verify the maximum flow rate per lamp that will result in the design delivered UV validated dosage. The flow-through bioassay test shall have been conducted for two UV-resistant organisms, such as MS2 phage and T1 or other organism acceptable to the Engineer, to ensure that delivered dosage can be provided by the equipment proposed. Dose development shall take into account the fouling factor and end of lamp life specified herein. All bioassay results shall be certified by an independent third party.
- j. Calculations showing power required to achieve the disinfection requirements specified herein. The UVSS shall state the power per lamp (including ballast loss) and the system peak power consumption (including ballast loss), for both new lamps and end of lamp life.

- k. Independent third-party certified test results for power (kW), power factor, and apparent power (kVA) for the entire system.
 - l. Hydraulic calculations demonstrating compliance with the specified head loss through the channel with all restrictions, weirs, and controls factored in at all flow conditions specified herein.
 - m. Minimum UV254 transmission of the quartz sleeves and their guaranteed useful life as based on third party certification.
 - n. Complete UV lamp and ballast output report prepared by an independent testing laboratory for the UVSS's current lamp technology. The report shall certify the output of the lamp and ballast at various operating conditions.
 - o. Guaranteed operating life of lamps in hours and ballasts in years.
 - p. Certification of the specified guaranteed cost of replacement lamps.
 - q. Complete dose response curve, transmittance measurements, and all supporting documentation utilized in submittals based on effluent samples where collected by the UVSS for system design.
 - r. UVSS's Project specific performance testing protocol.
 - s. Description of disinfection performance guarantee
2. Values submitted for headloss and power consumption will be verified during the performance and commissioning testing of the equipment, and prior to acceptance of the equipment by the Owner.

C. Operation and Maintenance Data and Manuals

- 1. Operations and maintenance manuals shall be submitted in accordance with the Submittals section. In addition to requirements specified in the operation and maintenance manuals shall include but not limited to the following:
- 2. General description of the UV system as required by the UVSS,
- 3. UVSS contact information,
- 4. Recommended routine and preventive maintenance schedules,
- 5. Step-by-step procedure for cleaning lamps, sensors, and reactors, including the volume of cleaning chemical required to clean one reactor and expected cleaning frequency given the water quality constituents,
- 6. Guide to troubleshooting,
- 7. Upon completion of installation and startup of the equipment, electronic copies of the PLC programs and OIT programs shall be submitted to the Owner.

1.07 SPARE PARTS

- A. The following spare parts shall be furnished and delivered with the system.

<u>Spare Parts</u>	<u>Quantity</u>
UV germicidal lamps, % of total supplied	10
Lamp ballasts, electronic, % of total supplied	5
Lamp sleeves or quartz jackets, % of total supplied	10
UV intensity monitor sensor with circuit board,	1
Lamp control logic circuit boards	1

- B. Spare parts shall be delivered to Owner as directed. All spare parts shall be in waterproof packages suitable for export service, labeled with the description and part numbers. Each item or set of parts expected to be installed at one time shall be in an individual package.
- C. If any of the above spare parts are used during the installation process, they shall be replaced at no cost to the Owner.

1.08 WARRANTY

- A. The equipment furnished under this section shall be free from defects in materials and workmanship, including damage that may occur during shipping, for a period of 1 year from the date of Substantial Completion for the Project.
- B. Lamps shall be warranted for a guaranteed lamp life of 15,000 hours based on actual operating hours, to produce a delivered dose as indicated by the control system provided by the UVSS, to achieve compliance with permit requirements. If 20 percent (20%) of the lamps installed fail in the period of the guaranteed lamp life, the UVSS shall replace all lamps within 30 days of written notification by the Owner, at no additional cost to the Owner, based on a prorated cost determined by the actual operating hours of the lamp. The full replacement of lamps does not apply if it can be demonstrated the lamp failures are not due to defects or if lamp failures are a result of system operation that is not in accordance with the UVSS operation and maintenance manual. Replacement cost will be prorated after 9,000 hours. On/Off cycles are limited to an average of four (4) per day accumulate over the guaranteed life of the lamp.
- C. Ballasts shall be warranted for a guaranteed ballast life of ten (10) years from Substantial Completion regardless of the power output and operating hours. Ballasts shall be designed for the service conditions for which they are provided. The UVSS shall replace failed ballasts within 30 days after written notification from the Owner, at no additional cost to the Owner, based on a prorated cost determined by the time from Substantial completion to failure of the ballast.
- D. Quartz sleeves shall be warranted for a minimum of ten (10) years from Substantial Completion. If 20 percent (20%) of the quartz sleeves fail to maintain a minimum transparency factor of 0.92 during the ten (10) year period, the UVSS shall replace all quartz sleeves within 30 days after written notification from the Owner, at no additional cost to the Owner. During the first five (5) years of operation, the UVSS shall test a

random sample of eight (8) quartz sleeves that have been in operation each year to determine the transparency factor. The full replacement of quartz sleeves does not apply if the failures can be shown to be no fault of the manufacturer or if they are a result of the system not being operated in accordance with the UVSS operation and maintenance manual.

- E. Intensity sensors shall be warranted for a minimum of five (5) years from Substantial Completion. The full replacement of the intensity sensors does not apply if the failures can be shown to be no fault of the manufacturer or if they are a result of the system not being operated in accordance with the UVSS operation and maintenance manual.
- F. The warranty for lamps, ballasts, sensors, and quartz sleeves shall include all parts and freight for replacement during the warranty period. A written warranty acceptable to Engineer and Owner shall be provided.

PART 2 PRODUCTS

2.01 SERVICE CONDITIONS

- A. The ultraviolet disinfection modules shall be installed outdoors within concrete channels following the tertiary filters. The UV system will be used to disinfect wastewater which has undergone screening, grit removal, activated sludge treatment, secondary clarification, and tertiary filtration. UV disinfection will be the final process other than post aeration prior to discharge from the plant.
- B. Electrical and control equipment enclosures not integral to the in-channel components will be installed indoors. The ambient temperature in the building where the equipment will be installed will be between 33- and 85-degrees F. The maximum relative humidity in the building where the equipment will be installed will be 100 percent (100%).

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

- A. The equipment shall be designed for installation in concrete channels with dimensions as indicated on the Drawings.
- B. It has been called to the attention of the Engineer that US patent 6,129,893 – Method for Preventing Replication in *Cryptosporidium parvum*, published on October 20, 2000, may be applicable to this Project.
- C. The end of lamp life UV dose produced by the system shall not be less than the value specified herein, as measured after the guaranteed lamp life indicated by UVSS has passed, in an effluent with UV transmission as indicated in the design requirements at 253.7 nm at peak flow with fouled sleeves at the end of lamp life.

D. The UV system shall be designed for the following performance and design requirements:

Peak flow	30.0	MGD
Maximum month design flow	10.9	MGD
Average daily flow	8.0	MGD
Minimum daily flow	1.4	MGD
Number of channels	2	
Peak Flow Per Channel	15.0	MGD
Redundant Banks Per Channel at Peak Flow	1	
Estimated UV Transmittance (at 253.7 nm through 1 cm deionized water) through flow tubes, for design sizing	65	%
Min. UV validated dosage, at design conditions, after minimum number of hours (as indicated by guaranteed lamp life of operation and adjusted for organism) based on MS2 phage	30	mJ/cm2
Lamp Output at End of lamp life,	86	%
Fouling factor	0.94	
Maximum daily effluent CBOD, permit	15	mg/L
Influent fecal coliforms/100 mL	40,000	cfu/100 mL
30-day geometric mean, effluent fecal coliform/100 mL	200	cfu/100 mL
Wastewater temperature range	1 to 30	°C
Effluent TSS	30	mg/L
Bioassay and CFD results required to verify validated dose	Yes	
Maximum allowable headloss across channel, at peak flow with fouling including level control gate	12	inches

Notes:

1. The UV system shall be designed to deliver a minimum UV dose specified at peak flow, in effluent having the specified UV transmittance, at end of lamp life (EOLL) after reductions for quartz sleeve fouling.
2. The UV Dose shall be adjusted using the end of lamp life factor as specified in the design requirements table to compensate for lamp output reduction over the time period corresponding to the manufacturer's lamp warranty. End of Lamp factor documentation shall be provided to the Engineer for approval at a minimum of 15 days before bidding.

3. The UV Dose shall be adjusted using a quartz sleeve fouling factor as indicated in the design requirements table when sizing the UV system, in order to compensate for attenuation of the minimum dose due to sleeve fouling during operation. The use of a higher quartz sleeve fouling factor will not be considered. Fouling factor documentation shall be provided to the Engineer for approval at a minimum 15 days before bidding.
4. When the largest module in each channel for the system provided is out of service, the remaining modules shall have a design flow capacity of the peak month flow.
5. The UV system shall be capable of dose pacing to reduce electrical energy consumption in response to the disinfection demand based on a minimum of channel flow signal (provided by others through either SCADA communications or 4-20,A signal), the UV sensor signal(s) and the online measured UV transmittance.
6. For determining UV dose during operation and for dose pacing, the UV intensity signal shall be incorporated into the UV control system's validated operating equation: this provides the most reliable method of monitoring and controlling the UV disinfection process during operation.
7. To avoid misrepresentation and possible over-reporting of UV dose during operation, equipment that does not utilize the UV sensor signal in determination of operational dose shall not be accepted.

2.03 GENERAL REQUIREMENTS

- A. The following paragraphs specify general requirements.
- B. No tools or special equipment shall be required for module removal.
- C. All wetted parts shall be Type 304 or 316 stainless steel, quartz glass, Teflon, or plastics not susceptible to UV or chemical degradation, including oxidants. All metal components above the water surface shall be Type 304 or Type 316 stainless steel. All wiring exposed to UV light shall be insulated with UV-resistant material and warranted for 5 years from Substantial Completion for both parts and labor. All material exposed to UV light shall be Type 316 stainless steel, Type 214 quartz, Teflon, or other material acceptable to the Engineer.
- D. UV Lamp
 1. The UV system shall utilize low pressure, high-intensity, mercury amalgam lamps capable of variable control of power output from a minimum of 50 to 100 percent (50% – 100%) installed in a staggered inclined arrangement. Each lamp shall be protected from contact with the fluid by a quartz sleeve. Lamps containing liquid mercury shall not be allowed.
 2. Lamp filaments shall withstand shock and vibration. Lamp bases shall be resistant to UV, ozone, chlorine, and chloramines. UV lamps shall not require a long cool down period prior to re-start should the power to the UV system fail or be interrupted for a short period of time.

3. The UV system lamps shall be available from the UVSS and/or at least two lamp suppliers. No modifications to the system shall be required for lamp installation. Lamp replacement costs shall be guaranteed for a minimum of ten (10) years from the date Substantial Completion for the Project. During these ten (10) years, the price shall be adjusted annually by the Producer Price Index – Industrial Commodities (where the base is 1982 = 100) published by the United States Department of Labor, Bureau of Labor Statistics, applicable on the anniversary of the date for Substantial Completion. Should only one lamp supplier be capable of providing these lamps, the UV system supplier shall issue a guaranteed lamp replacement price warranty for a period of 10 years of operation.
4. The UVSS shall provide independent laboratory certification that lamps will provide a minimum of 35 percent (35%) of input power emitted as UV light at a wavelength of 254 nm after 100-hour burn-in period, and at the maximum lamp operating temperature. The lamp temperature shall not exceed the maximum operating temperature under full scale, full power conditions for this Project.
5. Lamp output shall not fluctuate more than three percent (3%) with water temperature variations over the specified range. Independent test data including the specified process temperature range, shall be provide for output as a function of temperature. The operating skin temperature of the lamp shall not exceed 130°C. UV lamp maximum arc shall be as defined by each supplier. The lamps shall be capable of operating in a “No Flow” condition while submerged in water at the maximum specified process temperature, for a period of 60 minutes without causing any damage to the lamps.
6. Lamps will be operated by electronic lamp drivers with variable output capabilities ranging from 30 to 100 percent (30% to 100%) of normal power. The lamp assembly shall incorporate active filament heating to maintain a minimum lamp efficiency of 35 percent (35%) across the varying water temperatures and between the minimum and maximum stated lamp power levels.
7. The UVSS shall ensure disposal of the returned lamps (old/used) at no cost to the Owner upon receipt of the returned lamps at the supplier’s designated location.

E. UV Banks

1. UV Banks shall consist of UV lamps mounted on a heavy gauge Type 316 stainless steel frame. Lamp sleeves shall be provided around each UV lamp to prevent the lamps and electrical connections from coming in contact with the wastewater effluent. Lamp sleeves shall be single piece Type 214 clear fused quartz circular tubing containing at least 99.9% silicon dioxide as manufactured by General Electric or equal. The ends of lamp sleeves shall not protrude beyond the stainless-steel frame of the UV module. Type 316 stainless steel spacer/reflector panels shall be provided so that no UV light is emitted from the channel when the UV modules are installed, and the lamps are energized.
2. Each bank will contain a pre-formed Type 316 stainless steel wall on each side of the bank to prevent possible short circuiting at the side wall of the reactor. Bank lamp locks shall be included to prevent potential short circuiting over the top of the lamps and maximize disinfection efficiency. Each bank will be Type 6P rated.

3. All electrical connectors and motors located on the UV bank and above nominal channel water level shall either be rated at IP67 or located within IP67 enclosures suitable for temporary submersion.

F. Electronic Lamp Driver

1. The electronic lamp driver shall drive a pair of lamps with independent control and monitoring circuits, and provide independent lamp status to the UV system PLC. The ballasts shall be electronic microprocessor controlled. The ballast shall produce an earth free lamp power supply operating at above supply frequency and optimized to preserve lamp life. The lamp driver will be programmed start type utilizing filament preheat followed by a high voltage pulse to ignite the lamp.
2. The lamp driver shall have a power factor correction circuit to ensure a maximum 99 percent (99%) power factor and less than five percent (5%) total harmonic distortion (THD) current at the maximum power level and nominal input voltage. The lamp driver electrical efficiency shall be a minimum 95 percent (95%) at maximum power level. A ground fault output circuit shall be detected and communicated as a warning to the external controls system while the corresponding lamp operates undisturbed.
3. The ballast shall detect lamp failure and automatically initiate a re-start sequence. The ballast shall attempt three re-starts before shutting off. The ballast shall incorporate a galvanic separation of the circuits for the two lamps served. In case of the secondary circuit operating in abnormal conditions regarding voltage and/or amperage, the ballast shall shut the affected lamp off.
4. The ballast shall be held in a standby mode when not in operation to reduce start-up time and minimize stress on electronic components. Local visual diagnostic will be provided with LEDs for lamp drive status, lamp status (on, idle, preheat, fault) power and communications status. Lamp driver shall be UL, CE, and RoHS compliant.

G. Cleaning System

1. An automatic and integral lamp cleaning system shall be provided as part of the UV system. The cleaning system shall use chemical or mechanical wiping to de-scale the lamp sleeves. The cleaning system shall be fully operational without requiring either lamps or modules to be removed from service. The cleaning system will be provided with the required solutions to provide adequate cleaning. The wipers shall travel the full length of UV lamp arc. Cleaning system servicing will be provided so that servicing can be conducted while the system is operational.
2. The cleaning system shall be parked out of the effluent when not in service. The cleaning system shall be fully functional when the banks, lamps, and modules are submerged in the treated effluent. The cleaning cycle shall be field adjustable and shall be activated automatically from the UV control system or manually at the operator interface terminal or Power Distribution Center. The materials used for the wiper shall be resistant to high intensity UV radiation, wastewater, chemicals in the wastewater, and fluctuations in temperature. The wiper shall be designed to effectively and completely remove deposits from the lamp sleeves.

H. Channel Level Control

1. Level in the UV channel shall be controlled by a downward acting weir with modulating electric operator. The level control system equipment including gates, actuators, and instrumentation shall be provided by the UVSS as specified in other sections.
2. Each channel shall have one individual level control device and a backup low level switch.
3. The outlet weir shall prevent leakage of water at no flow conditions. Systems that run dry automatically at no flow conditions shall not be acceptable.
4. Control of the weir position by the UV control system shall maintain a constant water level upstream of the UV modules under all flow conditions in the channel to ensure optimum disinfection conditions.
5. An ultrasonic level sensor mounted onto a fixed structure above the channel shall measure the channel level continuously. The channel level shall be used by the UV control system to provide modulating control of the downward acting weir utilizing a PID control algorithm.

I. Equipment Tags

1. All equipment provided by the UVSS shall have a unique tag number. UVSS shall coordinate tag numbers with the Engineer and Owner. Tag number format for UV disinfection equipment shall be as follows:

UV-XYZ

where X = Channel Number (1 or 2)
 Y = UV Bank Number (1 through 4)
 Z = Optional UV Module Number (0 if no module number is required)

2.04 GENERAL ELECTRICAL REQUIREMENTS

- A. The UVSS shall provide data as required for the harmonic distortion abatement analysis by the Contractor to limit harmonics.
- B. If required, the UVSS shall supply isolation/step-down transformers for each Power Distribution Center. Transformers shall be K rated, 3 phase dry type, self-air cooled, suitable for floor mounting. Transformers shall be designed, manufactured, and tested in accordance with the latest applicable ANSI, NEMA, and IEEE standards. Transformers shall be UL Listed.
- C. Transformers shall be insulated with a UL recognized 220-degree C insulation system. Winding temperature rise shall be 150-degree C. Required performance shall be obtained without exceeding the specified temperature rise in a 40 degree C maximum ambient, with a 30 degree C average.

- D. Transformers shall be sized to supply at least 125 percent (125%) of the maximum UV system demand from each Power Distribution Center. Transformers shall have a delta primary winding and a solidly grounded wye secondary winding with secondary voltage ratings as required by the UVSS.
- E. The UV disinfection system shall be divided into electrical sub-systems. Each sub-system shall be powered from the power distribution center by means of waterproof cable interfacing with a watertight strain relief. Electrical supply to each power distribution center shall be a maximum 480/277 volts, 3 phase, 4 wire, 60 Hz, derived from the appropriately sized transformer.
- F. The enclosure material and enclosure ratings for the power distribution center shall be as specified in individual equipment specification sections.
- G. General Wiring and Connections Requirements
 - 1. All wiring and electrical connections shall be protected against moisture to prevent electrical shorts or failure. All electrical components, installation, wiring, and controls on or within the UV disinfection system as a whole shall be designed, constructed, and installed by the UVSS and in accordance with the current edition of the National Electrical Code and all applicable state and local electrical codes.
 - 2. The UV system modules shall be completely wired, requiring only an external connection for a single external power supply and monitoring and control wiring.
 - 3. External wiring to and from the control panel, except as noted, and power disconnect, and alarm circuits shall be furnished and installed under the Electrical section. All terminations, if needed between the lamps and ballasts shall be performed by the Contractor and tested by the UVSS. Wiring between the power distribution center and the ballast and lamp enclosures shall be provided under this section. UVSS shall provide the wiring from the ballasts to the lamps.

2.05 CONTROL AND INSTRUMENTATION

A. General

- 1. The UV system shall be provided with a System Control Panel furnished by the manufacturer. The panel shall be a NEMA 4X front opening, free standing panel with a full-length door hinge and three-point latch. The panel shall be designed for bottom entry of field wiring and for installation outdoors.

B. Power Supply

- 1. The System Control Panel shall accept a 120 volt, 60Hz, single phase power supply. The panel shall be protected by a circuit breaker with an interrupting rating of 10,000 amps.

C. Power and Control Wiring

- 1. The System Control Panel shall be completely wired with provisions for terminating all field wiring on terminal blocks. The terminal blocks shall be marked to agree with

the manufacturer's wiring diagram. Control terminal blocks shall be sized for No. 12 AWG copper wire. All interconnecting wiring and wiring to terminals for external connection shall be not less than No. 14 AWG copper, insulated for not less than 600 volts with a moisture and heat-resistant material and flame-retardant nonmetallic covering.

2. All wiring shall be grouped or cabled and firmly secured to the panel and shall be numbered at each termination with permanent labels corresponding to manufacturer drawings. Not less than 5 percent spare terminals shall be provided.

D. Programmable Logic Controller

1. A programmable logic controller (PLC) shall be provided in the System Control Panel for control of the UV system. The PLC shall be programmed for the functional control described herein and incorporating sequences and safety and equipment protective interlocks as recommended by the manufacturer. The PLC shall be at least an Allen Bradley CompactLogix PLC to meet the Owner's standards.
2. The PLC shall be connected to the Plant Control System Ethernet network and shall be provided with the required communication modules and media converters. The UVSS shall coordinate requirements with the plant control system supplier for communication between the UV system PLC and the Plant Control System.

E. Industrial (Panel-Mounted) Ethernet Switches

1. Each switch mounted in process areas shall include the following functionality:
 - a. Ports: Switch shall support the quantity of 10/100BaseTX ports and 100BaseFX fiber ports to meet the functionality indicated on the Drawings, with a minimum of 20 percent (20%) spare auto-negotiating 10/100Base-T, RJ-45 ports, and two multimode fiber uplink ports. A minimum of four UTP ports shall be provided.
 - b. Each switch connection shall automatically sense the network speed of the devices to which it is connected.
 - c. Capable of ring-based media redundancy with 30 ms recovery time.
 - d. Path Redundancy: IEEE 802.1w Rapid Spanning Tree Protocol.
 - e. Prioritization: IEEE 802.1p QoS Support.
 - f. Network Segregation: Port VLAN.
 - g. Management: SNMPv3 and Browser-based management shall be supported.
 - h. IGMP snooping supported.
 - i. LED indication of the link activity for each port.
 - j. Environmental: Suitable for installation in industrial environments. Operating Temperature Range: 0 to 60C. Optional -40 to 60C rating availability.

- k. Redundant 24 VDC power supply inputs.
 - l. Conformal coating option for use in hazardous environments.
 - m. Mounting: DIN-rail mounted suitable for panel installation.
 - n. All necessary memory upgrades, software feature sets, and cables needed for proper operation of these switches shall be furnished with each switch.
2. Switches shall be GarretCom Magnum 6K Series, Hirschmann RS-20 series, Moxa 508A series, N-Tron 708FX series, SIXNET SL-8MG Series , or equal. All new switches shall be compatible with the existing Ethernet network devices, so that plant data is exchanged between new and existing control system devices.

F. Operator Interface Terminal

1. An operator interface terminal (OIT) with a nominal diagonal display dimension of at least 10 inches with a minimum resolution of 640x480, 256 K colors, and a luminance of 400 cd/m² shall be provided. The OIT shall be NEMA 4X and shall be mounted on the System Control Panel face. The OIT shall display indications and alarms as recommended by the UV system manufacturer and as specified herein. A function keypad or a touch screen shall be provided for operator entry of commands and setpoints.

G. UPS

1. An UPS shall be provided within the control panel to provide backup power to the PLC, OIT, and Ethernet switch for at least 30 minutes when power is lost to the control panel. The UVSS shall be responsible for providing a properly sized UPS, installing the UPS in the control panel, and providing all necessary hardware and wiring to ensure a fully functional UPS backup system. For additional UPS requirements, the UVSS shall refer to Section 13570.

H. Programmable Logic Controller and Operator Interface Terminal Configuration.

1. The UV control system shall be configured and commissioned by the UVSS for operation of the system as specified herein and as required by the UVSS.
2. The UV system manufacturer shall be responsible for programming all pseudo- I/O or transfer registers plus providing memory for 25% spare pseudo-I/O. All pseudo-I/O plus the 25% spare shall be located in a contiguous block of data registers for communication to the Plant Control System.
3. All control mode status, control set points, equipment status, bank elapsed time, alarm and data points in the UV system shall be made available on OIT screen. Full control of the UV system shall be provided through the OIT.
- a. The OIT display shall include the following:

- 1) UV system in LOCAL-MANUAL

- 2) UV system in LOCAL-AUTO UV system in REMOTE
 - 3) UV bank on (each bank) UV bank elapsed time
 - 4) Lead and lag UV bank (each unit) Lead and lag channel
 - 5) Channel inlet gate open-closed position (each gate) Channel outlet gate continuous position (each gate) Channel gate in REMOTE
 - 6) Channel gate fail (each gate) UV intensity (each bank)
 - 7) UV power (each bank) Channel level
 - 8) UV dose in each channel Flow
- b. The UVSS shall provide complete electronic copies of all PLC, OIT database and graphics, I/O and configuration program data before shipment of the equipment for use in configuring the Plant Control System and shall provide updated versions of this information during the field commissioning start up and testing including final version before acceptance of the system.

I. Controls

1. The following describes functional control requirements for the UV disinfection system. UVSS shall integrate these functional requirements into the UV system controls. The functional controls shall include the UV system and the associated power actuated UV channel gates. All protective interlocks and start up and shutdown sequences are to be provided in accordance with the UV system manufacturer's recommendations. Also reference the Software Control Blocks Description section to coordinate the controls with the Plant Control System described in that section.
2. LOCAL-REMOTE and MANUAL-AUTO selectors shall be provided on the UV system OIT. When LOCAL and MANUAL are selected, operation of the channel gates and UV banks shall be controlled through the OIT and UV system PLC in accordance with the manufacturer's standard manual control practice. Hardwired controls shall also be provided as a backup to the PLC controls, to allow operation of the UV disinfection system in the event the UV system PLC is not available.
3. When LOCAL and AUTO are selected, the UV channel gates, and the UV system shall be controlled to provide the target dose to the flow of effluent through the channels. The target dose shall be calculated from the log removal entered through UV system OIT. The functional control shall be as follows with UV unit staging and interlocks to channel gates following the manufacturer's standard operating procedure:
 - a. The inlet gate for the LEAD channel shall always be open, and the LEAD bank in the channel shall always be on. The position of the outlet gate shall be modulated to maintain a setpoint level in the channel. On increasing demand, the power level shall increase to provide the target dose. When the power level of the LEAD bank in the LEAD channel reaches an adjustable maximum level, initially set at a level as recommended by the manufacturer, the LAG bank shall be powered, and the power to both banks shall be modulated in parallel to provide the target dose.
 - b. As demand continues to increase and power to both banks of the LEAD channel reaches the maximum, the LAG channel inlet gate shall open, the outlet gate

shall modulate to maintain a setpoint level in the channel, and both banks of the LAG channel UV unit shall be powered. Power to all 4 UV banks shall be modulated in parallel to provide the target dose.

- c. When demand decreases to a level no longer requiring the LAG channel, the LAG channel inlet gate shall close, the outlet gate shall position itself at a position as recommended by the UVSS, and the UV unit in the LAG channel shall power down. The power to the UV banks in the LEAD channel shall modulate in parallel to provide the target dose. On further decrease in demand to a level where the LAG UV bank in the LEAD channel is no longer required, the LAG unit shall power down, and power to the LEAD unit shall be modulated to provide the target dose.
4. The LEAD and the LAG channels and the LEAD and the LAG banks shall automatically alternate on a schedule as recommended by the manufacturer, to equalize operating time.
5. The UV system manufacturer shall provide its standard equipment for pacing the lamp output to meet the calculated target dose. The UV system PLC shall use the plant effluent flow rate, the UV transmittance of the plant effluent, and/or UV intensity in calculating the power required and shall adjust the power to the lamps to meet the target dose. The pacing flow signal will be available to the UV control system through the Plant Control System network.
6. On loss of the flow signal, the control system shall utilize a default flow value and control the system automatically to bring all UV channels online and energizing all UV lamps to the required power setting to meet the target dose. The default flow value shall be adjustable at the OIT.
7. When REMOTE is selected at the OIT, control shall be through the UV system PLC using setpoints and commands received from the Plant Control System. If MANUAL is selected at the Plant Control System human machine interface (HMI), display targets on the HMI will be provided to control UV channel inlet gate positions, the level setpoint in each channel, the ON/OFF of each UV bank, and power level for each UV bank. The UV system manufacturer's PLC shall be programmed to accept these inputs from the Plant Control System and control the equipment according to the commands made at the Plant Control System HMI.
8. When REMOTE is selected at the OIT and AUTO is selected at the Plant Control System HMI, the operator will enter the log removal at the HMI and the UV system PLC shall use the HMI entered log removal to calculate the target dose and to control the UV system and the associated channel gates as described above, to provide the target dose to the flow through the channels.
9. In all control modes, the UV system shall maintain submergence of the lamps, and shall provide alarms and interlocks to protect the lamps.

J. Alarms

1. Details of all alarms shall be displayed on the OIT. Alarms shall be categorized as non-critical or critical.

2. Non-critical alarms shall be displayed to indicate that maintenance attention is required and shall include the following:
 - a. Maximum end of lamp life hours exceeded,
 - b. Individual lamp failure indicated by address system,
 - c. Individual ballast failure indicated by address system,
 - d. Low UV intensity factory set to alarm at 45 percent of the intensity after 100 hours burn in of the lamps, adjustable at the OIT.
3. Lamps and ballasts shall be addressed by bank number, module number, and lamp or lamp pair number.
4. Critical alarms shall be displayed to indicate an alarm condition in which the UV disinfection performance may be jeopardized. Critical alarms shall include the following:
 - a. Low UV intensity alarm, preset at the factory for 25 percent of the intensity after 100 hours burn-in of the lamps, adjustable at the OIT.
 - b. Critical Instrument Failure. Failure of an instrument or communications link resulting in a control signal being lost. Critical Instrument Failure includes ground fault interruption failures when ground exceeds 10 millamperes in any UV module. This condition shall initiate a default routine in the PLC control to put all available UV lamps on to ensure that disinfection will be achieved if physically possible. Personnel and plant safety shall be maintained at all times.
 - c. Loss of flow signal.
 - d. Failure to meet minimum UV Dose.
 - e. PLC failure.
 - f. Multiple ballast failure indicated by address.
 - g. Multiple lamp failure indicated by address.
 - h. Low UV dose warning shall occur when the design dose is not being delivered. Set point shall be at the OIT.
 - i. Water level below lamp submergence level.
 - j. UV transmittance below design level.
 - k. High temperature for each module.
 - l. UV system power failure.
5. An alarm history shall be maintain by the UV control system, and at a minimum, the 100 most recent alarms shall be displayed on the OIT when prompted.

K. Data Exchange With Plant Control System.

1. The UV control system shall exchange the daily flow UV information with the existing Plant Control System.
2. The UV system supplier shall coordinate the UV control system, programming, and installation to provide a system that works with the Plant Control System. The UV system supplier shall coordinate the data transfer with the OWNER by providing a list of signals and addresses of the status and alarm data and attending a coordination meeting via teleconference with the OWNER.
3. In order to confirm that there are no issues with the communication link between the UV PLC and the Plant Control System, the UV system supplier shall program control logic that sets and resets a heartbeat bit between the control systems. If this logic fails, an alarm shall be generated to alert the operator of a failed communication link with the UV PLC. The UV system supplier shall coordinate the required logic for this communication heartbeat with the Plant Control System Integrator and/or OWNER.
4. At a minimum, the following information shall be communicated between the UV system PLC and the Plant Control System.

Discrete Data Sent To Plant Control System

- a. UV system/bank in LOCAL-MANUAL
- b. UV system/bank in LOCAL-AUTO
- c. UV system/bank in REMOTE
- d. UV bank on (each bank)
- e. Lead and lag UV bank (each unit)
- f. Lead and lag channel
- g. Channel gate in REMOTE (each gate)
- h. Channel gate fail (each gate)
- i. UV system major alarm
- j. UV system critical alarm
- k. Low UV dose warning*
- l. Failure to meet minimum UV dose*
- m. Water level below UV lamp submergence level (each channel)*
- n. UV system PLC failure
- o. Maximum lamp hours exceeded (each lamp)
- p. Lamp failure (each lamp)
- q. Ballast failure (each ballast)

*The identified alarms are critical alarms to be communicated separately to the plant control system and not included in the common critical alarm.

Discrete Data Sent From Plant Control System

- a. UV system/bank in REMOTE-MANUAL
- b. UV system/bank in REMOTE-AUTO
- c. UV bank on (each bank)
- d. UV channel inlet gate open/close

Analog Data Sent To Plant Control System

- a. UV bank elapsed time
- b. Channel outlet gate continuous position (each gate)
- c. UV intensity (each bank)
- d. UV power (each bank)
- e. Channel level (each channel)
- f. UV dose in each channel
- g. Flow

Analog Data Sent From Plant Control System

- a. UV channel water level (same setpoint for both channels)
- b. UV bank power (each bank)
- c. Log removal

L. Instrumentation

1. Instruments for monitoring and control of the UV system shall be provided and shall include UV intensity sensors for each bank, a transmittance analyzer for measurement of UV transmittance in the common inlet to the UV channels, ultrasonic level metering system for measuring level in the common inlet channel, and electrode conductance level switches for low water level for each UV channel. A bench photometer shall also be furnished to measure the UV transmittance of the effluent.
2. All instrumentation used in the UV disinfection system for control or monitoring shall be individually fused or circuit breaker protected to minimize the effects of any single point of failure. Instrumentation shall be installed in accordance with UVSS's instructions.

M. Intensity Sensor

1. The intensity sensor shall be compliant with either UVDGM, DVGW, or ONORM standards. Each UV bank shall be provided with a UV intensity sensor, mounted in the center of a representative UV module and connected to the UV control system. The UV intensity sensor shall have at least 95 percent sensitivity to only the germicidal portion of the spectrum (253.7 nm). The sensor shall not use a filter or degrade after prolonged exposure to UV light. The sensor shall be automatically cleaned at the same frequency as the lamp sleeves to prevent fouling of the sensor and hence spurious false alarms for low intensity.
2. An intensity monitor in a UV unit which has been turned off for low flow operation shall also be turned off so as to prevent the alarm from activating on the main control panel. An adjustable time delay (variable from 0-20 minutes) to bypass the alarm on start and warm-up of the lamps and system shall be provided if required to prevent nuisance alarms.

N. On-Line UV Transmittance (UVT) Sensor

1. A UVT sensor is not required.

O. Ultrasonic Level Transmitters

1. Each ultrasonic level transmitter shall be a microprocessor-based electronic unit consisting of a sensor assembly, a signal converter/transmitter, and an interconnecting cable. The sensor shall be encapsulated in a chemical and corrosion-resistant material such as kynar or CPVC and shall be suitable for operation over a temperature range of -20° to +150°F [-28° to +66°C] and a relative humidity of 10 to 100 percent. The sensor shall be compatible with the process media being measured. Sensors mounted in areas subject to freezing shall be provided with special transducers or protected against icing by heaters. Sensors mounted in direct sunlight shall be provided with sunshades.
2. The supplier shall coordinate the sensor mounting requirements and furnish drawings complete with dimensions and elevations.
3. The ultrasonic level transmitter shall have automatic compensation for changes in air temperature at the sensor location. If separate temperature sensing probes are provided, they shall be mounted with or adjacent to the ultrasonic sensor, as recommended by the manufacturer. The transmitter shall have a four-digit LCD display scaled to read in engineering units. Digit height shall be approximately 1/2 inch [12 mm]. The transmitter shall be designed to ignore momentary level spikes, false targets, or momentary loss-of-echo. A loss-of-echo condition shall be indicated on the transmitter unit and shall be available as an alarm contact output. The transmitter output shall be an isolated 4-20 mA dc signal linearly proportional to the measured level range, or where indicated on the drawings or in the Instrument Device Schedule, shall be characterized to be proportional to the tank volume. Calibration parameters shall be entered through a keypad on the unit and shall be stored in nonvolatile EEPROM memory. Accuracy of the transmitted signal shall be ± 0.5 percent of the level range.
4. A sufficient length of sensor-to-transmitter signal cable shall be furnished with the instrument to locate the sensor 25 to 200 feet [7.6 to 61 m] from the signal converter.
5. The signal converter electronics shall be housed in a weatherproof, corrosion-resistant NEMA Type 4X enclosure suitable for wall or pipestand mounting and for operating temperatures of -5° to +122°F [-20° to +50°C] and a relative humidity of 10 to 100 percent. A thermostatically controlled strip heater shall be provided in the signal converter enclosure.
6. The signal converter shall be of the ac-powered type. The ultrasonic level transmitter shall be Siemens HydroRanger 200, Endress & Hauser Prosonic, or STI/Magnetrol "Echotel 344."

P. Electrode/Conductance Relay Level Switches

1. Electrodes shall be rigid AISI Type 316 stainless steel solid rod type with a PVC outer sheath or flexible wire suspension type with shielded stainless steel electrode tips, as indicated on the drawings or in the Instrument Device Schedule. PVC spacers shall be provided at 4-foot [1.2 m] intervals of electrode length. Electrode holders shall be 4-inch [100 mm] ANSI Class 125 flange type.

2. Electrode relays shall be dual-coil or solid-state relay type with single-pole, double-throw output contacts rated not less than 5 amperes at 120 V ac. The relay primary power shall be 120 V ac, 60 Hz, single phase. Intrinsically safe solid-state relays shall be utilized whenever the electrodes are located in a hazardous area.
3. Relays shall be mounted in the System Control Panel. Electrodes and conductance relays shall be manufactured by B/W Controls or Warrick Controls.

2.06 FABRICATION

A. Fasteners

1. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel and shall be provided by the Contractor and approved by the UVSS.

B. Surface Preparation

1. All ferrous metal surfaces, except stainless steel, shall be shop cleaned by sandblasting or equivalent, conforming to the UV system supplier's recommendation. All mill scale, rust, and contaminants shall be removed before shop primer is applied.

C. Shop Painting

1. All ferrous metal surfaces, except stainless steel, shall be shop painted in accordance with Specification Section 09902 Finish Painting. Each UV disinfection system shall be factory prepared, primed, and finish-coated with the UV system supplier's standard protective coating system. Sharp corners of all rolled edges and all cut or sheared edges shall be ground to a radius as required to ensure paint adherence.

D. Stainless Steel Cleaning

1. All stainless steel shall be cleaned, chemical descaled (pickled), and passivated at the mill in accordance with ASTM A380 before being shipped. 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-welting and drying test or a ferroxyl test to detect the presence of residual embedded iron. All pickled surfaces damaged during fabrication, including welded areas, shall be repickled or passivated in accordance with ASTM A380 as required to remove all traces of iron contamination and heat tint. Vat dipping, paste, and other electrical/liquid techniques will be acceptable forms of passivation as acceptable to the Engineer. All stainless-steel surfaces shall be adequately protected during fabrication, shipping, handling, and installation to prevent contamination by contact with iron or carbon steel objects or surfaces. Blast cleaning of stainless steel will not be acceptable. Any field welds or repairs may be cleaned and passivated using hand powered tools equipped with clean stainless-steel brushes and grindery.
2. Alternative techniques during the manufacturing process to prevent contamination of stainless steel may be acceptable to the Engineer provided that the intent of the

paragraph above is met. Manufacturer shall submit a certification stating that the alternative techniques will meet the requirements described herein.

2.07 ACCESSORIES.

A. Lifting Eyes

1. All equipment weighing more than 100 pounds shall be provided with lifting eyes. Where a special lifting sling is required, it shall be furnished.

B. Safety Equipment

1. Safety equipment consisting of four (4) personnel goggles/face shields for protection against UV energy between 200 to 400 nm wavelength shall be provided. Four (4) UV area warning signs shall be provided.

C. Electrical and Control Equipment Enclosure Cooling

1. Where required by the UVSS's equipment when installed in the ambient conditions specified herein, the UVSS shall provide an air conditioning system to be installed by the Contractor, that will adequately cool the system electrical and control equipment enclosures.

2.08 FACTORY TEST

- A. All components of the UV system shall be factory tested by operating all lamps, monitoring equipment, and controls prior to shipment.
- B. The UV intensity monitor shall be calibrated to the UV system supplier's specifications. Defective equipment and controls disclosed by such tests shall be replaced and the equipment package placed in satisfactory operating condition before shipping. The UVSS shall provide written certification following factory testing. This test may be witnessed by the Owner at the expense of the Owner.

PART 3 EXECUTION

3.01 INSTALLATION AND OPERATION

- A. Equipment shall be installed and operated by, or with the guidance of an authorized representative of the UVSS. The UVSS representative shall have 2 years of experience commissioning UV systems of similar design. All equipment installed under this Contract shall be placed into successful operation according to the written instructions of the UVSS or the instructions of the UVSS's field representative.

3.02 FIELD QUALITY CONTROL

A. Installation Check

1. An experienced, competent, and authorized representative of the UVSS shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the UVSS's representative shall be present

when the equipment is placed in operation in accordance with Equipment Start-up and Testing section and as specified herein 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, is level and in accurate alignment, and has been operated satisfactorily both in manual and automatic modes.
3. All costs for these services shall be included in the contract price.

B. Pre-Commissioning

1. The Contractor shall coordinate commissioning with the Engineer. A commissioning plan shall be submitted to the Engineer one month before commissioning begins, and shall include, but not be limited to:
 - a. Initial Start Up Activities,
 - b. Verification of tags,
 - c. Verification of connections,
 - d. Instrumentation and control system checks,
 - e. Verification of UV control system with Plant Control System,
 - f. Verification of communication to Power Distribution Centers and cleaning system,
 - g. Verification of OIT operation.

C. Commissioning

1. Commissioning shall include, but not be limited to:
 - a. Testing electrical connections,
 - b. Testing control signal connections to the UVSS control panel Testing level controls.
2. Testing and calibration of instruments including:
 - a. Level switches,
 - b. UV transmittance analyzers,
 - c. UV intensity transmitter,
 - d. Level transmitters,
 - e. Temperature transmitter.
 - f. Flowmeters
3. Manual and automatic reactor/bank operation Start up sequence,
4. Normal and emergency mode shut down sequence,
5. Testing of process, equipment protective, and safety interlocks.

6. The UVSS shall start-up and operate all UVSS systems. The UVSS shall furnish materials, instruments, and incidental and expendable equipment required for commissioning the equipment.

D. Engineer's Discretionary Testing and Evaluation

1. The Engineer will direct that discretionary tests be performed to determine if the equipment is operating properly. The Engineer may require the Contractor initiate alarm conditions to determine if the control system is functioning properly.
2. The Engineer will identify any equipment that has not been properly installed and malfunctions which will require rectification before performance testing.

E. Installation Supervision

1. The UVSS shall furnish a qualified field installation supervisor during the equipment installation.
2. All costs for these services shall be included in the contract price.
3. Equipment Supplier shall include a minimum of 5 day(s) and 2 trip(s) to the site.
4. UVSS's installation supervisor shall observe, instruct, guide, and direct the installing contractor's erection or installation procedures. Supervision shall include overseeing the installation the UV lamps by the Contractor.
5. The contractor shall provide the UVSS with written notification 10 days prior to the need for such services.

3.03 EQUIPMENT ACCEPTANCE

- A. Performance testing is required before the system will be accepted by the Engineer.
- B. Scope. This section covers the performance testing for the open channel UV disinfection system.
- C. General
 1. Prior to equipment acceptance, performance tests shall be conducted on each UV reactor/bank to demonstrate the equipment meets requirements specified in the Open Channel Ultraviolet Disinfection System section. The tests shall be conducted after the equipment installation has been approved by the UVSS and the UV lamps have been operated for at least a 100-hour burn-in period. The UV banks shall be manually operated as needed before testing to meet this requirement.
 2. Performance tests shall be conducted based on conditions for flow, UV transmittance, and dose as specified, and considering degradation such as equipment aging and wear, fouling, and cleaning efficiency.
 3. Performance test scheduling shall be coordinated with the Owner and Engineer.

4. Performance testing of the UV disinfection units shall be completed before the date of Substantial Completion specified in the Agreement.
5. Performance testing shall be at the expense of the Contractor.

D. Performance Testing

1. The Owner will provide the wastewater effluent to the UV system during start up and testing. All reasonable efforts will be made by the Owner to approximate the specified flow conditions at a steady state for the duration required to allow samples to be taken.
2. The performance tests shall be under the direct supervision of the UVSS's field representative. Contactor shall supply personnel and equipment necessary to conduct the performance test.
3. The UVSS's field representative shall prepare a report on the test results. Five copies of the report shall be submitted to the Engineer within 15 days of testing. The information collected will be used as a basis for determining UV system acceptance.

E. Field Testing

1. Each module shall be tested separately. Testing shall be at the design dose at conditions to simulate reduced power simulating end of lamp life UV output.
2. The lamps shall be cleaned as recommended by the UVSS for the duration of the test. Manual cleaning will not be allowed during the performance testing period.
3. UV banks shall be tested at the peak and average daily flow rates based on a flow rate per lamp basis. Testing shall be as follows:
 - a. Each bank shall be tested individually at the design flow rate/lamp and at the average daily flow/lamp.
 - b. One channel shall be tested with the control system in automatic setting at average daily flow/lamp.
4. Adjustment shall be made to power output of lamps for variations in transmittance so that the design dose is delivered during the test. Test durations at each flow rate shall be approximately 2 hours. Samples shall be collected every ½ hour at the influent and effluent of the system tested, with the first sample taken after the system warm up period. The microbial results for all samples collected from the tests on all UV banks, will serve as the basis for determination of acceptance of the equipment. All test results shall be less than performance requirements described in Open Channel Ultraviolet Disinfection System section.
5. Owner reserves the right to conduct additional sampling and testing at any time at Owner's expense without providing advance notification to the UVSS.

6. Data for each sample shall include, but not limited to the following:
 - a. The flow and detention time through the UV disinfection unit at the time of sampling. Detention time shall be calculated from flow and volume of the UV channel minus the volume occupied by the submerged UV equipment.
 - b. The number of UV lamps in operation at the time of testing. The measured UV dose in $\mu\text{W}\cdot\text{sec}/\text{cm}^2$.
 - c. The microbial count per 100 mL in the UV system influent and effluent. The total suspended solids concentration in the UV system influent.
 - d. The percent transmittance at a wavelength of 254 nm in the UV system effluent.
 - e. The UV lamp intensity measured by online instrumentation in $\mu\text{W}\cdot\text{cm}^2$ at a distance of 1 centimeter and as a percentage of UV intensity range.
 - f. Water surface elevations in each channel upstream and downstream of the reactor.
7. Additional data shall be obtained as necessary to demonstrate compliance with Open Channel Ultraviolet Disinfection System section.
8. The following data shall be collected on the first UV system influent sample on the first day of testing:
 - a. pH
 - b. Hardness
 - c. Calcium
 - d. Total dissolved solids (TDS)
 - e. Iron
 - f. Water temperature
9. Electrical power consumption shall be measured and recorded continuously during performance testing for verification of the power consumption of the UV system. Power consumption shall be measured by a temporary recording watt meter or data logging system. Plot of system power consumption (kWh operating and kW demand), versus flow rate (mgd) during the previous 24-hour period shall be prepared by the UV equipment supplier.
10. Data recorded shall be provided to the Engineer in a Microsoft Excel spreadsheet in hard copy.

F. Sample Collection and Analysis

1. Sample collection and analysis shall be by an independent, state-certified, Owner-approved testing laboratory. Sample collection, handling, and analysis shall be in accordance with the procedures described in the latest edition of "Standard Methods for the Examination of Water and Wastewater" and 40 CFR Part 136 procedures for effluent testing. In any event, the temperature of samples shall be held below 4°C

during a maximum transport time of 2 hours. Samples shall be refrigerated upon receipt in the laboratory and processed within 2 hours.

2. The Engineer and Owner will review the performance test report and will notify the UVSS in writing of UV system acceptance.
3. If after the second, and any subsequent retests allowed, the equipment does not meet the performance requirements, the Owner will select one of the following courses of action:
 - a. Allow the UVSS to make additional modifications and retesting.
 - b. Accept the UV equipment without conditions and issue a written notice that the UV equipment is acceptable.
 - c. Reject the equipment and require the UVSS to remove all equipment from the site, with the UVSS refunding all payments received and compensating Owner for cost of a replacement system.

3.04 PERSONNEL TRAINING

- A. An experienced, competent, and authorized representative of the UVSS shall train the Owner's personnel in operating, maintaining, and repairing the equipment specified in this section. All training shall be conducted at the Owner's location. Training shall commence as mutually agreed to by the Owner, Engineer, Contractor, and UVSS. The scheduled hours for training shall be coordinated with the Owner. The UVSS shall maintain a record of the individuals that have completed training and provide information required for the documentation of Professional Development Hours required by the Owner.
- B. Training sessions may be videotaped by the Owner at the Owner's expense.
- C. The UVSS shall provide required materials, texts, handouts, and supplies. Training material shall be provided to the Owner in written and electronic format. Training materials shall be submitted for review with the O&M manuals.
- D. The UVSS shall provide a combination of classroom and hands-on training. The following training shall be provided.

Type of Training	Number of Shifts	Number of Participants	Classroom Training (Hours)	Hands-On Training (Hours)
UV Disinfection System	1	4	2	4
Mechanical Equipment	1	4	2	4
Electrical, Instrumentation, and Control Equipment	1	4	4	4

- E. Hands-on training shall reinforce classroom training through a demonstration of equipment operation and maintenance procedures. Hands-On Training shall be limited to groups of 8. In the event that more than 8 personnel are to be trained, multiple hands-on training sessions shall be conducted.
- F. Types of training specified above shall include the following:
 - 1. UV Disinfection System
 - a. UV disinfection theory
 - b. UV disinfection system overview
 - c. UV disinfection reactors, banks, modules and lamps
 - d. UV disinfection processes (start up, shut down, flow and dose pacing)
 - e. Maintenance
 - 2. Mechanical Equipment Training
 - 3. Electrical, Instrumentation, Control System
 - a. Electrical equipment operation and maintenance,
 - b. Control system equipment,
 - c. OIT operation,
 - d. Instrumentation calibration and maintenance.

3.05 SERVICE PLAN

- A. The equipment identified in this Specification shall be supplied with a Service Plan. As part of that Service Plan, an experienced, competent, and authorized representative of the UVSS shall perform yearly 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, and address any questions from the Owner. The supply and installation of replacement parts is not included as part of the Maintenance Plan.

END OF SECTION

SECTION 11280

SLIDE GATES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install, complete and ready for operation and field test stainless steel slide gates or approved composite slide gates, operators, operating stems, and appurtenances as shown on the Drawings and as specified herein.
- B. The gates and appurtenances shall be supplied in accordance with the latest edition of AWWA C561-21 Standard for Fabricated Stainless Steel Slide Gates as modified herein. The allowable leakage rate for the stainless-steel gates in this specification shall be 1/2 the allowable leakage listed in the latest revision of AWWA C561-21.
- C. This Specification describes fabricated stainless steel slide gates with full aperture closure, designed for either seating or unseating head. Manual operators shall be furnished for all gates.

SLIDE GATE SCHEDLE									
Gate No.	Width ^a (in.)	Height ^a (in.)	Frame Type ^b	Head Condition/ Max WSE	Invert Elevation	Operator	Normal Position	Operating Floor Elevation	Sheet Number
Headworks									
SG-01	72	96	FB/SC	1147.20	1138.50	Electric	Open	1148.50	MA-3
SG-02	72	96	FB/SC	1147.20	1138.50	Electric	Open	1148.50	MA-3
SG-03	72	96	FB/SC	1147.20	1138.50	Electric	Open	1148.50	MA-3
SG-04	72	96	FB/SC	1147.20	1138.50	Electric	Open	1148.50	MA-3
SG-05	44	96	FB/SC	1147.20	1136.50	Electric	Open	1148.50	MA-3
SG-06	44	96	FB/SC	1147.20	1136.50	Electric	Open	1148.50	MA-3
SG-07	72	96	FB/SC	1147.20	1138.50	Manual	Closed	1148.50	MA-3
SG-08	72	96	FB/SC	1147.20	1138.50	Manual	Closed	1148.50	MA-3
Secondary Clarifier Distribution Box									
SG-09	36	36	FB/SC	1135.13	1115.50	Manual	Open	1139.00	MD-1
SG-10	30	30	FB/SC	1135.13	1124.87	Manual	Open	1139.00	MD-1
SG-11	36	36	FB/SC	1135.13	1115.50	Manual	Open	1139.00	MD-1
UV Channel									
SG-12	44 ^c	60	FB/SC	1127.24	1120.38	Electric	Open	1129.38	MH-1
SG-13	44 ^c	60	FB/SC	1127.24	1120.38	Electric	Open	1129.38	MH-1
Post Aeration									
SG-14	48	48	FB/SC	1124.19	1109.00	Manual	Open	1129.38	MH-1
SG-15	48	48	FB/SC	1124.19	1109.00	Manual	Open	1129.38	MH-1
SG-16	48	48	FB/SC	1124.19	1109.00	Manual	Open	1129.38	MH-1
SG-17	48	48	FB/SC	1124.19	1109.00	Manual	Open	1129.38	MH-1
^a Wall Opening Dimensions ^b FB - Flush Bottom, EMB - Embedded, SC - Self-contained ^c Width may vary depending on the UV Equipment Supplied									

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. Section 15160 – Electric Actuators

1.04 REFERENCE STANDARDS

- A. ASTM International (ASTM), latest edition:
 - 1. ASTM A48 Standard Specification for Gray Iron Castings
 - 2. ASTM A126 Standard Specifications for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - 3. ASTM A249 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - 4. ASTM A276 Standard Specification for Stainless Steel Bars and Shapes
 - 5. ASTM A480 Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
 - 6. ASTM B26 Standard Specification for Aluminum-Alloy Sand Castings
 - 7. ASTM B98 Standard Specification for Copper Silicon- Alloy Rod, Bar and Shapes
 - 8. ASTM B584 Standard Specification for Copper Alloy Sand Castings for General Applications

9. ASTM D2000 Standard Classification System for Rubber Products in Automotive Applications
10. ASTM D4020 Standard Specification for Ultra-High-Molecular-Weight Polyethylene Molding and Extrusion Materials
11. ASTM F593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
12. ASTM F594 Standard Specification for Stainless Steel Nuts

B. American Water Works Association (AWWA), latest edition:

1. AWWA C561 Standard for Fabricated Stainless Steel Slide Gates
2. AWWA C540 Power-Actuating Devices for Valves and Slide Gates
3. AWWA C563 Standard for Composite Slide Gates

C. 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 copies of all materials required to establish compliance with this Section. Submittals shall include the following:

1. Complete bill and description of all materials,
2. Certified shop and installation drawings showing all details of construction including dimensions of the gate opening, material thickness, dimensions, tolerances, clearances, and anchor bolt locations,
3. Descriptive literature, bulletins and/or catalogs of the equipment,
4. Design calculations for the gate and actuator. Calculations shall identify loading conditions, anchorage, and shall verify that stresses and deformations will not impair operation and are within specification requirements. These calculations shall be stamped by a professional engineer experienced in gate design.

B. Operating and maintenance instructions shall be furnished as provided for in Section 01782, Operating and Maintenance Data. The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc, that are required to instruct operating and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include trouble shooting data and full preventive maintenance schedules.

C. Provide a Statement of Conformance letter stating conformance to the Drawings and Specifications with all exceptions noted. Statement of conformance must be signed by an individual authorized to make such statements. Omission of the Statement of

Conformance letter or failure to note all exceptions to the Drawings and Specifications is justification for submittal rejection.

1.06 QUALITY ASSURANCE

- A. All equipment specified under this Section shall be furnished by a single manufacturer, unless specifically noted otherwise, who is fully experienced, reputable and qualified in the manufacture of the equipment furnished. The slide gates, operators, operating stems, wall thimbles and all related equipment shall be designed, manufactured and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings.
- B. All equipment furnished under this Section shall be new and unused and shall be the standard products of manufacturers having a successful record of manufacturing and servicing the equipment and systems specified here in.
- C. The gate, slide, and frame shall be fabricated to within 1/8-inch squareness, flatness, and dimensional tolerance with respect to gate opening. All bolt holes shall be accurately located to mounting patterns indicated on the drawings and shall be drilled or punched and free of all burrs and defects. All machined parts shall be accurately machined with interchangeable parts, so that replacement parts can be provided at any time and replaced in the field with minimal effort. All parts shall conform to the design dimensions and shall be free from defects in material and workmanship. Castings shall be clean, sound, and without defects that could impair their function.
- D. Services of Manufacturer's Representative
 - 1. A factory representative who has complete knowledge of proper operation and maintenance shall be provided for one 4-hour day (exclusive of travel time) to instruct representatives of the Owner on the proper operation and maintenance of the equipment. This day is in addition to the time required under Part 3 of these documents for Inspection and Testing.
 - 2. If there are difficulties in operation of the equipment due to the manufacturer's fabrication or the Contractor's installation, additional service shall be provided at no change in Contract Price or Time.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Slide Gates
 - 1. Slide gates and thimbles shall conform to the standard requirements for fabricated stainless steel slide gates, ANSI/AWWA C561 or for composite slide gates ANSI/AWWA C563, except as otherwise specified herein, and shall have the characteristics and dimensions shown on the drawings and listed in the Slide Gate Schedule in this Specification.

2. The fabricated stainless steel slide gates shall be manufactured by WACO Environmental Products, Baltimore MD, Hydro Gate, Denver CO, Whipps Inc., Athol MA; Golden Harvest Inc., Burlington, WA; Fontaine USA Inc., Bedford New Hampshire; Waterman Valve, Exeter California; or prior approved equal. Composite slide gates shall be manufactured by Alfa-Laval, Houston Texas, no equals. The named manufacturers' standard products may or may not conform to this Section, and in case of conflict between this Section and a manufacturer's standard products, this Section shall have precedence.
3. When the width of the gate opening in feet multiplied by the maximum design head in feet is less than 100 square feet the portion of the slide member that engages the guide shall be 1/4" thick. When the width of the gate opening in feet multiplied by the maximum design head in feet is between 100-140 square feet the portion of the slide member that engages the guide shall be 1/2" thick. When the width of the gate opening in feet multiplied by the maximum design head in feet is greater than 120 square feet, the portion of the slide that engages the guide members shall be of a "thick edge" design.
4. The gates shall be self-contained; rising stem unless otherwise noted, fabricated of 316 stainless-steel having a minimum thickness of 1/4-inch, and shall be designed to have adequate strength to prevent distortion in handling and placing and under any condition of service outlined herein. All metal used in the fabrication of these gates shall be Type 316 stainless steel.
5. Finish: Mill finish on stainless steel. Welds shall be sandblasted to remove weld burn and scale. All iron and steel components shall be properly prepared and shop coated with a primer.
6. Leakage: Under the design head, seating and unseating, leakage shall not exceed 0.05 gpm/ft of seating perimeter. Leakage for all sizes shall be below that allowed by AWWA C561 standards for fabricated stainless steel slide gates.
7. All welds shall be performed by welders with AWS D1.6 certification.

8. Materials:

Components	Materials
Frame, Guides, Yoke, & Slide	Stainless Steel, Type 316, ASTM A-240
Invert and Stiffeners	Stainless Steel, Type 316, ASTM A-276
Stem & Stem Guides	Stainless Steel, Type 316, ASTM A-276
Stem Couplings	Stainless Steel, Type 316, ASTM A-276
Invert Seal, Crown Seal	Neoprene ASTM D-2000
Seats	Ultra-High Molecular Weight Polyethylene ASTM D4020
Wedges	Stainless Steel, Type 316, ASTM A-276 or UHMW Polyethylene ASTM D4020
Thrust Nuts, Stop Nuts, & Lift Nuts	Bronze ASTM B584
Stem Block	Stainless Steel, Type 316, ASTM A-240
Pedestal & Gear Housing	Stainless Steel, Type 316, ASTM A-276
Gears	Steel – AISI 8620
Anchor Bolts and Fasteners	Stainless Steel, Type 316, ASTM A-276

2.02 OPERATORS

- A. Slide gate operators shall conform to the standard requirements of ANSI/AWWA C561-21, except as otherwise specified herein, and shall have the characteristics and dimensions shown on the drawings and listed in the Slide Gate Schedule in this Specification.
- B. The maximum effort on the handwheel is to be limited to less than a 40 lb. pull. The lift mechanism will be capable of withstanding an effort of up 200 lbs. or more without damage to the operator, stem or gate frame. Manually operated gates are to be supplied with adjustable stop collars as required to set the gate opening range.
- C. Gates shall be operated by a stand mounted or frame mounted manual hand crank operator unless otherwise specified.
- D. A side mount or front mount operator system utilizing right angle bevel boxes, stainless steel interconnecting shafting, and flexible couplings shall be furnished by the manufacturer when the stand is located over 48-inches above the operating floor. The transmission system design shall provide for the gate to be operated from a position 30-inches above the operating floor.
- E. Floor stands shall be furnished for all gate operators not supported on the gate yoke. Floor stands shall be fabricated stainless steel construction. The pedestal height shall be such that the crank shaft will be approximately 36-inches above the operating floor. Floor stands shall be mounted on the floor surface and align with the gate stem. The anchor bolts shall be sized to transfer the upward or downward thrust required to ultimately fail the stainless-steel stem. The design and detail of the brackets and anchor bolts shall be provided by the gate manufacturer and shall be approved by the Engineer. The bracket, anchors, backplate and accessories shall be supplied as part of the gate assembly by the gate manufacturer.

- F. Operators shall be equipped with fracture resistant clear butyrate plastic stem covers which shall not discolor or become opaque for a minimum of 5-years after installation. The top of the stem cover shall be closed. The bottom end of the stem cover shall be mounted in a housing or adapter plate for easy field mounting. Stem covers shall be complete with indicator markings to indicate gate position.
- G. An arrow with the word "OPEN" shall be permanently attached or cast onto the operator to indicate the direction or rotation to open the gate. The direction of rotation to open shall be clockwise.
- H. A threaded operating stem shall be utilized to connect the operating mechanism to the slide. On rising stem gates, the threaded portion shall engage the operating nut in the manual operator or motor actuator. The threaded portion of the stem shall have machine rolled threads of the full Acme type with a 16-microinch finish or better. Stub threads or cut threads are not acceptable.
- I. All gates having widths greater than twice their height shall be provided with two lifting devices connected by a tandem shaft for simultaneous operation. Cross shafting shall be stainless steel. Flexible couplings shall be provided at each end of the cross shafting. Operators shall be crank operators as specified above, joined together such that operating a crank on one will cause both operators to move together.
- J. All manual operators shall include provisions for operation with portable electrical operators. One electric powered portable operator shall be furnished as a part of this Contract.

2.03 SURFACE PREPARATION

- A. As required all surfaces shall be prepared as part of the work of this Section. Surface preparation shall be as specified in Division 9.
- B. The only items requiring protective coating are carbon and alloy steels, exposed to weather.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation of all gates, guides and appurtenances shall be done in a workmanlike manner. It shall be the responsibility of the Contractor to handle, store and install the equipment specified in this Section in strict accordance with AWWA C561-21 and with the manufacturer's drawings and recommendations.
- B. Frames and guides shall be installed in a true vertical plane and shall be installed with 90-degree corners.

3.02 INSPECTION AND TESTING

- A. Furnish the services of a factory representative for 1-day, who has complete knowledge of the proper installation, startup and operation of the slide gates, to inspect the final installation and supervise testing of the equipment.
- B. After installation, all slide gates shall be field tested to ensure that all items of equipment are in compliance with this Section, including the leakage requirements. Each gate shall be cycled through a minimum of three consecutive full open/close cycles. Gates shall operate without binding, scraping, or distorting. The effort to open and close manual operators shall be measured and shall not exceed the maximum torque specified above. Electric motor and operators shall function smoothly and without interruption. Each gate shall be given a hydrostatic test to insure that leakage does not exceed the limits specified above.
- C. In the event that any unit fails to meet the above requirements, the necessary changes shall be made, and the unit retested. If the unit remains unable to meet the test requirements to the satisfaction of the Engineer, it shall be removed and replaced with a satisfactory unit and retested at no change in Contract Price or Time.

3.03 WARRANTY

- A. Fabricated Stainless Steel Slide Gates shall be guaranteed by the Manufacturer for a period of not less than two (2) years from the date of Substantial Completion. The Manufacturer shall guarantee during this period that leakage shall be no more half of that allowed by ANSI/AWWA C561 and that the gate shall operate freely.
- B. Composite Slide Gates shall be guaranteed by the Manufacturer for a period of not less than ten (10) years from the date of Substantial Completion. The Manufacturer shall guarantee during this period that leakage shall be no more than that allowed by ANSI/AWWA C563 and that the gate shall operate freely with no required exercising.
- C. The warranty shall cover the entire gate assembly including seals and fabricated components.
- D. Gate Operators shall be covered by the operator manufacturer's standard warranty which shall cover the equipment for a minimum of 2 years.
- E. Should an issue occur during the warranty period, the Manufacturer shall repair or replace the gate at no cost to the Owner.

END OF SECTION

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SECTION 11282

WEIR GATES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required and install complete, weir gates, operators, operating systems and appurtenances as shown on the Drawings and as specified herein.
- B. The gates and appurtenances shall be supplied in accordance with the latest edition of AWWA C561-21 Standard for Fabricated Stainless Steel Slide Gates as modified herein. The allowable leakage rate for the stainless-steel gates in this specification shall be 1/2 the allowable leakage listed in the latest revision of AWWA C561-21.

Gate Schedule:

WEIR GATE SCHEDULE									
Gate No.	Width ^a (in)	Height ^b (in)	Frame Type	Head Condition/ Max WSE	Invert Elevation	Operator	Operating Floor Elevation	Normal Position	Sheet No.
Wet Weather Diversion Structure									
WG-01	72	60	Surface Mounted Self-Contained	1142.50	1138.00	Electric	1148.50	Open	MA-3
WG-02	72	60	Surface Mounted Self-Contained	1142.50	1138.00	Electric	1148.50	Open	MA-3
WG-03	48	36	Surface Mounted Self-Contained	1144.00	1141.00	Manual	1148.50	Open	MA-3
BNR Basin									
WG-04	96	60	Surface Mounted Self-Contained	1136.65	1132.00	Manual	1138.50	Open	MB-1
WG-05	96	60	Surface Mounted Self-Contained	1136.65	1132.00	Manual	1138.50	Open	MB-1
WG-06	96	60	Surface Mounted Self-Contained	1136.90	1132.00	Electric	1138.50	Open	MB-1
WG-07	96	60	Surface Mounted Self-Contained	1136.90	1132.00	Electric	1138.50	Open	MB-1
Aeration Basin									
WG-08 ^c	12	12	Surface Mounted Self-Contained	1135.42	1134.50	Manual	1137.50	Open	MC-1
WG-09 ^c	12	12	Surface Mounted Self-Contained	1135.42	1134.50	Manual	1137.50	Open	MC-1

WEIR GATE SCHEDULE, CONTINUED									
Gate No.	Width ^a (in)	Height ^b (in)	Frame Type	Head Condition/ Max WSE	Invert Elevation	Operator	Operating Floor Elevation	Normal Position	Sheet No.
Filter Cells									
WG-10	120	36	Surface Mounted Self-Contained	1130.00	1128.00	Electric	1133	Open	MH-1
WG-11	120	36	Surface Mounted Self-Contained	1130.00	1128.00	Electric	1133	Open	MH-1
WG-12	120	36	Surface Mounted Self-Contained	1130.00	1128.00	Electric	1133	Open	MH-1
WG-13	120	36	Surface Mounted Self-Contained	1130.00	1128.00	Electric	1133	Open	MH-1
UV Channel									
WG-14 ^d	44	84	Surface Mounted Self-Contained	1127.24	1120.38 ^e	Electric	1129.38	Open	MH-1
WG-15 ^d	44	84	Surface Mounted Self-Contained	1127.42	1120.38 ^e	Electric	1129.38	Open	MH-1
^a Wall Opening Dimensions ^b Gate Panel Height ^c Supplied by Owner. ^d Supplied as part of the UV Equipment Package, width may vary based on UV equipment supplied ^e Structure Floor Elevation 1116.00'									

- C. Operators shall be furnished for all gates.

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 9 – Finished Coating
- C. Section 11243 – Pile Cloth Media Filter
- D. Section 11260 – UV Disinfection System
- E. Section 15160 – Electric Actuators

1.04 REFERENCE STANDARDS

- A. ASTM International (ASTM), latest edition:
 - 1. ASTM A126 Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings
 - 2. ASTM A240 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - 3. ASTM A276 Standard Specification for Stainless Steel Bars and Shapes
 - 4. ASTM A380 Standard Practice for Cleaning, Descaling, and Passivation of Stainless-Steel Parts, Equipment, and Systems
 - 5. ASTM A480 Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
 - 6. ASTM B26 Standard Specifications for Aluminum-Alloy Sand Castings

7. ASTM B98 Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes
8. ASTM B584 Standard Specification for Copper Alloy Sand Castings for General Applications
9. ASTM D2000 Standard Classification System for Rubber Products in Automotive Applications
10. ASTM D4020 Standard Specification for Ultra-High-Molecular-Weight Polyethylene Molding and Extrusion Materials
11. ASTM F593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
12. ASTM F594 Standard Specification for Stainless Steel Nuts

B. American National Standards Institute (ANSI), latest edition:

1. ANSI/AWWA C540 Power-Actuating Devices for Valves and Slide Gates
2. ANSI/AWWA C561 Fabricated Stainless Steel Weir Gates

C. Factory Mutual (FM), latest edition

D. Underwriters Laboratories (UL), latest edition

E. 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, copies of all materials required to establish compliance with the Section. Submittals shall include:
- B. Complete description of all materials,
- C. Certified shop and installation Drawings showing all details of construction, including dimensions, material thickness, tolerances, clearances, and anchor bolt locations,
- D. Descriptive literature, bulletins and/or catalogs of the equipment,
- E. A complete bill of materials,
- F. The weight of each component,
- G. Design calculations for the gate and actuator. Calculations shall identify loading conditions, anchorage, and shall verify that stresses and deformations will not impair operation and are within specification requirements. These calculations shall be stamped by a Professional Engineer experienced in gate design.

- H. In the event it is not possible to conform to certain details of this Section, describe completely all non-conforming aspects.
- I. Operation and Maintenance Data
- J. Operating and maintenance instructions for each type of equipment shall be furnished to the Engineer as provided for in Section 01782, Operation and Maintenance Data.

1.06 QUALITY ASSURANCE

- A. The weir gates, operators, operating stems, and appurtenances specified under this Section shall be furnished by manufacturers who are fully experienced, reputable, and qualified in the manufacture of the equipment furnished. The weir gates, stop plates, operators, operating stems, and all related equipment shall be designed, constructed, and installed in accordance with the best practices and methods.
- B. All equipment furnished under this Section shall be new and unused and shall be the standard products of the manufacturer.
- C. The gate, slide, and frame shall be fabricated to within 1/8-inch squareness, flatness, and dimensional tolerance with respect to the gate opening. All bolt holes shall be accurately located to mounting patterns indicated in the drawings and shall be drilled or punched and free.

PART 2 PRODUCTS

2.01 STAINLESS-STEEL WEIR GATES

- A. The weir gates shall have the characteristics and dimensions as shown on the drawings and specified in the Gate Schedule in this Specification.
- B. The weir gates shall be manufactured by Fontaine USA, Hydro Gate, Whipps, Golden Harvest, Waterman Valve, or approved equal. The named manufacturers' standard products may or may not conform to this Section, and in case of conflict between this Section and a manufacturers' standard product, this Section shall have precedence.
- C. The stainless-steel weir gates and accessories shall be fabricated Type 316 stainless steel, self-contained type with the gate arranged to lower or raise to open and with the guides designed to mount on the face of, or embedded in concrete. All gates are to be designed and manufactured to meet or exceed all AWWA C561-21 "Standard for Fabricated Stainless-Steel Weir Gates" specifications, including those defining allowable leakage, head and loading calculations, structural strength and deflection requirements, and material specifications and minimum dimensions.
- D. The guides shall be of Type 316 stainless steel construction. The guides shall be designed for maximum rigidity, shall have a thickness of not less than 1/4-inch and will be provided with holes for anchor bolts for face mounted units or embedding keyways for embedded units. Guides shall require no additional reinforcing where it extends above the operating floor to support the operator.

- E. A self-adjusting UHMW seal or hollow bulb "J" or "P" seal will be attached with stainless steel strips and attaching bolts. The seal shall be arranged so that it will deflect a minimum of 1/16-inch. All seats and seals shall be field replaceable without the need to remove the frame from the wall. Angle, strips, and bolts shall be the same material as the guides.
- F. The operating stem shall be Type 316 stainless steel construction with a minimum diameter of 1 1/2-inch designed to withstand at least twice the rated output of the operator. The threaded portion shall be machine rolled and shall have full depth Acme threads, polished to a 16 micro-inch finish or better. The slenderness ratio (l/r) shall be less than 200.
- G. Where the guides extend above the operating floor, they shall be sufficiently strong so that no further reinforcing will be required. Where required, the yoke to support the operating bench stand will be formed by two (2) angles or channels welded at the top of the guides to provide a one-piece rigid frame. The arrangement of the yoke will be such that the disc and stem can be removed without disconnecting the yoke.
- H. The disc or sliding member shall be of Type 316 stainless steel construction with a minimum thickness of 1/4-inch. When the width of the gate opening in feet multiplied by the maximum design head in feet is less than 100 square feet the portion of the gate member that engages the guide shall be 1/4" thick. When the width of the gate opening in feet multiplied by the maximum design head in feet is between 100-140 square feet the portion of the slide member that engages the guide shall be 1/2" thick. When the width of the gate opening in feet multiplied by the maximum design head in feet is greater than 120 square feet, the portion of the slide that engages the guide members shall be of a "thick edge" design. The disc shall not deflect more than 1/360 of the span of the gate, under the design head. Reinforcing ribs shall extend vertically, adjacent to the guides or into the guides so that they overlap the seating surface of the guide. A specially molded resilient invert seal shall be mounted on the bottom of embedded unit discs or on the edge of the disc to provide flush bottom closure. The invert seal shall be mechanically fastened. The shape of the seal shall produce a seating surface having a minimum width of 3/4-inch and the seal shall extend into the secondary slot of the guide. The vertical face of the seal shall be in contact with the seating surface of the guide to provide a proper seal at the corners. Reinforcements, retainer and bolts shall be of the same material as the disc. The invert of embedded unit frames shall have an angle welded to the lower ends of the guides to form a seating surface for a resilient seal mounted on the disc. Angle shall be of the same material as the guides.
- I. All welded stainless-steel components shall be mechanically passivated in accordance with ASTM A380.
- J. All welds shall be performed by welders with AWS D1.6 certification.
- K. All structural parts of the gate shall have a minimum thickness of 1/4-inch.
- L. All necessary attaching bolts and anchor bolts shall be Type 316 stainless steel and shall be furnished by the weir gate manufacturer. Anchor bolts shall have a minimum diameter of 1/2-inch.

2.02 OPERATORS

- A. Slide gate operators shall conform to the standard requirements of ANSI/AWWA C561, except as otherwise specified herein, and shall have the characteristics and dimensions shown on the drawings and listed in the Weir Gate Schedule in this Specification.
- B. The maximum effort on the handwheel is to be limited to less than a 40 lb. pull. The lift mechanism will be capable of withstanding an effort of up to 200 lbs. or more without damage to the operator, stem or gate frame. Manually operated gates are to be supplied with adjustable stop collars as required to set the gate opening range.
- C. Gates shall be operated by a stand mounted manual hand crank operator unless otherwise specified.
- D. Floor stands shall be furnished for all gate operators not supported on the gate yoke. Floor stands shall be fabricated stainless steel construction. The pedestal height shall be such that the crank shaft will be approximately 36-inches above the operating floor. Floor stands shall be mounted on the floor surface and align with the gate stem. The anchor bolts shall be sized to transfer the upward or downward thrust required to ultimately fail the stainless-steel stem. The design and detail of the brackets and anchor bolts shall be provided by the gate manufacturer and shall be approved by the Engineer. The bracket, anchors, backplate and accessories shall be supplied as part of the gate assembly by the gate manufacturer.
- E. Operators shall be equipped with fracture resistant clear butyrate plastic stem covers which shall not discolor or become opaque for a minimum of 5-years after installation. The top of the stem cover shall be closed. The bottom end of the stem cover shall be mounted in a housing or adapter plate for easy field mounting. Stem covers shall be complete with indicator markings to indicate gate position.
- F. An arrow with the word "OPEN" shall be permanently attached or cast onto the operator to indicate the direction or rotation to open the gate. The direction of rotation to open shall be clockwise.
- G. All gates having widths greater than twice their height shall be provided with two lifting devices connected by a tandem shaft for simultaneous operation. Cross shafting shall be stainless steel. Flexible couplings shall be provided at each end of the cross shafting. Operators shall be crank operators as specified above, joined together such that operating a crank on one will cause both operators to move together.
- H. On gates as shown, provide nonrising stem type operators consisting of a stem with 2-inch square nut on top mounted in a cast iron floor box set in the concrete floor above the gate. Provide one tee wrench for each gate.
- I. All manual operators shall include provisions for operation with portable electrical or gasoline engine operators.

2.03 SURFACE PREPARATION

- A. As required all surfaces shall be prepared as part of the work of this Section. Surface preparation shall be as specified in Division 9.

- B. The only items requiring protective coating are carbon and alloy steels, exposed to weather.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation of all gates and guides shall be done in a workmanlike manner. Handle, store and install the equipment specified in this Section in strict accordance with the manufacturer's drawings and recommendations. Frames and guides shall be installed in a true vertical plane and shall be installed with 90-degree corners.
- B. Gates with embedded guides and inverts shall be installed in accordance with the recommendations of the manufacturer subject to the Engineer's approval.
- C. The installation of all gates shall be under the supervision of a representative of the manufacturer furnishing the gates.

3.02 FIELD TESTING

- A. Furnish the services of a factory representative, who has complete knowledge of proper operation and maintenance to inspect the final installation and supervise a test of the equipment.
- B. After installation, all weir gates shall be field tested at maximum differential head to ensure that all items of equipment are in compliance with this Section, including the leakage requirements.
- C. Maximum allowable leakage for weir gates and weir gates shall be 0.1 gpm/ft of perimeter under the design seating head or unseating head.
- D. In the event that any unit fails to meet the above requirements, the necessary changes shall be made, and the unit retested. If the unit remains unable to meet the test requirements to the satisfaction of the Engineer, it shall be removed and replaced with a satisfactory unit at no additional cost to the Owner.

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SECTION 11310

SUBMERSIBLE PUMPS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals to install submersible pumps at the Bentonville WRRF. Pumps shall be tested and ready for operation and with all accessories 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 01171 – Electric Motors
- B. Section 01782 – Operation and Maintenance Data
- C. Division 2 – Site Work
- D. Division 3 – Concrete
- E. Section 05500 – Miscellaneous Metals
- F. Division 9 – Finishes
- G. Division 13 – Special Construction
- H. Division 15 – Mechanical
- I. Division 16 – Electrical

1.04 REFERENCE STANDARDS

- A. American National Standard Institute (ANSI)
- B. American Bearing Manufacturers Association (ABMA)
- C. National Electrical Manufacturers Association (NEMA)
- D. National Electrical Code (NEC)
- E. Factory Mutual (FM)
- F. Underwriters Laboratories (UL)
- G. Hydraulic Institute (HI)
- H. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 SYSTEM DESCRIPTION

- A. Pumps furnished under this Section shall be the product of a single manufacturer. Design criteria for the pumps is included in Part 4, Equipment Schedules.
- B. The rated horsepower of the drive unit shall be such that the unit will not be overloaded, nor the service factor reduced when the pump is operated at any point on the pump's capacity curve. If, due to the slope of the pump's performance curve, a drive unit of greater horsepower than specified is required to meet this condition, the pump will be considered for approval only if any and all changes in electrical work, etc, required by such a change will be provided at no additional cost to the Owner and be to the satisfaction of the Engineer.

1.06 SUBMITTALS

- A. Submit, in accordance with Section 01300, Submittals, copies of all materials required to establish compliance with this Section. Submittals shall include the following:
 - 1. Certified shop and erection drawings showing all important details of construction, dimensions, and anchor bolt locations,
 - 2. Descriptive literature, bulletins and/or catalogs of the equipment,
 - 3. Data on the characteristics and performance of the pumps. Data shall include guaranteed performance curves, based on actual shop tests of duplicate units, which show that they meet the specified requirements for head, capacity, efficiency, allowable NPSH, allowable suction lift and horsepower. Curves shall be submitted on 8 1/2-inch by 11-inch sheets. Curves for variable speed pumps shall be provided with at least five curves plotted from maximum rpm to minimum rpm,
 - 4. The total weight of the equipment including weight of the single largest item,

5. A complete total 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. Include gaskets, packing, etc. on the list. List the bearings by the bearing manufacturer's numbers only,
7. A statement indicating bearing life,
8. Complete data on motors and power factor correction capacitors (if required) in accordance with Section 01171, Electric Motors,
9. Complete description of surface preparation.

B. Operation and Maintenance Data

1. Copies of an operating and maintenance manual for each size pump shall be furnished to the Engineer as provided for in Section 01782, Operation and Maintenance Data. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.
2. A technical representative, from the respective pump manufacturer who has complete knowledge of proper operation and maintenance shall be provided as specified herein. Qualification of Service Engineer shall be submitted for approval. Man-day requirements listed are exclusive of travel time and do not relieve the Contractor of obligation to provide sufficient service to place equipment in satisfactory operation. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner.
 - a. Installation: to assist in the proper installation of base elbows, anchor bolts, guide rails, and coordination of piping: one (1) 8-hour day.
 - b. Start-up, testing and calibration: two (2) 8-hour days.
 - c. Operation, maintenance, startup, shutdown, troubleshooting, lubrication, and safety instruction: one (1) 8-hour day.

1.07 DESIGN REQUIREMENTS

- A. All equipment included herein is intended to be standard for submersible use in wastewater.
- B. The design criteria for the pumps is included in Part 4 Equipment Schedule.

1.08 WARRANTY

- A. Written warranties shall be provided to the Owner on all equipment specified in this Section for the pumps and motors. The pumps and motors shall be covered by a five (5) year manufacturer's warranty. The warranty shall comprise the following terms: The

initial year from substantial completion and acceptance by the owner of the equipment shall be covered 100% for all required parts and labor. For years two (2) through five (5) following substantial completion and acceptance by the owner the pumps shall be covered for 50% for parts and labor for each warranty claim event. The warranty shall not be limited by hours of running time or operation from variable speed drives.

1.09 MAINTENANCE

- A. One set of all special tools required for normal operation and maintenance shall be provided as specified in Section 01170, Special Provisions.
- B. The following spare parts shall be provided:
 - 1. One (1) extra set of mechanical seals for each pump
 - 2. Two (2) complete sets of gaskets, O-rings, etc. for each pump
 - 3. One (1) set of pump radial and thrust bearings for each pump
 - 4. One (1) set of wearing rings for each pump
 - 5. One (1) impeller for each type or size of pump
 - 6. One (1) of any proprietary manufacturer's recommended spare part for each pump
- C. All tools and spare parts shall be furnished in accordance with Section 01170, Special Provisions. Spare parts shall be delivered to the Owner on the day of equipment startup in the presence of the Engineer and equipment manufacturer's representative.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. General
 - 1. This Section is intended to give a general description of what is required but does not cover all details which will vary in accordance with the requirements of the equipment as offered. It is, however intended to cover all materials, equipment and appurtenances for the complete pumping units as herein specified, whether specifically mentioned in this Section or not.
 - 2. For all units there shall be furnished and installed all necessary and desirable accessory equipment and auxiliaries whether specifically mentioned in this Section or not and as required for an installation incorporating the highest standards for the type of service.
 - 3. Pump bases or base elbows as the case may be, shall be rigidly and accurately anchored into position on concrete and all necessary foundation bolts, plates, nuts and washers shall be furnished and installed. Anchor bolts shall be Type 304 stainless steel.
 - 4. Brass or stainless-steel nameplates giving the name of manufacturer, the rated capacity, head, speed and all other pertinent data shall be attached to each pump and each motor.

5. The pump shall conform to the noise limitations specified in Section 01170, Special Provisions.
6. The manufacturer shall supply complete factory mounted equipment with sufficient power and signal cable, as required by the location.
7. Each pump and drive shall be designed to withstand the maximum turbine run-away speed of the pump due to backflow through the pump.
8. All electrical materials and equipment shall be UL listed or FM approved and NEMA rated and shall otherwise be equal to that supplied under Division 16, where applicable.
9. Local pump control panels are supplied by the control system integrator. The pump manufacturer shall supply sensor relays or pump control modules loose for installation into the local pump control panel by others. The pump manufacturer shall supply, at a minimum, sensing relays or pump control module for pump overtemp and pump seal fail.

2.02 PUMP CONSTRUCTION

- A. The pumps shall be totally submersible, solids handling, non-clog, screenless pumps. The pumps specified shall be mounted on a guide rail system to allow the pumps to be easily removed for inspection or service, requiring no bolts, nuts or other fastenings to be removed for this purpose and no need for personnel to enter the pump well. Each pump shall be fitted with a stainless-steel lifting chain of adequate strength and length to permit raising the pump for inspection and removal.
- B. The stator casing, coil casing and volute shall be constructed of gray iron. All external bolts and nuts shall be of stainless steel.
- C. The impeller shall be of nodular iron and shall either be hardened or coated to resist abrasion. The impeller shall be protected by a stainless-steel wear ring and neoprene O-ring at the inlet of the pump. The impeller shall be of a centrifugal, non-clog design, capable of passing solids, fibrous material, and heavy sludge, and constructed with long throughway with no acute turns.
- D. Each pump shall be provided with a tandem double mechanical seal running in an oil reservoir, composed of two separate lapped seal faces. Each seal face shall consist of one (1) stationary and one (1) positively driven rotating silicon-carbide or tungsten-carbide ring with each pair held in contact by a separate spring, so that the outside pressure assists spring compression in preventing the seal faces from opening. The compression spring shall be protected against exposure to the pumped liquid. The pumped liquid shall be sealed from the oil reservoir by one face seal and the oil reservoir from the air-filled motor chamber by the other. The seals shall require neither maintenance nor adjustment, and shall be easily replaced. Conventional double mechanical seals with a single spring between the rotating faces, requiring constant differential pressure to effect sealing and subject to opening and penetration by pumping forces shall not be considered equal to tandem seal specified and required. No seal damage shall result from operating without water, nor shall the sealing system rely on

the pumped media for lubrication. A leak detector shall be integral to the oil reservoir to detect intrusion of water and to activate an alarm once water is sensed.

- E. Pump shafts shall be of one-piece stainless-steel construction, ANSI 431 or equal.
- F. Pump and motor bearings shall be anti-friction type with a L-10 life of 50,000 hours minimum throughout the minimum and maximum limits of the pump operating curve.
- G. Each pump shall be provided with a lifting handle, suitable for use with a lifting chain as later specified herein.
- H. For the pumps specified with a guide rail system:
 - 1. Each pump discharge elbow connection shall be permanently installed in the wet well along with the discharge piping. Each pump shall be automatically connected and sealed to its discharge connection elbow when lowered into place and shall be easily removable. Each pump shall be mounted on a sliding guide bracket which is used to guide the pump into place with the discharge connection elbow. The sliding guide bracket and the pump casing shall have a machined angle connection with yoke to connect with the cast iron discharge connection, which shall be bolted to the floor of the wet well and so designed as to receive the pump angle connection without the need of any bolts or nuts. Provide Type 304 stainless steel anchor bolts for attachment to the floor. The base shall be sufficiently rigid to firmly support the guiderails, discharge piping, and pumping unit under all operating conditions. The base shall be provided with one or more integral support legs or pads suitable for bolting to the floor of the wetwell. The face of the discharge elbow inlet flange shall be perpendicular to the floor and shall make contact with the face of the pump discharge nozzle flange. The diameter and drilling of the elbow outlet flange shall conform to ANSI B16.1, Class 125.
 - 2. Sealing of a pumping unit to its discharge connection shall be accomplished by a simple linear downward motion of the pump with the entire weight of the pumping unit guided to and wedging tightly against the angled discharge connection; no portion of the pump shall bear directly on the wet well floor and no rotary motion of the pump shall be required for sealing. Sealing at the discharge connection by means of a diaphragm or similar method of sealing will not be accepted as an equal to a metal contact of the pump discharge and mating discharge connection as specified and required.
 - 3. Guide rails shall be provided for the installation and removal of each pump without having to dewater the wet well. The guide rails shall be constructed of Type 304 or 316 stainless steel and consist of standard dimension Schedule 40 piping. The upper guide rail support bracket and intermediate guide rail supports shall be constructed of 316 stainless steel. The upper guide rail support bracket shall be mounted in the opening of the access cover to support and guide the pumps into and out of the wet well.
 - 4. The lower guide rail holders shall be integral with the discharge connection. Each pump shall ride on dual guide rails when raised and lowered in the wet well. The discharge connection elbow shall have a flanged connection to the discharge piping.

- I. Pump motors shall be housed in an air-filled watertight submersible casing and shall have at least Class H insulated windings which shall be moisture resistant. Pump motors shall be supplied at the voltage, phase and frequency designated in Part 4 Equipment Schedule. Motor characteristics are specified above. Pump motors shall have cooling characteristics suitable to permit continuous operation, in a totally, partially, or non-submerged condition without the use of an external cooling jacket. The pump motor shall be capable of running unsubmerged without damage, for a minimum of fifteen (15) minutes. Pump and motor shall be explosion-proof, suitable for Class I, Division I, Group D applications. Motor shall be provided with pilot thermal sensors embedded in stator windings and shall be connected to the control panel.
- J. Pump power cable shall be suitable for submersible pump and Class I, Division I, Group D applications. Cable sizing shall conform to NEC standards for pump motors. Cable entry to each pump shall be designed for submersible pump applications. The cable entry junction box and motor shall be separated by a stator load sealing gland or terminal board which shall isolate the motor interior from foreign materials gaining access through the pump top. Provide cable holder as herein specified. All cables for wetwell mounted pumps shall be of sufficient length to terminate in a junction box outside the wetwell as indicated on the Drawings, with 10 feet [3 m] of slack which will be coiled on a cable hook at the top of the wetwell. Each cable shall be supported by AISI Series 300 corrosion-resistant stainless steel Kellems or woven grips to prevent damage to the cable insulation. Mounting of cable supports in the wetwell shall be coordinated by Contractor to prevent damage to the cable.
- K. The pumps, with their appurtenances and cable, shall be capable of continuous submergence under water without loss of watertight integrity to a depth of 65 feet. The pumps shall receive a factory test to determine that each unit operates satisfactorily and that all seals are properly in place, under the above specified conditions.
- L. Motors shall be specifically selected for service with an adjustable frequency type speed controller and shall be derated to compensate for harmonic heating effects and reduced self-cooling capability at low-speed operation so that the motor does not exceed Class B temperature rise when operating in the installed condition at load with power received from the adjustable frequency drive. All motors driven by variable frequency drives shall be supplied with full phase insulation on the end turns and shall meet the requirements of NEMA MG 1, Part 31. In addition to the requirements of NEMA MG 1, Part 31, motors shall be designed to be continually pulsed at the motor terminals with a voltage of 1600 volts ac.

2.03 PUMP INTAKE

- A. The pump manufacturer shall confirm the size and dimensions of the pump intake, the required clearance to the finished floor of the basin, and general layout of the pumps within the basin. The pump manufacturer shall certify conformance with intake design and anti-vortexing requirements of the Hydraulic Institute (HI). The Contractor shall make such adjustments in the basin structure, with Engineer's approval, as necessary to meet the sizing and dimensions of the pumps and pump intakes.

2.04 MONITORING SENSORS

- A. The pumps shall be factory equipped with, as a minimum, the following sensor devices with dry contacts for connection to instrumentation and control components.
 - 1. Motor winding high temperature sensors. The pump manufacturer shall supply loose the sensing relay or control module for installation into the local control panel by others.
 - 2. A leakage sensor to detect liquid moisture in the stator chamber. The pump manufacturer shall supply loose the sensing relay or control module for installation into the local control panel by others.
- B. The motor controls shall be compatible with all sensors selected.
- C. The sensor wires shall either be bundled together to form a single, multi-conductor cable or bundled with the pump power cables. Single device cables are not acceptable.

2.05 PUMP CONTROLS

- A. Each pump shall be controlled manually from the local control panel and remotely (automatically) from the SCADA control system.
- B. Provide necessary relays, contacts, etc. for monitoring and indication of thermal and moisture sensors and provide discrete outputs for wiring as shown on the Electrical Drawings.

2.06 ACCESSORIES AND APPURTENANCES

- A. Pump accessories and appurtenances shall include, but not be limited to:
 - 1. Power and control/sensory holder
 - 2. Lifting chain(s)
 - 3. Safety chain hook
 - 4. Access hatches
 - 5. Guide rails
 - 6. Upper guide rail brackets
 - 7. Intermediate guide rail brackets
- B. Chain, safety chain hook, and cable holder shall be stainless steel. Chain hooks and cable holder shall be positioned near the access hatch cover frame on the concrete. Cable holder and safety chain hook shall be stainless steel.
- C. The access hatch shall be cast into the wet well slab flush with the surface. Hatch opening shall be suitably sized for the removal of the pumps. Hatch shall be of aluminum fabrication, designed for H 20 loading. Hatch shall be equipped with diamond pattern cover plate, channel frame complete with safety grating, anchor flange, pintle hinges, at least two spring operators, automatic hold open arm and release handle, removable key wrench, and slam lock with flush grip handle. Cover plate and channel frame shall be at least 1/4-inch thick. Hardware shall be stainless steel throughout. Aluminum components shall be mill finished with bituminous coating on the exterior of the frame.

- D. Provide upper guide bar brackets near the hatch frame on the concrete deck to support the pump guide bars.
- E. All exposed metal within the wet well, except stainless steel, aluminum, or unless otherwise specified herein, shall be primed and finish painted to meet the Division 9 specification.

2.07 SURFACE PREPARATION

- A. All wetted parts including the pump, motor, volute, impeller, both interior and exterior surfaces of base elbow shall be shop primed and finish coated with a solvent free ceramic coating meeting the following requirements:
 - 1. Primer and Finish Paint:
 - a. Solids by volume: 65%
 - b. Type: Solvent-free ceramic coating impregnated with aluminum oxides
 - c. Total Dry Film Thickness: 400 microns (15 mils) minimum
 - d. Minimum Adhesion: 14 Newtons per square millimeter (2,030 psi) per ISO 4624
 - e. Minimum Hardness: 110 on Buchholz Indentation scale
 - f. Resistance: Level 1 (continuous duty) for sewage with pH of 6-11
 - 2. Surface Preparation
 - a. Method: Blasting per ISO 12944-4
 - b. Standard Cleanliness Grade: 2.5
 - c. Minimum Peak to Valley Height: 70 microns (2.75 mils)

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordinate with other trades, equipment and systems to the fullest extent possible.
- B. Take all necessary measurements in the field to determine the exact dimensions for all work and the required sizes of all equipment under this contract. All pertinent data and dimensions shall be verified.

3.02 INSTALLATION

- A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. Anchor bolts shall be set in accordance with the manufacturer's recommendations and setting plans.
- B. The pump manufacturer shall supply the services of a factory representative to check over the completed pump installation to the satisfaction of the Engineer. If the Contractor does not have a qualified engineer and/or serviceman on the job during the installation, the Engineer may direct him/her to provide the services of a factory representative to give the necessary instructions to ensure a proper installation.

- C. Qualified supervisory services, including manufacturers' engineering representatives, shall be provided as specified herein to ensure that the work is done in a manner fully approved by the respective equipment manufacturer. The pump manufacturer's representatives shall specifically inspect the installation of the pump, the grouting, and the alignment of the connecting piping. If there are difficulties in the start-up or operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner. Services of the manufacturer's representatives and training shall be provided when the first pump is started, with follow-up visits upon start-up of each subsequent pump.
- D. A written certification from each equipment manufacturer shall be submitted stating that the installation of his/her equipment is satisfactory, that the equipment is ready for operation and that the operating personnel have been suitably instructed in the operation, lubrication and care of each unit.
- E. 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.

3.03 INSPECTION AND TESTING

- A. Factory Test
 - 1. The pumps shall be factory tested as follows: each pump shall be hydrostatically tested at 100 psig internal pressure and 30 psig external pressure. Motor and cable insulation shall be tested for moisture content and defects before and after the above tests. Manufacturer shall submit written report with the details and results of the tests.
 - 2. Controls shall be factory tested and documentation of the test shall be submitted.
 - 3. No equipment shall be shipped until the above test results are received.
 - 4. Each pump shall be tested at the factory for capacity, power requirements, and efficiency at specified rated head, shutoff head, operating head extremes, and at as many other points as necessary for accurate performance curve plotting. All tests and test reports shall be made in conformity with the requirements and recommendations of the Hydraulic Institute Standards. Acceptance testing shall be per Table 11.6.5.4 Grade 1U, with no minus tolerance or margin allowed.
- B. After all pumps have been completely installed, conduct in the presence of the Engineer, and station operator such tests as are necessary to indicate that pump efficiency and discharge conform to the requirements specified. Field tests shall be performed on all pumps furnished under this Section.
- C. If the pump performance does not meet the specified requirements, corrective measures shall be taken, or pumps shall be removed and replaced with pumps that satisfy the conditions specified. A twenty-four (24) hour operating period of the pumps will be required before acceptance.

- D. The pumps and motors shall be designed and constructed to avoid the generation of objectionable noise or vibration. The sound pressure level at full load shall not exceed 90 (A Scale) decibels above 300 cycles, when measured at a point not exceeding 5-ft from the motor. Mufflers or external baffles will not be accepted. When operating at any point between no-load and full-load, the vibration measured in a horizontal plane at the top of the motor shall not exceed the limits recommended by the Hydraulic Institute Standards.
- E. Any component parts which are damaged as a result of testing or which fail to meet the requirements specified shall be replaced, reinstalled, and retested at the Contractor's expense.

PART 4 EQUIPMENT SCHEDULE

4.01 Lift Station No. 4

- A. The pumps shall be two (2) submersible non-clog sewage pumps: FLYGT Model NP 3127 SH 3~ Adaptive 446.
- B. Design Criteria:
 - 1. Location: Lift Station No. 4
 - 2. Number of Units: Two (2) (One Duty, One Standby)
 - 3. Equipment Identifiers: LSPS-03, LSPS-04
 - 4. Configuration: Wet Pit Submersible
 - 5. Capacity and Head: 100 GPM @ 35.8-Feet TDH (Full Speed)
 - 6. Minimum Free Passage Solids Size: 2-inch
 - 7. Type of Drive: Variable Frequency
 - 8. Motor Hp (Minimum): 7.5 Hp
 - 9. Motor Type: Air-filled
 - 10. Pump Discharge Size: 3-inch
 - 11. Voltage: 460V, 3-Phase, 60 Hertz, NEMA DESIGN B
- C. These pumps shall be used to pump raw sewage and floor drain flow from the Lift Station No. 4 to the Influent Building.
- D. The pumps shall be operated at variable speeds, controlled by the water level in the pump station.

4.02 Surface Wasting Pump Station

- A. The pumps shall be two (2) submersible non-clog sewage pump: FLYGT Model NP 3102 MT 3~ Adaptive 464.
- B. Design Criteria:
 - 1. Location: Surface Wasting Pump Station
 - 2. Number of Units: Two (2) (One Duty, One Shelf Spare)
 - 3. Equipment Identifiers: 3300-SW-SW1
 - 4. Configuration: Wet Pit Submersible
 - 5. Capacity and Head: 390 GPM @ 23-Feet TDH (Full Speed)

6. Pump Speed at Design Capacity (Maximum): 1750 RPM
7. Minimum Free Passage Solids Size: 2-inch
8. Type of Drive: Variable Frequency
9. Motor Hp (Minimum): 5.0 Hp
10. Pump Discharge Size: 4-inch
11. Voltage: 460V, 3-Phase, 60 Hertz, NEMA Design B

C. These pumps shall be used to pump mixed liquor and scum from the Surface Wasting Pump Station to the Thickener Distribution Box.

D. The pump shall be operated at variable speed, controlled by the water level in the pump station.

4.03 Fermenter Feed

A. The pumps shall be three (3) submersible non-clog sewage pump: FLYGT Model NP NP 3102 LT 3~ Adaptive 423.

B. Design Criteria:

1. Location: BNR Basin Zones AN 1-2 and AN 2-2
2. Number of Units: Three (3) (Two Duty, 1 Shelf Spare)
3. Equipment Identifiers: 2103-BNR1-FP1, 2203-BNR2-FP2
4. Configuration: Wet Pit Submersible
5. Capacity and Head: 550 GPM @ 3-Feet TDH (Full Speed)
6. Pump Speed at Design Capacity (Maximum): 1760 RPM
7. Minimum Free Passage Solids Size: 3-inch
8. Type of Drive: Variable Frequency
9. Motor Hp (Minimum): 5 Hp
10. Pump Discharge Size: 6-inch
11. Voltage: 460V, 3-Phase, 60 Hertz, NEMA DESIGN B

C. These pumps shall be used to pump mixed liquor from Fs (AN 1-2, AN 2-2) to Mixed Liquor Fermenter Basins (MLF 1-1, MLF 2-1).

D. The pumps shall be operated at variable speed, controlled by the SCADA system.

4.04 RAS Pump Station No. 2

A. The pumps shall be two (2) submersible non-clog sewage pumps: FLYGT Model NP 3171 LT 3~ 613.

B. Design Criteria:

1. Location: RAS Pump Station No. 2
2. Number of Units: Two (2) (One Duty, One Standby)
3. Equipment Identifiers: 4517-RAS-P17, 4518-RAS-P18
4. Configuration: Wet Pit Submersible
5. Capacity and Head: 2100 GPM @ 28-Feet TDH (Full Speed)
6. Minimum Efficiency at Design Capacity: 70 percent (70%)
7. Pump Speed at Design Capacity (Maximum): 1160 RPM

8. Minimum Free Passage Solids Size: 2-inch
 9. Minimum Shut-off Head: 46-feet
 10. Type of Drive: Variable Frequency
 11. Motor Hp (Minimum): 25 Hp
 12. Motor Type: Air-filled
 13. Pump Discharge Size (Maximum): 10-inch
 14. Voltage: 460V, 3-Phase, 60 Hertz, NEMA DESIGN B
- C. This pump shall be used to pump return activated sludge from the RAS Pump Station No. 2 to the Wet Weather Distribution Structure.
- D. The pump shall be operated at variable speeds, controlled by the SCADA system.
- 4.06 Fermenter Drain Pumps
- A. Provide and install base 90 and rails for future installation of a submersible pump (by others) when needed to drain the proposed basins. The number and location of the base 90 and rails as well as the design criteria for the future pumps are shown below.
- B. Design Criteria:
1. Location: BNR Basins, MLF 1-1 and MLF 2-1
 2. Number of Units: Two (2) 90-degree bases and rails compatible with Flygt pump model number 3102.060-0158.
- C. The Contractor is not responsible for the procurement or installation of the future pumps.

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SECTION 11313

VERTICAL CLOSE COUPLED PUMP

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to install, complete, field test, and make ready for operation, vertical closed coupled pump and motor as shown on the Drawings and as specified herein.
- B. Equipment furnished under this section shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless specific exceptions are noted by the Engineer.
- C. 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. Also included shall be supervisory services during installation and field testing of each unit and instructing the regular operating personnel in the proper care, operation, and maintenance of the 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 01782 – Operation and Maintenance Data
- B. Division 9 – Painting

1.04 REFERENCE STANDARDS

- A. Design, manufacturing, and assembly of elements of the equipment specified herein shall be in accordance with, the following:
1. American Gear Manufacturers Association (AGMA)
 2. American Institute of Steel Construction (AISC)
 3. American Iron and Steel Institute (AISI)
 4. American Society of Mechanical Engineers (ASME)
 5. American National Standards Institute (ANSI)
 6. American Society for Testing Materials (ASTM)
 7. American Water Works Association (AWWA)
 8. American Welding Society (AWS)
 9. Anti-Friction Bearing Manufacturers Association (AFBMA)
 10. Hydraulic Institute Standards
 11. Institute of Electrical and Electronics Engineers (IEEE)
 12. National Electrical Code (NEC)
 13. National Electrical Manufacturers Association (NEMA)
 14. Occupational Safety and Health Administration (OSHA)
 15. The Society for Protective Coatings (SSPC)
 16. Underwriters Laboratories (UL)
- B. Where reference is made to one of the above standards, the revision in effect at the time of Contract signing shall apply.

1.05 SYSTEM DESCRIPTION

- A. The vertical closed coupled pump shall deliver waste activated sludge (WAS) from the existing WAS Pump Station to the Gravity Thickeners. The pumped liquid is WAS from the secondary clarifiers. This pump is intended as a spare pump to be kept onsite for operational redundancy. The pump manufacturer shall provide a complete vertical closed coupled pump assembly with proven ability to operate under the specified system conditions. The pump shall be operated and controlled as specified in the manufacturer's recommendations.

1.06 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, Submittals, shop drawings and product data. Submittals shall include the following:
1. Certified dimensional drawings of each item of equipment and auxiliary apparatus to be furnished.
 2. Certified foundation, pump support, and anchor bolt plans and details; minimally including anchor bolt installation method, bolt length, and minimum embedment depth.
 3. Schematic electrical wiring diagram and other data as required for complete pump installation.

4. Literature and drawings describing the equipment in sufficient detail, including parts list and materials of construction, to indicate full conformance with the detailed specifications.
5. Total weight of pumping unit.

B. Design Data

1. Manufacturer's certified rating curves, to satisfy the specified design conditions, showing pump characteristics of discharge, anticipated field head, brake horsepower, bowl efficiency and guaranteed net positive suction head required (NPSHR). Curves shall show the full recommended range of performance and include shut-off head. This information shall be prepared specifically for the pump proposed. Catalog sheets showing a family of curves will not be acceptable.

C. Test Reports

1. Certified motor test data.
2. Tabulated data for the drive motors including rated HP, full load RPM, power factor and efficiency curves at 1/2, 3/4 and full load, service factor and kW input, including when the pump is at its design point. Submit a certified statement from the motor manufacturer that the motors are capable of continuous operation on the power supply without affecting their design life for bearings or windings.
3. A schedule of the date of shop testing and delivery of the equipment to the job site.
4. Description of pump factory test procedures and equipment.
5. Reed Critical Frequency Analysis Report to demonstrate conformance with combined system natural frequency separation requirements specified herein. The report shall include bump test data for the proposed motor to document the motor's actual Reed Critical Frequency value. Any requests for variation from these requirements shall be clearly documented in the pump manufacturer's submittal.

D. Operation and Maintenance Data

1. Complete operating and maintenance instructions shall be furnished for all equipment included under this Section as provided in Section 01782, Operation and Maintenance Data. The maintenance instructions shall include troubleshooting data and full preventative maintenance schedules and complete spare parts lists with ordering information.

1.07 QUALITY ASSURANCE

- A. To assure unity of responsibility, the motors, and supporting sole plates be furnished and coordinated by the pump manufacturer. The Contractor and manufacturer shall assume responsibility for the satisfactory installation and operation of the entire pumping system including pumps, motors, etc. as specified.

- B. The equipment covered by this Section is intended to be standard pumping equipment of proven ability as manufactured by a company having extensive experience in the production of such equipment similar to the applications stated in Paragraphs 1.01 and 1.06. Units specified herein shall be furnished by a single manufacturer. The equipment furnished shall be designed, constructed, and installed to operate satisfactorily when installed as shown on the Drawings.
- C. Pumps shall be manufactured and tested in accordance with the Hydraulic Institute Standards for vertical closed-coupled pumps, except where otherwise specified herein.
- D. The pump manufacturer shall be fully responsible for the design, arrangement, and operation of all connected rotating components, including supporting sole plate(s), if any, of the assembled pumping unit mounted on a fabricated steel base plate, to ensure that neither harmful nor damaging vibrations occur at any speed within the specified operating range.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the unit and equipment are ready for operation.
- B. All equipment and parts must be properly protected against any damage during shipment. Store equipment in accordance with manufacturer's recommendations.
- C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- D. The finished surfaces of all exposed flanges shall be protected by wooden or equivalent blank flanges, strongly built, and securely bolted thereto.
- E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- F. No shipment shall be made until approved by the Engineer in writing.
- G. For protection of bearings during shipment and installation, the bearing shall be properly processed. Anti-friction bearings shall be protected in accordance with the bearing manufacturer's recommendations against formation of rust during a long period of storage while awaiting completion of installation and start-up of the machine in which they are used.

1.09 WARRANTY

- A. Written warranties shall be provided to the Owner on all equipment specified in this Section. Warranties shall provide that, in the event of failure of any parts or equipment during the warranty period due to defective materials or workmanship, such parts or equipment will promptly be replaced and installed by the Contractor at no additional cost to the Owner. Warranty to extend 12 months from Substantial Completion and acceptance by the Owner.

1.10 MAINTENANCE

- A. Furnish all special tools and test equipment required for the proper servicing of all equipment.
- B. Spare parts shall be suitably 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.
- C. Furnish the following spare parts for each size pump:
 - 1. One (1) impeller of each size,
 - 2. One (1) seal and set of wear rings and bearings for each size and type of pump

PART 2 PRODUCTS

2.01 GENERAL

- A. The Contractor will furnish a quantity of one (1) Fairbanks Morse 3" (Discharge) x 3" (Suction) Model vertical closed coupled dry pit non-clog pumping unit. Each unit shall be furnished with a pump and driver. Drivers are to be mounted on a heavy-duty high-ring base and connected to the pump with a flexible coupling.

2.02 CONDITIONS OF OPERATION

- A. Each pump shall be operated at constant or variable speed capable of providing the following hydraulic conditions:

<u>Design Condition</u>	<u>Primary Condition</u>	<u>Secondary Condition</u>
Capacity (GPM)	200	260
Total Dynamic Head (TDH)	13	11
Efficiency (%)	67	63
Maximum Speed (RPM)	880	880
Min. Shutoff Head (Feet)	19	
Max NPSHR (Feet)	3.5	
Max. Solid Size (Inches)	2	
Max Horsepower covering runout (HP)	1.5	
Motor HP Supplied (HP)	3.0	

- B. The pump will be clockwise rotation when viewed from the driver end looking at the pump.

2.03 MATERIALS

- A. The impeller shall be a balanced non-clogging type made of close-grained cast iron conforming to ASTM A48 Class 30. The impeller shall be of one-piece, single suction, enclosed blade-less or two-vane or three-vane, radial flow design with well-rounded leading vanes and then tapered toward the trailing edge for a circular flow pattern. The waterways through the impeller will have extremely smooth contours, devoid of sharp corners to prevent rags or stringy, fibrous material from catching or clogging. The

clearance between the impeller outside diameter and cutwater shall be capable of passing a 2" sphere. The impeller is to be balanced and secured to the shaft using a bolt, washer, and key. The arrangement shall be such that the impeller cannot be loosened from torque in either forward or reverse rotation. Wiper vanes on the back impeller shroud are not allowed.

- B. The volute shall be matched to the impeller and made of close-grained cast iron conforming to ASTM A48 Class 30. The volute is to be of one-piece circular constant flow, equalizing pressure design with smooth fluid passages large enough to pass any size solid that can pass through the impeller. The volute shall be side-flanged tangential discharge and capable of rotation in 45° increments to accommodate piping orientation. Diffusion vanes are not permitted. The volute shall be furnished with large cleanout openings located at the impeller centerline, to allow access to the impeller. Volute priming, drain, and 1/2" minimum gauge connections shall be provided. Flanges shall be 125 lbs. flat-faced flanges per ANSI drilling. The casing shall be designed to permit the removal of the rotating assembly without disturbing the suction or discharge piping. The casing shall be hydrostatically tested to 1.5 times the design head or 1.25 times the shutoff head, whichever is greater.
- C. The fronthead shall be made of close-grained cast iron conforming to ASTM A48 Class 30. The fronthead shall be cast separately from the volute and connected to the suction base elbow.
- D. A separately cast close-grained cast iron backhead with large access openings and integral sealing box conforming to ASTM A48 Class 30 shall be provided. The sealing box shall be designed for use with conventional packing or mechanical seal without requiring re-machining. The sealing box shall be furnished with a 1/4" injection and vent tap for a clear water or grease connection to a water seal ring to prevent air from entering the pump through the sealing box. A 3/4" minimum sealing box drain tap shall be provided. Sealing box leakage will be collected by the packing box drain trough and piped directly to the drain, eliminating any drippage to the floor. A minimum of 5 rings of graphite-impregnated synthetic packing and a split Teflon water seal ring shall be furnished. Glands shall be two-piece split interlocking made of cast iron [bronze] held in place by studs and nuts.
- E. The bearing frame shall be close-grained cast iron conforming to ASTM A48 Class 30 and of heavy, rugged design for carrying the bearings and machined for accurate and permanent bearing alignment completely enclosing the shaft between the bearings. The bearing housing shall be of dust-proof design incorporating lip-type grease seals in contact with the shaft to prevent the entrance of contaminants. Jacking bolts for external impeller adjustment are required. Zerk-type grease fittings for bearing lubrication shall be supplied at the bearing housings.
- F. The pump shaft shall be high-strength alloy steel with a minimum 100,000 PSI tensile strength and 75,000 PSI yield strength of sufficient diameter to carry the maximum loads imposed and to prevent vibration and fatigue. The shaft shall be accurately machined along its entire length and precision ground at bearing locations. Keyways shall be provided at both ends. A renewable straight shaft sleeve, positive adhesive sealed to prevent leakage between the shaft and the sleeve, shall protect the shaft through the sealing box area. The shaft sleeve shall be stainless steel with a Brinell hardness of 300-350. Radial (inboard) bearings shall be single-row on T20 frames, grease-lubricated ball

bearings designed to carry the hydraulic radial loads encountered in the service conditions. Thrust [outboard] bearings shall be single row on T20 frames designed to carry the pump hydraulic axial and dead load thrust. Bearing shall be designed for a nominal L 10 life of 100,000 hrs. per AFBMA at best efficiency point.

- G. A rugged heavy-duty fabricated steel base, with openings large enough to permit access to the suction elbow and cleanout, bolted directly to the volute shall be provided. The base shall be designed to support the assembled weight of the pump and driver. A cast iron suction elbow with 1/2" gauge connection, contoured handhole cleanout, and 125 lb. flat-faced flange conforming to ANSI drilling shall be furnished.
- H. The volute (casing), fronthead, backhead, and frame shall be manufactured with concentric shoulder fits to assure accurate alignment. All machine bolts, nuts, and capscrews shall be of the hex head type and will not require the use of any special tools.
- I. The motor high ring base shall be cast iron or fabricated steel of adequate height to permit access to the coupling and furnished with a coupling guard.

2.04 PUMP CONSTRUCTION

- A. All necessary bolts and hardware for the pump assembly, motor, and foundation shall be corrosion resistant and selected by the pump manufacturer based on the specified operating conditions.
- B. Pump assembly components and materials of construction, minimally including the pump volute/casing, impeller, impeller shaft, fronthead, backhead, frame, base, elbow, and couplings materials shall be selected by the pump manufacturer unless specifically defined by the Engineer. The manufacturer's selections shall be the most suitable for this application based on the specified operating conditions when the material or component options are available.
- C. The limits of vibration as set forth in the standards of the Hydraulic Institute shall govern.

2.05 SHOP TESTS

- A. The Engineer shall have the right to witness the factory tests and inspect any equipment to be furnished under this Section prior to their shipment from place of manufacture.
- B. Each bowl assembly shall be factory tested with a Standard Performance Test as described in Hydraulic Institute Test Standards and all test data submitted for approval by the Engineer prior to shipment. Certified copies of the calculated pump performance curves shall be submitted including anticipated head, capacity, bowl efficiency, total brake horsepower, NPSH, and required submergence. A minimum of five (5) points, including shutoff, shall be taken for each test with at least one point being as near as possible to the specified conditions.
- C. The discharge head and bowl assembly of each pump shall be hydrostatically tested in full compliance with the Hydraulic Institute Test Standards.
- D. Pump motor tests as shall be submitted for approval by the Engineer prior to shipment.

2.06 SURFACE PREPARATION

- A. Each piece of equipment in the pumping system including pump, support system, column piping, and motor shall be finish painted as specified in Division 9.
- B. All interior and exterior wetted surfaces of pump columns and discharge elbows and the exterior of the bowl assemblies shall be cleaned of all rust and mill scale and supplied with a protective coating.

2.07 QUALITY ASSURANCE

- A. The pump is to be engineered and manufactured under a written Quality Assurance program. The Quality Assurance program is to be in effect for at least five (5) years, to include a written record of periodic internal and external audits to confirm compliance with such program.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Contractor shall provide shelf-spares pump located in the Waste Activated Sludge Pump Station. Anchor bolts shall be located in accordance with the pump manufacturer's recommendations and setting plans.

3.02 SURFACE PREPARATION AND PAINTING

- A. Apply primer and finish coating to all exposed metal within the, except stainless steel or unless otherwise specified herein, and in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 11315

SUMP PUMPS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, and incidentals to install and test a complete sump pump system, including submersible pumps with float control switches, as shown on the Drawings, and as specified herein.
- B. Furnish and install necessary and desirable accessory equipment and auxiliaries, whether specifically mentioned in this specification or not, as required for an installation incorporating the highest standards for the 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 01782 – Operation and Maintenance Data
- B. Section 02640 – Valves, Hydrants, and Appurtenances
- C. Division 03 - Concrete
- D. Section 09902 – Finish Painting
- E. Division 13 – Instrumentation (unless specified herein)

1.04 REFERENCE STANDARDS

- A. American National Standard Institute (ANSI)

- B. Anti-Friction Bearing Manufacturers Association (AFBMA)
- C. National Electrical Manufacturer's Association (NEMA)
- D. National Electrical Code (NEC)
- E. 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 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. Descriptive literature, bulletins and/or catalogs of the equipment,
 - 2. Data on the characteristics and performance of the pumps, including the following:
 - a. Performance curves, based on actual shop tests of duplicate units, showing that they meet the specified requirements for head, capacity, efficiency, allowable NPSH, allowable suction lift and horsepower,
 - b. Submit curves electronically on 8 1/2-inch by 11-inch sheets.
- 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 operating and maintenance instructions to the Engineer as provided for in Section 01782, Operation and Maintenance Data.

1.06 QUALITY ASSURANCE

- A. The pumps covered by these Specifications are intended to be standard pumping equipment, as modified by these Specifications, of proven ability, and as manufactured by a single manufacturer, having long experience in the production of such pumps.
- B. Should equipment which differs from these Specifications be offered and determined to be equal to that specified, such equipment is acceptable only on the basis that any revisions in the design and/or construction of the structure, piping, appurtenance equipment, electrical work, etc., required to accommodate such a substitution is made at no cost to the Owner and is approved by the Engineer.
- C. Size the drive unit such that operation will not overload nor reduce the motor service factor when the pump is operated at any point on the pump's capacity curve.
- D. If, due to the slope of the pump's performance curve, a drive unit of greater horsepower than specified is required to meet this condition, the pump will be considered for approval only if any and all changes in electrical work, etc., required by such a change will be provided at no additional cost to the Owner and be to the satisfaction of the Engineer.

1.07 SYSTEM DESCRIPTION

A. General

1. All sump pumps shall be simplex submersible pumps with cast iron housings, thermoplastic impellers, and stable constantly rising performance curves to shut-off head.

B. Conditions of Installation

1. One (1) pump (SP-01) shall be located in the Blower Building Valve Vault. The pump shall discharge from the vault to the manhole as shown on the drawings.
2. One (1) pump (SP-02) shall be located in Digester No. 4 Valve Vault. The pump shall discharge from the vault to the manhole as shown on the drawings.
3. One (1) pump (SP-03) shall be located in Surface Wasting Pump Station Valve Vault. The pump shall discharge from the vault into the Surface Wasting Pump Station Wet Well
4. One (1) pump (SP-04) shall be located in the RAS Pump Station Flow Meter Vault No. 1. The pump shall discharge from the vault to the Surface Wasting Pump Station Valve Vault.
5. One (1) pump (SP-05) shall be located in the RAS Pump Station Flow Meter Vault No. 2. The pump shall discharge from the vault to the Surface Wasting Box at Aeration Basin No. 2.
6. One (1) pump (SP-06) shall be located in the RAS Pump Station Flow Meter Vault No. 3. The pump shall discharge from the vault to Manhole MH33-3.
7. One (1) pump (SP-07) shall be located in the Waste Meter Vault. The pump shall discharge from the vault to Manhole MH33-3.

1.08 MAINTENANCE

- A. Provide one (1) set of all special tools required for normal operation and maintenance as specified in Section 01782, Operation and Maintenance Data.
- B. Provide (1) spare sump pump.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. General

1. Pumps shall be simplex sump pumps with 0.3 Hp, 115V, 60Hz motors capable of pumping 10 GPM @ 21 FT-TDH. Pump shall include an integral float switch, oil filled motor, thermal overload protection, cast iron case, and thermoplastic impeller.

- #### B. Each pump shall be equipped with a PVC check valve and a PVC union on the discharge line.

C. Manufacturer

1. Sump pumps shall be similar and equal to Hydromatic Model V-A1.

PART 3 EXECUTION

3.01 INSTALLATION

- #### A. Install pumps and appurtenances in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings.

3.02 INSPECTION AND TESTING

- #### A. Perform field tests on all pumps furnished under this Section.
- #### B. If the pump performance does not meet the Specifications, correct deficiencies or corrective measures remove and replace with pumps that satisfy the conditions specified.
- #### C. Replace, reinstall, and replace any component parts that are damaged as a result of testing or that fail to meet the requirements of these Specifications, and no additional cost to the Owner.

3.03 SURFACE PREPARATION AND PAINTING

- #### A. Apply primer and finish coating to all exposed metal within the, except stainless steel or unless otherwise specified herein, and in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 11322

GRIT REMOVAL EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, equipment, materials, tools, and appurtenances required for a complete, tested, and operable installation of the grit removal, washing, dewatering, and conveying system as shown in the Plans and specified herein.
- B. The grit removal, washing, dewatering, and conveying system shall be furnished by a single manufacturer having overall system responsibility to ensure coordination of and compatibility of all major components of the system. Overall system responsibility shall include start-up, training, calibration, and successful operation of the equipment in conformance with the performance criteria of the specification.
- C. Electric motors shall be furnished as part of the work of this Section and shall conform to all applicable portions of Section 01171, Electric Motors.
- D. Coordinate with the System Integrator (SI) regarding all required ethernet communications with the SCADA 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 RELATED SECTIONS

- A. Section 01171 – Electric Motors
- B. Section 01300 – Submittals
- C. Section 01782 – Operation and Maintenance Data

- D. Section 01783 – Product Warranties
- E. Division 9 – Finishes
- F. Section 15100 – Valves and Appurtenances
- G. Section 15160 – Electric Actuators
- H. Division 16 – Electrical

1.04 REFERENCE STANDARDS

- A. Comply as a minimum with applicable provisions and recommendations of the following:
 - 1. American Bearing Manufacturers Association (ABMA)
 - 2. ASTM International (ASTM)
 - 3. American Welding Society (AWS)
 - 4. Anti-Friction Bearing Manufacturer Association (AFBMA)
 - 5. Institute of Electrical and Electronic Engineers (IEEE)
 - 6. National Electric Code (NEC)
 - 7. National Electrical Manufacturers Association (NEMA)
 - 8. Steel Structures Painting Council (SSPC)
 - 9. American National Standards Institute (ANSI)
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 SYSTEM DESCRIPTION

- A. Install a grit removal, washing, dewatering, and transporting system to remove grit from the raw wastewater.
- B. The grit removal, washing, dewatering, and conveying system shall include two (2) grit separator units (GS-01 and GS-02), two (2) grit pumps (GP-01 and GP-02), two (2) grit classifying, washing, and dewatering units (GC-01 and GC-02), and two (2) control panels.
- C. Each grit separator shall be placed in a concrete tank and receive the incoming screened flow from the proposed Influent Facility. Each grit separator shall provide sufficient surface area to remove the specified grit particles from the specified peak flow and concentrate the grit in a sump at the bottom of the unit. Effluent from the grit separator shall be weir discharged as shown on the drawings. The grit separator shall be Headcell by Hydro-International.

- D. The grit separator equipment at the Bentonville Water Resource Recovery Facility shall be as follows:

1. Number of Trains:	2
2. Tag Numbers:	GS-01 and GS-02
3. Tray Diameter:	12 feet
4. Number of Trays:	12
5. Surface Area Per Unit (Minimum):	1,356 square feet
6. Maximum Surface Loading Rate:	15.4 gpm/ft ²
7. Peak Flow Per Unit:	30.0 MGD
8. Average Flow Per Unit:	8.0 MGD
9. Grit Removal Performance at Peak Flow:	95% of all grit >125 microns
10. Grit Removal Performance at Average Flow:	95% of all grit >75 microns
11. Headloss at Peak Flow (Maximum):	12 inches

- E. The grit shall be pumped from the grit sump to a grit washing and classifying system which will hydraulically separate the grit, sand, and sediment from the organics and water.

- F. The grit pumping system shall utilize centrifugal close coupled horizontal pumps by Egger or approved equal. The grit pumps shall be as follows:

1. Number of Pumps:	2
2. Tag Numbers:	GP-01 and GP-02
3. Flow Rate (per pump):	300 gpm
4. Total Head:	33 feet
5. Motor HP (minimum):	5
6. Motor Speed:	1,022 RPM
7. Pump Discharge Size:	4-inch
8. Voltage:	460V, 3-Phase, 60 Hertz

- G. The grit washing and classifying system shall be GritCleanse by Hydro-International. The grit washing/classifying equipment at the Bentonville Water Resource Recovery Facility shall be as follows:

1. Number of Trains:	2
2. Tag Numbers:	GC-01 and GC-02
3. Design Flow Rate (per train):	300 gpm
4. Headloss at Design Flow Rate:	3 inches
5. Influent Solids Concentration:	<1.5%
6. Grit Removal Performance at Design Flow:	95% of all grit >75 microns
7. Capacity (Maximum):	1.5 CY/HR
8. Auger Diameter (Minimum):	12 inches
9. Clarifier Diameter (Minimum):	84 inches

- H. All components subject to submergence or splashing shall be constructed of corrosion resistant materials. Metallic components shall be Type 316 stainless steel.

1.06 SUBMITTALS

- A. Submit, in accordance with Section 01300, copies of all materials required to establish compliance with this Section. Submittals shall include the following:
1. Certified shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations,
 2. Non-Potable Water requirements,
 3. Pump hydraulic calculations,
 4. Performance Testing data,
 5. Descriptive literature, bulletins and/or catalogs of the equipment,
 6. The total weight of the equipment, including the weight of the single largest item or component and lifting points,
 7. A complete total bill of materials for all equipment,
 8. A list of the manufacturer's recommended spare parts. Include gaskets, packing, etc., on the list,
 9. Recommended summer and winter grade of lubricants along with alternative references to equal products of other manufacturers,
 10. Details of the torque overload device,
 11. Complete data on motor and power factor correction capacitors (if required) in accordance with Section 01171, Electric Motors,
 12. Complete description of surface preparation and shop prime painting,
 13. Manufacturer's Warranty,
 14. Manufacturer's Installation Drawings,
 15. Complete master wiring diagrams, elementary or control schematics, physical dimensional or elevation drawings and system single line drawings specific to this Contract. Standard preprinted sheets or drawings simply marked to indicate applicability to this Contract will not be acceptable,
 16. Submittal information shall include detailed information indicating wiring connection points for all external devices and controls as specified herein,
 17. Complete description of the control panel required components,
 18. Show all connections and programming related to equipment described in Division 13 and controlled by the control panel furnished under this Section.

B. In the event that it is impossible to conform to certain details of this Section, describe completely all non-conforming aspects.

C. Operating and Maintenance Data

1. Operating and maintenance instructions shall be furnished to the Engineer as provided in Section 01782. The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions that are required to instruct operating and maintenance personnel unfamiliar with such equipment.
2. A factory representative who has a complete knowledge of the proper operation and maintenance shall be provided as specified herein. Qualification of Service Engineer shall be submitted for approval. Man-day requirements listed are exclusive of travel time and do not relieve the Contractor of obligation to provide sufficient service to place equipment in satisfactory operation.
 - a. During installation, assist in location of anchor bolts; setting, leveling, and field erection of equipment; coordination of piping, electrical, and miscellaneous utility connections: one (1) 8-hour day.
 - b. Startup, testing and calibration: one (1) 8-hour days.
 - c. Operation, maintenance, startup, shutdown, troubleshooting, lubrication, and safety instruction: one (1) 8-hour day.
 - d. Service inspections during first two (2) years of operation, for use at Owner's request, and exclusive of repair, malfunction, or other troubleshooting service calls: two (2) 8-hour days (not anticipated as consecutive).

D. Process Control Strategy Submittal

1. The process control schemes shall be developed in a ladder logic diagram or functional block (logic) diagram presentation based on information from the Specifications. Included with each diagram shall be:
 - a. Brief Scope of the Control Function,
 - b. Listing of all scanned inputs to the control function,
 - c. A short narrative of the control strategy,
 - d. Any assumptions made in developing the program,
 - e. Listing of all inputs and outputs (i.e., AI, DI, AO, DO) from the control function,
 - f. Cross reference list of all I/O showing to which I/O modules or software modules they are linked,
 - g. Listing of all operator inputs/outputs to and from the control function. Any special LCD displays related to the function shall be illustrated. A description of the operation of any panels shall be described as it relates to the control function,

h. Failure contingencies shall be described in detail.

2. This submittal shall cover all of the associated ladder logic developed under this Contract required to implement the control functions specified.

E. Manufacturer's Certificate: Certify that all equipment and materials provided are AIS compliant, as necessary.

1.07 QUALITY ASSURANCE

A. In order to assure uniform quality, ease of maintenance and minimal parts storage, it is the intent of these Specifications that a single manufacturer shall supply all equipment called for under this Section. The equipment manufacturer shall, in addition to the Contractor, assume the responsibility for proper installation and functioning of the equipment.

B. The Manufacturer shall provide a list of at least 20 successful installations of the specified type equipment at different locations in the United States. At least five (5) installations must have been in service for a minimum of five (5) years. The Engineer may require evidence, in the form of operating records, from these installations to substantiate any claims concerning the ability of the equipment to perform as required.

C. Field measurements shall be taken at the site to verify, or supplement indicated dimensions and to ensure proper coordination of all other construction items.

D. The equipment manufacturer's shop welds, welding procedures, welders and welding operators shall be qualified and certified in accordance with the requirements of the latest edition of ANSI/AWS D1.1 "Structural Welding Code Steel" published by the American Welding Society.

E. The manufacturer shall field test or furnish performance test results documenting that the system has achieved the specified performance requirement in Section 1.05.

1.08 SURFACE PREPARATION

A. All stainless-steel components shall undergo a pickling and passivation process in accordance with ASTM A380.

B. All non stainless components shall be coated in accordance with Section 09902, Finish Painting.

1.09 WARRANTY

A. The equipment supplier shall warrant the equipment against defects in manufacturing and materials for a period not less than one (1) year from date of substantial completion or if that cannot be provided, warranty shall be two (2) years from startup, in accordance with Specification Section 01783, Product Warranties. If any part of the equipment should fail during the warranty period, it shall be repaired or replaced at no cost to the Owner.

- B. The manufacturer is responsible for providing equipment storage instructions prior to equipment delivery. Equipment warranty will not be lessened due to damage during storage should those requirements be satisfied.

1.10 MAINTENANCE

- A. Special tools, if required for normal operation and maintenance, shall be furnished with the equipment by the manufacturer.
- B. Provide the following spare parts:
 - 1. One (1) year supply of all lubricants
 - 2. One (1) set of solenoid valves
 - 3. One (1) extra set of mechanical seals for each pump
 - 4. Two (2) complete sets of gaskets, O-rings, etc. for each pump
 - 5. One (1) shaft coupling for each pump
 - 6. One (1) set of pump bearings for each pump
 - 7. One (1) set of wearing rings for each pump
 - 8. One (1) set of mechanical seals for each pump
 - 9. One (1) impeller for each pump
 - 10. One (1) of any proprietary manufacturer's recommended spare part
- C. Spare parts shall be delivered to the Owner on the day of equipment startup in the presence of the Engineer and equipment manufacturer's representative.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. This Section calls attention to certain features but does not purport to cover all details of construction of the equipment. Furnish and install the equipment complete in all details and ready for operation. All equipment shall be provided by a single manufacturer.
- B. The grit separator, washer, dewatering, and conveying equipment shall include all necessary equipment and appurtenances as manufactured and supplied by Hydro-International.

2.02 GRIT SEPARATORS

- A. Flow shall transition from the inlet channel or pipe to the trays via an inlet duct positioned above the trays. Each tray shall be connected to the inlet duct by a horizontal nozzle with a rectangular cross section and large clear openings. The inlet flume shall be constructed of minimum 14 gauge formed stainless steel sheet with minimum 3" clear openings. Multiple flexible connections to the trays, units using a piped upflow influent distribution design, and designs with hydraulic turns greater than 45 degrees are not allowed.
- B. The grit separator shall be all-hydraulic consisting of self-cleaning corrosion resistant, non-metallic trays with no moving parts within the unit. All flow passages shall be self-cleaning and free of sharp projections or fittings that may snag stringy or fibrous materials.

- C. Grit separator trays shall be molded thermoplastic with a minimum ¼ inch thick LDPE or HDPE on the pans and sidewalls. Formed and welded stainless steel trays shall not be allowed.
- D. The stack of trays shall securely fit into a stainless-steel support frame. The support frame shall fit and secure to the bottom of the concrete support structure.
- E. A formed sump bottom with integrated fluidizing ring shall be provided with the Grit separator to aid in transporting the grit to the underflow pipe. The sump bottom with fluidizing ring shall be installed in the concrete tank and incorporate a threaded connection to the water supply line.
- F. No gap in the grit basin shall be less than 3 inches.
- G. All pipe flanges shall conform to ANSI B16.1 bolt patterns.
- H. Each grit concentrator shall include all valving and accessories necessary for a complete installation.

2.03 GRIT PUMPS

- A. The grit pumps shall be designed to pump abrasive grit slurry from the grit separator to the grit classifier.
- B. Pump shall be mounted on a painted fabricated steel base
- C. The pump shall be equipped with a fully recessed, curved vane, vortex type impeller.
- D. The mechanical seals shall be single cartridge type.
- E. The impeller and casing shall be ASTM A 532 high chrome iron with a Brinell Hardness of 625.

2.04 GRIT WASHER/CLASSIFIER/DEWATERING

- A. Operation
 - 1. The grit washing and classifying unit shall be designed to handle grit slurry underflow from the grit separator.
 - 2. The grit slurry is introduced to the clarifier tangentially where the grit is forced into the low velocity boundary layer where it decelerates and follows the rotary flow path as it settles towards the sand bed located at the bottom of the clarifier.
 - 3. The dewatered overflow and lighter organics are discharged via the tangential overflow at the top of the clarifier.
 - 4. Screened Supply Water shall be continuously supplied to the grit washing and classifying unit to keep the sand bed in the bottom of the clarifier fluidized.

5. Washing occurs at the top of the fluidized bed where heavier organic particles are separated from the grit.
6. Rotating Stirring bars keep the fluidized sand bed well mixed and aid in washing by agitating the interphase between the sand bed and organics layer.
7. Heavier organics and organics washed off the grit that accumulate in the clarifier are discharged intermittently via an electrically actuated plug valve located in on the side of the clarifier.
8. The depth of the fluidized sand bed is measured by a pressure sensor.
9. Over time the bed depth increases due to the addition of washed grit. Once it has reached a certain value the dewatering screw auger turns on automatically and discharges a portion of the washed and dewatered grit into the grit receptacle.
10. Degritted Effluent from the grit washing and classifying unit shall be free discharge.

B. Construction

1. The grit washing and classifying unit shall be provided with an conical clarifier with a cylindrical base which shall provide at least 3 inches of freeboard.
2. The clarifier shall have a tangential inlet and outlet and internal baffle to establish a structured rotary flow path aiding in settling out grit particles.
3. A motor operated agitator shall be mounted at the center of the clarifier.
4. Grit washing and classifying unit shall be fabricated from stainless steel. The clarifier walls and conveyor trough shall be 3/16 inch thick.
5. The conveying screw shall have 3/16-inch-thick flights mounted on a 3 1/2 inch diameter schedule 40 pipe.
6. The housing for the dewatering auger shall be fitted under the clarifier. The housing for the dewatering auger shall be stainless steel and shall be inclined at 45 degrees.
7. The clarifier and auger housing shall be fully covered. All covers and hardware shall be stainless steel.
8. The auger trough shall be provided with one (1) threaded drain.
9. The grit washing and classifying unit support structure shall be as shown on the general arrangement drawing and anchored to a stable base.
10. All flanges shall be spinning flanges, a minimum of 1/2 inch thick, and drilled to match ANSI 150 lb. pipe flanges.

11. The grit washing and classifying unit shall be supplied with the below as standard with access to ease maintenance:
 - a. Externally accessible bearing unit
 - b. Swiveling conveyor housing to aid access to base of clarifier and lower auger
 - c. Clarifier observation and maintenance hatches
 - d. Rodding/Flushing water access point opposite of the unit drain
12. The grit washing and classifying unit shall have one (1) 1 inch NPT pipe stub for connection of the organics flushing supply water.
13. An electrically actuated valve shall be supplied to control the Organics Flushing Drain.
14. The grit washing and classifying unit shall be supplied with a factory installed manifold to split and introduce the fluidizing water. The manifold shall have one (1) 1 inch NPT connection for supply water.

C. Motors and Drives

1. The grit washing and classifying unit shall be provided with an auger and an agitator drive, each consisting of the motor and the helical gear reducer, mounted as a single integrated unit. All Bearings shall be anti-friction, ball, or roller type bearings.
2. The motors shall be 3 phase, 460 VAC, 60 Hz, NEMA Design B, TENV enclosure. Motors as manufactured by SEW-Eurodrive are acceptable for equipment specified within this section.
3. The helical gear reducer shall have hardened alloy steel gears accurately cut to shape.
4. The drive speed for both units shall be adjusted by variable speed drives housed in the control enclosure. The auger speed and agitator speed shall be adjustable from 1-10 rpm.

D. Valves and Accessories

1. Each grit washing and classifying unit shall be supplied with the following equipment to regulate and automate the system water supply, organics discharge, and auger operation:
 - a. One (1) 4" round full port cast iron plug valve with electric actuator, 120V, 60 Hz, 1PH, NEMA 4X, to control the Organics Discharge.
 - b. One (1) 1" NEMA 4X brass solenoid valve to automate the organics flush water supply.

- c. One (1) 1" bronze ball valves to isolate the organics flush solenoid valve.
- d. One (1) 1" NEMA 4X brass solenoid valve to automate the fluidizing water supply.
- e. Two (2) 1" bronze ball valves to shut off the fluidizing water and isolate the solenoid valve.
- f. One (1) 0-30 gpm polysulfone in line flow meter
- g. Four (4) 0.5" bronze ball valves to isolate the fluidizing pipe manifold
- h. One (1) pressure sensor NEMA 4X to monitor the pressure inside the unit
- i. One (1) 3" stainless steel valve to located on the unit drain.
- j. Ball valves as manufactured by Apollo are acceptable for equipment specified within this section. Solenoid valves as manufactured by ASCO are acceptable for equipment specified within this section.

2.05 CONTROL PANEL

- A. Each train shall include a control panel.
- B. Each control panel shall adhere to the following specifications:
 - 1. Enclosure Rating: NEMA 12
 - 2. Material: Carbon Steel
 - 3. Voltage: 480 Volt
 - 4. Phase: 3 Phase
 - 5. Frequency: 60 Hz
 - 6. Logic: Panel with PLC logic. Allen-Bradley Micro850 PLC with a PanelView 6" display is acceptable for each main control panel.
- C. The Control panel shall contain all timers, VFDs, switches, indicator lights, and other components necessary to operate the equipment:
- D. The control panel shall be supplied with applicable control relays and time delay relays with a minimum one extra normally closed and one extra normally opened contact is provided for each relay.
- E. The panel shall be provided with an ethernet connection to facilitate all I/O contacts necessary.
- F. The panel door layout shall include the following items:
 - 1. Front panel mounted combination main disconnect switch and circuit breaker
 - 2. Back lit, push-to-test Power On indicating light
 - 3. System three position HOA switch

4. System Emergency Stop push button
5. System Alarm Reset push button
6. Grit Pump running light
7. Grit Pump fault light
8. Grit Dewatering Screw running light
9. Grit Dewatering Screw three position HOA switch
10. Grit Dewatering Screw fail indicating light
11. Grit Dewatering Screw manual STOP push button
12. Grit Dewatering Screw manual START push button
13. Grit Dewatering Screw manual speed potentiometer
14. Grit Dewatering Screw rinse water valve three position HOA switch
15. Grit Dewatering Screw rinse water valve OPEN indicating light
16. Grit Dewatering Screw FAIL RESET push button
17. Grit Dewatering Screw LOCAL/REMOTE switch for escalator speed control
18. Grit Dewatering Screw CONTINUOUS/INTERMITTENT switch
19. Grit Pump running light
20. Grit Separator fluidizing valve OPEN light
21. Grit Separator fluidizing water HOA switch
22. Cycle Run ON/OFF switch
23. Grit Washing / Dewatering Agitator three position HOA switch
24. Grit Washing / Dewatering Agitator Running indicating light
25. Grit Washing / Dewatering Agitator Fault indicating light
26. Grit Washing / Dewatering Organics Flush three position OPEN/CLOSE/AUTO switch
27. Grit Washing / Dewatering Organics Flush Opened indicating light
28. Grit Washing / Dewatering Organics Valve three position OPEN/CLOSE/AUTO switch
29. Grit Washing / Dewatering Organics Valve Opened indicating light
30. Grit Washing / Dewatering Organics Valve Closed indicating light
31. Grit Washing / Dewatering Organics Valve Fault indicating light

PART 3 EXECUTION

3.01 DELIVERY AND INSTALLATION

- A. Install all equipment per the manufacturer's recommendations and as shown on the plans.
- B. The equipment and material shall be shipped complete except where partial disassembly is required by transportation regulations or for protection of components.
- C. Spare parts shall be packed in containers bearing packing lists clearly designating contents and pieces of equipment for which they are intended.
- D. The Contractor shall inspect equipment prior to unloading and notify the manufacturer of any damage to equipment within 5 days to effect proper remedial action. Failure to notify the Manufacturer of damage to equipment prior to unloading shall void all warranties pertaining to subject equipment.
- E. The Contractor shall unload, store and safeguard equipment, materials, and spare parts in accordance with Manufacturer's recommendations.

3.02 FINISHES

- A. All surfaces shall be free of sharp edges, weld splatter, and residue. All welds shall be ground smooth. All stainless-steel weld surfaces shall be acid washed.
- B. All non-submerged exterior surfaces shall be glass bead blasted to a uniform finish.

3.03 INSPECTIONS AND FIELD TESTING

- A. All inspections shall be performed by a factory-trained representative of the equipment manufacturer.
- B. Contractor will notify Engineer and manufacturer a minimum of two (2) weeks prior to inspection that the system is ready to be inspected.
- C. The Contractor is to make all adjustments required by the manufacturer.

3.04 OPERATOR TRAINING

- A. Provide operator training for Owner's personnel after system is operational. Training will take place while manufacturer's representative is at the job site for inspection. Training shall include a review and instruction for the use of the Operation and Maintenance Manuals.
- B. The Owner and the Engineer shall be given not less than one (1) week's prior notification of the scheduling of Operator Training. Operator training conducted prior to the final acceptable operation of the equipment will not be accepted.

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SECTION 11331

MECHANICAL BAR SCREENS WITHOUT BOTTOM SPROCKETS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to install, test, complete, and make ready for operation the mechanical bar screens BS-01 and BS-02, and appurtenant equipment as shown on the Drawings and as specified herein. The Mechanical Bar Screen supplier shall be responsible for providing the associated screening washer/compactor units complete and operational with the Bar Screens.
- B. Screens shall be furnished with but not limited to the following: bar rack, dead plate, discharge chute, side frames, covers, rake blades, drive chains, sprockets (per manufacturer) and bearings, scraper assembly, drive motor, gear reducer, anchor bolts, controls and all accessories and appurtenances specified or otherwise required for a complete and properly operating installation.
- C. The mechanical bar screen shall be a front-raked, front-return screen with chain or link mounted rake arms.
- D. The Contractor shall coordinate all details of the equipment with other related parts of the work, including verifying that all structures, piping, wiring, and equipment components are compatible.
- E. Electric motors shall be furnished as part of the work of this Section and shall conform to all applicable portions of Section 01171, Electric Motors.
- F. One control panel shall be manufactured to control both the new Mechanical Bar Screen, Screw Conveyor, and Screenings Washer/Compactor as described on Section 11333, Screening Washer/Compactor. Control panels shall conform to all applicable portions of Division 13.
- G. The Manufacturer shall develop all required Programmable Logic Controller (PLC) I/O listings, including the assigning of point addresses and point names.
- H. Coordinate with the System Integrator (SI) regarding all required Ethernet communications with SCADA 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 RELATED SECTIONS

- A. Section 01171 – Electric Motors
- B. Section 01782 – Operation and Maintenance Data
- C. Division 3 – Concrete
- D. Division 9 – Finishes
- E. Section 11333 – Screenings Washer/Compactor
- F. Section 14552 – Screw Conveyors
- G. Section 14552 – Screw Conveyors
- H. Division 13 – Instrumentation and Control
- I. Division 15 – Mechanical
- J. Division 16 – Electrical

1.04 REFERENCE STANDARDS

- A. American Bearing Manufacturers Association (ABMA), latest edition:
 - 1. ANSI/ABMA 9 Load Ratings and Fatigue Life for Ball Bearings
 - 2. ANSI/ABMA 11 Load Ratings and Fatigue Life for Roller Bearings
- B. American Gear Manufacturers Association (AGMA), latest edition
- C. American Institute of Steel Construction (AISC), latest edition
- D. American National Standards Institute (ANSI), latest edition
- E. ASTM International (ASTM), latest edition:
 - 1. ASTM A36 Standard Specification for Carbon Structural Steel
 - 2. ASTM A48 Standard Specification for Gray Iron Castings

3. ASTM A322 Standard Specification for Steel Bars, Alloy, Standard Grades
4. ASTM A380 Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems

- F. American Welding Society (AWS), latest edition
- G. National Electrical Manufacturers Association (NEMA), latest edition
- H. Underwriters Laboratories (UL), latest edition
- I. National Fire Prevention Association (NFPA), latest edition
- J. Society of Automotive Engineers (SAE), latest edition

1.05 SUBMITTALS

- A. Submit, in accordance with Section 01300, Submittals copies of all materials required to establish compliance with this Section. Submittals shall include the following:
 1. Certified shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.
 2. Descriptive literature, bulletins and/or catalogs of the equipment.
 3. The total weight of the equipment, including the weight of the single largest item or component and lifting points.
 4. A complete total bill of materials for all equipment.
 5. A list of the manufacturer's recommended spare parts. Include gaskets, packing, etc., on the list.
 6. Recommended summer and winter grade of lubricants along with alternative references to equal products of other manufacturers.
 7. Documentation of the AGMA rating of the drive assembly.
 8. Details of the torque overload device.
 9. Complete data on motor and power factor correction capacitors (if required) in accordance with Section 01171.
 10. Complete description of surface preparation.
 11. Manufacturer's Warranty
 12. Manufacturer's Installation Drawings
 13. Complete master wiring diagrams, elementary or control schematics, physical dimensional or elevation drawings and system single line drawings specific to this

Contract. Standard preprinted sheets or drawings simply marked to indicate applicability to this Contract will not be acceptable.

14. Submittal information shall include detailed information indicating wiring connection points for all external devices and controls as specified herein.
 15. Complete description of the control panel required components.
 16. Show all connections and programming related to equipment described in Section 11333, Screenings Washer/Compactor, and controlled by the control panel furnished under this Section.
- B. In the event that it is impossible to conform to certain details of this Section, describe completely all nonconforming aspects.
- C. Operating and Maintenance Data
1. Operating and maintenance instructions shall be furnished to the Engineer as provided in Section 01782, Operator and Maintenance Data. The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions that are required to instruct operating and maintenance personnel unfamiliar with such equipment.
 2. A factory representative who has a complete knowledge of the proper operation and maintenance shall be provided as specified herein. Qualification of Service Engineer shall be submitted for approval. Man-day requirements listed are exclusive of travel time and do not relieve the Contractor of obligation to provide sufficient service to place equipment in satisfactory operation.
 - a. During installation, assist in location of anchor bolts; setting, leveling, and field erection of bar screen; coordination of piping, electrical, and miscellaneous utility connections: one (1) 8-hour day.
 - b. Startup, testing and calibration: two (2) 8-hour days.
 - c. Operation, maintenance, startup, shutdown, troubleshooting, lubrication, and safety instruction: one (1) 8-hour day.
 - d. Service inspections during first two (2) years of operation, for use at Owner's request, and exclusive of repair, malfunction, or other troubleshooting service calls: two (2) 8-hour days (not anticipated as consecutive).
- D. Process Control Strategy Submittal
1. The process control schemes shall be developed in a ladder logic diagram or functional block (logic) diagram presentation based on information from the Specifications. Included with each diagram shall be:
 - a. Brief Scope of the Control Function
 - b. Listing of all scanned inputs to the control function

- c. A short narrative of the control strategy
 - d. Any assumptions made in developing the program
 - e. Listing of all inputs and outputs (i.e., AI, DI, AO, DO) from the control function
 - f. Cross reference list of all I/O showing to which I/O modules or software modules they are linked
 - g. Listing of all operator inputs/outputs to and from the control function. Any special LCD displays related to the function shall be illustrated. A description of the operation of any panels shall be described as it relates to the control function
 - h. Failure contingencies shall be described in detail
- 2. This submittal shall cover all of the associated ladder logic developed under this Contract required to implement the control functions specified.
 - 3. This submittal shall acknowledge the data registers by the Local SCADA system as defined in Division 13. The submittal shall list the memory location for these registers.
 - 4. After completion of installation, testing, and acceptance, the programs developed for PLCs, HMIs, and any other programmable equipment, shall be provided electronically. The programs must be documented for future troubleshooting by the Owner using the PLC/HMI manufacturer programming tools.

1.06 QUALITY ASSURANCE

- A. All the equipment specified under this Section shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the equipment to be furnished. The mechanical bar screen shall be suitable for satisfactory operation within the maximum and minimum water levels of the channel in which it is installed and as indicated in this Section.
- B. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service prior to delivery, except as required by testing.
- C. The equipment shall be designed, constructed, and installed in accordance with the best practices and methods and shall be the FlexRake Bar Screen by Duperon Corporation, Aqua Caiman Articulating Rake Mechanical Bar Screen by Parkson Corporation, or Multi-rake Bar Screen VersaMax by Huber.
- D. Should equipment which differs from this Section be offered and determined to be the equal of that specified, such equipment shall be acceptable only on the basis that any revisions in the design and/or construction of the structure, piping, appurtenant

equipment, electrical work, etc., required to accommodate such a substitution shall be made at no additional cost to the Owner and be as approved by the Engineer.

- E. Manufacturer shall have at least 50 installations of link driven mechanically cleaned bar screen equipment that has been in successful operation, at similar installations.

1.07 SYSTEM DESCRIPTION

- A. All of the equipment specified herein is intended to be standard mechanical bar screening (fine screen) equipment capable of removing miscellaneous suspended objects (screenings) greater in any dimension than the clear bar spacing from raw sanitary wastewater. The bar screen shall be a front-raked, front-return screen with chain or link mounted rake arms. Equipment featuring reciprocating rake arms will not be accepted. Equipment featuring a bottom (submerged) sprocket will not be accepted.
- B. The screening equipment shall consist of stainless-steel bars, each spaced as noted below that are mechanically cleaned by rakes engaging the bars from the front (upstream side) at the channel invert and positively removing the miscellaneous objects (screenings) trapped and caught on the bars during each upward travel of the rake, discharging them above the liquid surface. The screenings will be discharged from the screen into a screw conveyor as specified under Section 14552, Screw Conveyors, and transported to a washer/compactor as specified under Section 11333, Screenings Washer/Compactor, for further disposal. The main control panel shall power and control all pieces of equipment.
- C. A main control panel shall be furnished for each bar screen, screw conveyor, and washer/compactor set to provide the required equipment control. The main control panel shall be located indoors in a climate-controlled environment, rated for NEMA12, and shall be a free-standing enclosure with 12-inch full depth leg kit. A local control panel shall be furnished for each bar screen and conveyor/washer/compactor set to provide local maintenance interface. All local control panel components located at the bar screen shall be rated for installation inside a Class 1 Division 2 envelope. Each bar screen shall be controlled by receiving start and stop signals from the PLC based on timer, differential level, and manual on/off as supplied under this section and as shown in the Contract Drawings.
- D. The frequency of screenings removal shall be normally controlled by a timer. This timer mode of operation shall be overridden by a high differential liquid level across the screen. The level sensing system preference is upstream and downstream radar sensors. The radar sensors may be loop-powered units with 4-20mA signal to the control panel PLC, or may be provided with controllers mounted in the main control panel. The radar sensors shall be provided by the equipment manufacturer for Contractor installation. Any other manufacturer proposed method of controlling the bar screen operation will only be considered during the submittal phase (after award of the Contract).
- E. The Manufacturer shall provide all PLC programming functions, including but not limited to, control strategies and communications.

- F. The mechanical bar screen equipment at the Bentonville Water Resource Recovery Facility shall be as follows:

1. Number of Units:	Two (2)
2. Type:	Mechanically Cleaned Inclined Screen
3. Location:	Bentonville, AR
4. Tag:	BS-01, BS-02
5. Peak Flow:	30.0 million gallons per day (each)
6. Channel width:	6 feet
7. Channel depth:	10 feet
8. Channel water depth:	1.25 to 8.0.feet
9. Minimum Screen Height:	10 feet
10. Bar rack angle of incline:	60 degrees (from horizontal)
11. Bar spacing (clear space):	1/4-inch
12. Rack Speed:	22 to 112 inches/minute (continuous)
13. Motor HP:	3/4 hp, minimum (sized by manufacturer)
14. Motor type:	Horizontal, Explosion-proof, NEMA Design B, Outdoor Service

- G. All components shall be designed such that jamming at any point will not result in structural failure but will cause the motor to stall. All components shall be designed to withstand the stalling torque without damage or permanent distortion.

1.08 MAINTENANCE

- A. Special tools, if required for normal operation and maintenance, shall be furnished with the equipment by the manufacturer.
- B. Provide the following spare parts:
1. Four (4) rake bars
 2. One (1) complete set of screen chains for each side of the screen, assembled with attachment fittings and couplings
 3. One (1) drive clevis pin per screen
 4. Ten (10) snap/retaining rings per screen
 5. Four (4) link clevis pins per screen
 6. Four (4) sets of scraper bolts and nuts per screen
 7. One (1) snap ring tool
 8. One (1) 3-ounce tube of Never Seez ®
 9. 5-year supply of lubrication for bar screen components for both screens
- C. Spare parts shall be delivered to the Owner on the day of equipment startup in the presence of the Engineer and equipment manufacturer's representative.

1.09 WARRANTY SUBMITTAL REQUIREMENTS

- A. Manufacturer shall provide a written one (1) year standard warranty of the mechanically cleaned bar screen equipment to guarantee that there shall be no defects in material or workmanship in any item supplied, commencing at the date of final acceptance by the Owner.

- B. Manufacturer shall provide a written five (5) year standard warranty for all rotating parts of the mechanically cleaned bar screen including the gear motor, bearing, drive head, and the link system including the links, castings, pins and retaining rings.

PART 2 PRODUCTS

2.01 MATERIAL AND EQUIPMENT

- A. This specification calls attention to certain features but does not purport to cover all details of construction of the equipment. Furnish and install the equipment complete in all details and ready for operation. Unless otherwise noted, all bar screen components shall be constructed of Type 304 stainless steel. Carbon steel, plated steel, or any other material is not acceptable.
- B. All the mechanical bar screening equipment shall be assembled in the manufacturer's shop to ensure proper fitting of parts, the control panel shall be prewired, tested, and then matchmarked for erection, and disassembled for shipment.

2.02 BASIS OF DESIGN

- A. The mechanically cleaned bar screen shall have a head sprocket only, with no sprockets, bearings, idlers, or similar drive components under water to trap the chain. Equipment featuring reciprocating rake arms is not acceptable.
- B. The mechanically cleaned bar screen shall clean the entire bar screen a minimum of every 14 seconds at high speed.
- C. The mechanically cleaned bar screen shall be designed to run continuously (24/7) when energized by the controls.
- D. The equipment shall have multiple scrapers on the bar screen at one time cleaning continuously from bottom to top, the entire width of the bar screen. The drive output shaft rotation shall be constant and in one direction in order to reduce maintenance and increase product life. Units which have single raking arms shall not be allowed. Cleaning mechanisms that utilize shock absorbers, springs or other dampening or hydraulic actuations are unacceptable.
- E. The link system shall have jam evasion capability by flexing around and collecting large objects and surges of solids at peak loading times without overloading and shutting down the unit. The link system shall be such that it bends in one direction only, and the unit shall have a 1,000-pound lifting capacity.
- F. Designs employing the use of endless moving media or cables and hydraulic cylinders to remove debris from the channel and units utilizing proximity or limit switches for reverse cycles are not acceptable.
- G. Equipment using a motor greater than 1 hp to complete a screen cleaning cycle is not acceptable.

- H. The design shall be such to ensure that all maintenance can be accomplished at the operating floor level or above. No part of the drive system including sprockets shall be located below the water surface at maximum design flow.

2.03 COMPONENTS

A. Bar Screen Assembly

1. Screen Bars: Bars shall be Type 304 or 316 stainless steel and be tear-shaped with a Hydraulic Coefficient shape factor of 0.76 and the minimum dimensions of 0.25-inch x 0.75-inch x 0.13-inch. Bars shall be individually replaceable without welding.
2. Link System: The link system shall be stainless steel castings and have a minimum ultimate strength of 60,000 lbs. with a minimum cross section of 1.5 inches and weighing a minimum of 4.5 lbs. each. System shall include 302 stainless steel retaining rings and 304 stainless steel pins. Link slide assembly shall be provided per manufacturer standard design and shall be constructed of UV Stable UHMW PE rollers and 304 stainless steel supports and components
3. Frame: The screen framework shall be 304 stainless steel bent plate with minimum of 1/4 inch cross section. Horizontal members shall be of stainless-steel bent plate or stainless-steel pipe. Support members and frame shall adequately support the bar screen based on site specific requirements. A stainless-steel channel bottom plate shall be an integral part of the bar screen assembly to fully engage scrapers in the bar screen at the base of the unit and assure that the raking mechanism reaches the bottom of the screen to prevent debris accumulation
4. Dead Plate: Dead plate shall be 1/4-inch thick 304 stainless steel. The dead plate shall be flat and true; span the entire width of the unit; and transition from bar screen to discharge point.
5. Discharge Chute: Discharge Chute: The discharge chute shall be 11-gauge (0.12 inch) 304 stainless steel. The discharge chute shall be bolted to the dead plate and shall be designed to allow debris to be transferred from discharge point into the debris containment.

B. Scrapers and Return Guide

1. Scrapers: Scrapers shall be spaced 24 inches apart. To provide long product life the scraper shall move at no greater than 34 inches per minute at standard operating speed of 0.71 rpm allowing for approximately 1.41 debris discharge per minute. Staging Scrapers and Thru Bar Scrapers shall be a maximum ratio of 3:1 per manufacturer recommendations. At least one scraper every 102 inches shall fully penetrate the bar screen, cleaning all three sides of the bars as well as through to the cross members in openings of 1/4, 3/8 and 1/2 inches.
 - a. Staging Scrapers: Staging Scrapers shall be 1-inch-thick x 5 inches x screen width UV Stable UHMW-PE with a serrated edge.
 - b. Thru Bar Scrapers: Thru Bar Scrapers shall be minimum .375 inch thick 304 stainless steel.

2. Return Guide/Closeouts: Return guide/Closeouts shall be 304 stainless steel and shall assure proper alignment of scrapers as they enter the bar screen and assure that there is no space wider than the clear opening between bars to prevent passage of larger solids than allowed through the screen.

C. Debris Blade

1. A 304 stainless steel and UV Stable UHMW-PE debris blade assembly, which does not require a separate drive, shall be installed to assist in removing debris from the scraper on the mechanically cleaned bar screen unit as recommended by the manufacturer.

D. Screen Enclosure

1. A 14-gauge, #4 brushed satin finish 304 stainless steel enclosure shall be installed to cover the screen above the operating deck level. Front enclosure shall have removable panels for access to equipment and a polycarbonate viewing pane. Removable panels shall be 16-gauge 304 stainless steel and shall be provided with knurled knobs for "no tool required" access. Alignment notches shall be included to support repositioning of removable panels. Rear enclosure shall have hinged removable doors and shall be secured with a lift-slide-latch handle. Rear removable door shall include an integral viewing door that shall be secured with a lift-slide-latch handle to provide access for a quick look inside.

E. Drive Unit

1. Each mechanically cleaned bar screen unit shall operate independently and shall have its own drive unit and driven components. The Drive Head shall be located at the top of the mechanically cleaned bar screen
 - a. Drive Sprockets and end castings shall be cast 304 stainless steel.
 - b. Drive Shaft shall be 304 stainless steel.
 - c. Gearbox shall be shaft-mounted, right-angle type and incorporate cycloidal and spiral bevel gearing with a total ratio of 424:1. The gear reducer output shaft speed shall be controlled by a volts/hertz type inverter or per rake manufacturer's recommendation. It shall have at least a 1.39 or greater service factor based on machine torque requirements. The gearbox shall not be vented to the outside atmosphere.
 - d. The motor shall be AC induction type, 3 phase 240/480 volt, and mounted to the gear reducer. Motor shall be 3 hp, designed for 1800 RPM base speed, and rated for Class I, Groups C & D, Class II Groups F & G environments, and for use with an inverter. Motor shall have a 6/1 speed range, EPNV enclosure, NEMA design B with a 56C frame size. Service factor shall be 1.0 with 1600V, Class F insulation rated for temperatures up to 40 degrees C. The motor will have 1600-volt insulation, optimized for IGBT type inverters and shall be UL listed.

- e. Motor shall have built in thermostat to protect from overheating that is to be field wired to corresponding terminal in control panel for redundant (ambient) overload protection.
 - f. All drive head components shall be of components available in the United States.
- 2. Bearing: Bearing shall be greased ball bearing type, non-self-aligning, sealed and lubricated and shall have a 24/7/365 L10 life of 20 years when in compliance with stated O&M recommendations.
 - 3. Speed Reducer: Speed reducer shall be 0.69 to 4.13 (in high flow conditions) output rpm, 11,000 in.-lb. output torque 424:1.

F. Corrosion Protection Requirements

- 1. Permanent or intermittently wetted parts shall be constructed of Type 304 or Type 316 stainless steel, as appropriate for the operations environment. These parts shall include but are not limited to structural support frame, rake support arm, rake, and bar rack. All stainless-steel components permanently or intermittently wetted shall undergo a pickling and passivation process in accordance with ASTM A380. All other stainless-steel components shall have a Type 2B finish and all welds shall be passivated.
- 2. All non stainless bar screen components shall be coated in accordance with Section 09902, Finish Painting.

2.04 CONTROL PANELS

A. General

- 1. A main control panel shall be furnished for each bar screen, screw conveyor, and washer/compactor set to provide the required equipment control. The main control panel shall be located indoors in a climate-controlled environment, rated for NEMA12, and shall be a free-standing enclosure with 12-inch full depth leg kit. A local control panel shall be furnished for each bar screen, conveyor, and washer/compactor set to provide local maintenance interface. All local control panel components located at the bar screen shall be rated for installation inside a Class 1 Division 2 envelope. Each bar screen shall be controlled by receiving start and stop signals from the PLC based on timer, differential level, and manual on/off as supplied under this section and as shown in the Contract Drawings.
- 2. The frequency of screenings removal shall be normally controlled by a timer. This timer mode of operation shall be overridden by a high differential liquid level across the screen. The level sensing system preference is upstream and downstream radar sensors. The radar sensors may be loop-powered units with 4-20mA signal to the control panel PLC, or may be provided with controllers mounted in the main control panel. The radar sensors shall be provided by the equipment manufacturer for Contractor installation. Any other manufacturer proposed method of controlling the bar screen operation will only be considered during the submittal phase (after award of the Contract).

3. Each drive shall automatically restart after a power failure.
4. The Manufacturer shall coordinate the function of the control panel with all related equipment. The Contractor shall provide all wiring, conduit and accessory items between the control panels, bar screen and associated screw conveyor/washer/compactor equipment.
5. The main control panel shall contain a programmable logic controller (PLC) required for the correct operating sequence. The PLC shall be Allen-Bradley CompactLogix 5380 as specified in Division 13.
6. The main control panel shall be suitable for use on a 460 Volt, 60 Hz power supply. Local control panels shall be suitable for use on a 120 Volt, 60 Hz power supply.
7. The Base Bid for this project shall take into consideration the controls, ancillary features, and operational sequences as described in this Section. Any other manufacturer proposed method of controlling the bar screen operation will only be considered during the Engineer's review of the equipment submittal for the bar screen.

B. Control Description

1. The controls described herein apply to a bar screen and associated Screw Conveyor and Screenings Washer/Compactor specified in Sections 14552 and 11333, respectively. Any deviations from the control sequence described shall be approved by the Engineer.
2. The main control panel shall include control of the screens and screenings washer/compactor with interlocks as follows:
 - a. The screen and associated screw conveyor and screenings washer/compactor shall be operable continuously or automatically based on differential head signals provided by the bar screen PLC. A timer override shall be provided with the ability for the operator to operate the screens based on a timed basis.
 - b. The controls for the screen shall be interlocked with the screw conveyor and washer/compactor such that upon a bar screen stop sequence of operation, or on a timer if the bar screen is operating continuously, the bar screen shall operate for a pre-set time period to clean the bar screen and the screw conveyor and screenings washer/compactor will also continue for a period to empty the screw conveyor and washer/compactor.
 - c. Motion detector switches or another approved method shall be provided on the screening washer/compactor and shall be interlocked in the main control panel to shut down the bar screen if the screening washer/compactor or screw conveyor is not operating. A sound alarm shall be provided for equipment failure of any of the three (3) system components.
 - d. A high differential level alarm shall be provided to override the normal operating controls for the bar screens so that the bar screen and respective screenings

washer/compactor operates continuously whenever the differential water level is high.

3. With the Local/Off/Remote selector switch at the local control panel in the Local position, the bar screen shall run as dictated by the local station start switch. In the Remote position, the bar screen shall be automatically started from the main control panel based on a timed function as described below:
 - a. The bar screen shall be cycled on and off by control signals from the main control panel PLC based on a timed sequence. Cycle frequency and duration times shall be set through the main control panel operator interface.
 - b. The system shall be designed to allow a main control panel PLC timer override. The override system shall be generated from a differential level calculation based on the upstream and downstream continuous level transmitters. Once a preset differential level has been reached, the PLC shall initiate the bar screen override system. Once directed to start, the bar screen shall continue to operate until the differential level is reduced to a normal operating level. At that time the frequency and duration timing shall operate the bar screen.
 - c. The bar screen shall include auto-reverse or other features to address jamming or other obstructions to the rakes.

C. Main Control Panel

1. The following door mounted- controls shall be provided along with any other desirable functions or displays not listed below: The functions listed below shall be available with individual components or replicated with an Operator Interface touchscreen display located on the front of the control panel.
 - a. FORWARD and REVERSE red pilot lights
 - b. Green STOP pilot light
 - c. AUTOMATICMANUAL selector switch
 - d. RAISE and LOWER pushbuttons
 - e. Amber TORQUE OVERLOAD pilot light
 - f. RESET pushbutton
 - g. RUN/STOP maintained contact pushbutton
 - h. Frequency Timer Set point: For selection of time duration between starts (from one (1) to twenty-four (24) hour)
 - i. Duration Timer Set point: To ensure that the screen will continue to operate for a run time
 - j. Differential Level

- k. Differential High Level set point
 - 2. In addition, an amber flashing light shall be mounted on top of the control panel to signal alarm conditions.
- D. Local Control Panel
- 1. The following local control panel controls shall be provided along with any other desirable functions or displays not listed below:
 - a. Local/Off/Remote Switch
 - b. Start Switch
 - c. Emergency Stop Switch/Pull Cord (or Push Button)
- E. Ethernet Network
- 1. The main control panel PLC shall be linked to the SCADA Control System network via a Cat5e/Fiber Optic cable. The manufacturer shall provide a continuous memory map to the System Integrator for inclusion of equipment status and alarms. The information to be supplied to the SCADA network is listed in Division 13.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in strict accordance with the respective manufacturer's instructions and recommendations in the locations 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. Anchor bolts shall be furnished by the equipment manufacturer and set in accordance with the manufacturer's recommendations and setting drawings.
- B. The CM shall be responsible for the coordination of this equipment with the requirements of the screenings hopper for the compactor to obtain a complete, integrated, and satisfactory operating installation.

3.02 INSPECTION AND TESTING

- A. The manufacturer shall furnish the services of a factory representative, as provided under Paragraph 1.03C above, who has complete knowledge of proper operation and maintenance to inspect the final installation and supervise a test run of the new and re-located equipment. These services may be combined with those provided under Paragraph 1.03C above.
- B. Working under the direction of the factory representative, and in the presence of the Engineer, perform dry field tests on the mechanical bar screen as follows:
 - 1. First, the mechanical bar screen shall have a dry test run to demonstrate the correct alignment, smooth operation, proper and equal spacing of screen bars, freedom from vibration, excessive noise and overheating of the parts and bearings.

2. Secondly, an overload torque test shall be conducted to test the torque overload device to operate and stop the bar screen at a loading condition equal to 150 percent of the actual working load of the primary drive chain or as required to protect the drive unit, whichever is less.
3. Modified anchor bolts furnished by the equipment manufacturer shall be bolted to the screen bars. The anchor bolting arrangement shall be suitable for the loads applied and simulate solids jamming the screen bars.
4. The necessary adjustments and settings to the overload device shall be made at this time to ensure that the mechanical bar screen will stop, switch off the drive motor and sound an alarm when a predetermined overload condition occurs on the screen bars.
5. Manufacturer's representative shall demonstrate proper and sequential operation of the screen, including rake teeth profiling and reaction to jamming and obstructions.
6. 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 CM.
7. The tests shall be conducted in the presence of the Engineer.
8. In the event the mechanism fails to meet the above test, the necessary changes shall be made, and the mechanism retested. If the mechanism remains unable to meet the test requirements to the satisfaction of the Engineer, it shall be removed and replaced with a satisfactory mechanism at the CM's expense.

END OF SECTION

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SECTION 11333

SCREENINGS WASHER/COMPACTOR

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to install, test, complete and make ready for operation the washer/compactor unit SC-01 and SC-02, including appurtenant equipment as shown on the Drawings and as specified herein. The Mechanical Bar Screen supplier shall be responsible for providing the associated screenings washer/compactor unit complete and operational with the bar screens.
- B. The requirements of this Section 11333 should be considered in conjunction with the requirements of Section 11331, Mechanical Bar Screens without Bottom Sprockets.
- C. The Contractor shall coordinate all details of the equipment with other related parts of the work including verifying that all structures, piping, wiring, and equipment components are compatible. The Contractor shall also be responsible for all structural and other alterations required to accommodate equipment differing in dimensions or other characteristics from these Specifications and Drawings.
- D. Electric motors shall be furnished as part of the work of this Section and shall conform to all applicable portions of Section 01171, Electric Motors.
- E. Control panel devices and other control panel required items are included in Section 11331, Mechanical Bar Screen without Bottom Sprocket.
- F. The washer/compactor shall be constructed of AISI 304 stainless steel.
- G. Coordinate with System Integrator (SI) regarding all required Ethernet communications with SCADA 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 RELATED SECTIONS

- A. Section 01771 – Electric Motors
- B. Section 01782 – Operation and Maintenance Data
- C. Division 3 – Concrete
- D. Division 9 – Finishes
- E. Section 11331 – Mechanical Bar Screens without Bottom Sprockets
- F. Section 14552 – Screw Conveyors
- G. Division 15 – Mechanical
- H. Division 16 – Electrical

1.04 REFERENCE STANDARDS

- A. American Bearing Manufacturers Association (ABMA), latest edition:
 - 1. ANSI/ABMA 9 Load Ratings and Fatigue Life for Ball Bearings
 - 2. ANSI/ABMA 11 Load Ratings and Fatigue Life for Roller Bearings
- B. American Gear Manufacturers Association (AGMA), latest edition
- C. American Institute of Steel Construction (AISC), latest edition
- D. American National Standards Institute (ANSI) latest edition
- E. ASTM International (ASTM), latest edition:
 - 1. ASTM A36 Standard Specification for Carbon Structural Steel
 - 2. ASTM A48 Standard Specification for Gray Iron Castings
 - 3. ASTM A322 Standard Specification for Steel Bars, Alloy, Standard Grades
 - 4. ASTM A380 Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
- F. American Welding Society (AWS) latest edition
- G. National Electrical Manufacturers Association (NEMA) latest edition
- H. Underwriters Laboratories (UL) latest edition

1.05 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, Submittals copies of all materials required to establish compliance with this Section. Submittals shall include the following:
1. Certified shop and erection drawings showing all important details of construction, dimensions, and anchor bolt locations
 2. Descriptive literature, bulletins and/or catalogs of the equipment
 3. Details of bearings
 4. Certifications by a professional engineer, licensed in the State of Arkansas that:
 - a. The auger is protected from overload when the auger's torsional loading exceeds 50 percent (50%) of its torsional rating
 - b. At its torsional rating, the stress in the auger does not exceed 50 percent (50%) of the F_y value in the outermost extreme fiber of the flight material
 5. The total weight of the equipment including the weight of the single largest item or component
 6. A complete total bill of materials for all equipment
 7. A list of the manufacturer's recommended spare parts. Include gaskets, packing, etc., on the list
 8. Recommended summer and winter grade of lubricants along with alternative references to equal products of other manufacturers
 9. Documentation of the AGMA rating of the drive assembly
 10. Details of the torque overload device
 11. Complete data on motor and power factor correction capacitors (if required) in accordance with Division 16
 12. Complete description of surface preparation and shop prime painting
 13. Show all connections and programming related to equipment described in Section 11331, Mechanical Bar Screen without Bottom Sprockets and controlled by the control panel furnished under this Section
- B. In the event that it is impossible to conform to certain details of this Section, describe completely all non-conforming aspects.

C. Operating and Maintenance Data

1. Operating and maintenance instructions shall be furnished to the Engineer as provided in Section 01782, Operation and Maintenance Data. The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists and descriptions that are required to instruct operating and maintenance personnel unfamiliar with such equipment.
2. A factory representative who has complete knowledge of the proper operation and maintenance shall be provided as specified herein. Qualification of Service Engineer shall be submitted for approval. Man-day requirements listed are exclusive of travel time and do not relieve the Contractor of obligation to provide sufficient service to place equipment in satisfactory operation.
 - a. During installation, assist in location of anchor bolts; setting, leveling, and field erection of bar screen; and coordination of piping, electrical, and miscellaneous utility connections: one (1) 8-hour day
 - b. Startup, testing and calibration: two (2) 8-hour days
 - c. Operation, maintenance, startup, shutdown, troubleshooting, lubrication and safety instruction: one (1) 8-hour day
 - d. Service inspections during first two (2) years of operation, for use at Owner's request, and exclusive of repair, malfunction, or other troubleshooting service calls: two (2) 8-hour days (not anticipated as consecutive)

1.06 QUALITY ASSURANCE

- A. All the equipment specified under this Section shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the equipment to be furnished.
- B. The equipment shall be designed, constructed, and installed in accordance with the best practices and methods and shall be as manufactured by Parkson Corporation, Duperon Inc., Huber Technology, or approved equal.
- C. Should equipment which differs from this Section be offered and determined to be the equal of that specified, such equipment shall be acceptable only on the basis that any revisions in the design and/or construction of the structure, piping, appurtenant equipment, electrical work, etc., required to accommodate such a substitution shall be made at no additional cost to the Owner and be as approved by the Engineer.

1.07 SYSTEM DESCRIPTION

- A. The system shall be designed to receive, positively convey, wash and compact screenings discharged from the bar screens and screw conveyors as described in Section 11331, Mechanical Bar Screens without Bottom Sprockets, and Section 14552, Screw Conveyors. The screenings shall be discharged from the bar screen to the screw conveyors and into the inlet washer/compactor hopper, directly to a washing zone

followed by a compacting zone and discharge them through a discharge tube and into a dumpster (by others) for final disposal.

- B. The washer/compactor shall have a minimum design capacity of 25 cubic feet per hour and be suitable for use with a continuously operating bar screen. The washer/compactor shall remove a minimum of 30 percent (30%) free water, reduce screenings volume by a minimum of 70 percent (70%), and produce a dry screenings content of 30 to 60 percent (30% to 60%) capable of passing a Paint Filter Test.
- C. The conveyor/washer/compactor equipment shall be as follows:
 - 1. No. of units: Two (2)
 - 2. Conveyor length: See Drawings
 - 3. Drive configuration: Push drive
 - 4. Motor Hp (min.): 3 hp
 - 5. Motor type: Explosionproof, NEMA Design B, Outdoor Service
- D. The conveyor/washer/compactor length is not exact. Washer/compactor manufacturer shall coordinate system to function as shown on the Drawings and specified herein.
- E. The overall dimensions of the washer/compactor and appurtenances shall fit within the space shown on the Drawings. Verify equipment supports, structure dimensions and arrangement and notify the Engineer of any discrepancy before submitting shop and erection drawings for approval. Coordinate all interfaces of the washer/compactor equipment with all related equipment specified in this section and in other related Sections. The washer/compactor shall comprise complete coordinated systems including, but not limited to drive, discharge pipe, supports, liner, gear reducer, motor, limit switch, and all appurtenances as shown on the Drawings or as specified herein.

1.08 MAINTENANCE

- A. Special Tools
 - 1. Special tools, if required for normal operation and maintenance, shall be furnished with the equipment by the manufacturer. Special tools are considered to be those tools which, because of their limited use, are not normally available, but which are necessary for maintenance. Special tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such special tools until completion of the project at which time they shall be delivered to the Owner.
- B. Furnish the following spare parts for the washer/compactor:
 - 1. Two (2) replacement augers
 - 2. Two (2) sets of UHMW screw supports with stainless steel fasteners
 - 3. One (1) set of shaft seals
 - 4. One (1) thrust bearings (if applicable)
 - 5. One (1) complete set of tools and fasteners to make repairs
 - 6. Sufficient oil to provide one (1) oil change for reducer gear motors

- C. Spare parts shall be delivered to the Owner on the day of equipment startup in the presence of the Engineer and equipment manufacturer's representative.

1.09 WARRANTY SUBMITTAL REQUIREMENTS

- A. For the equipment specified, submit a warranty from the equipment manufacturer. The manufacturer's warranty period shall be for one (1) year, unless otherwise specified, commencing at the time substantial completion and final acceptance by the Owner.

PART 2 PRODUCTS

2.01 GENERAL

- A. This Section calls attention to certain features but does not purport to cover all details of construction of the equipment. Furnish and install the equipment complete in all details and ready for operation. Unless otherwise noted, all washer/compactor components shall be constructed of Type 304 or 316 stainless steel. Carbon steel, plated steel, or any other material is not acceptable.
- B. The washer/compactor system shall be designed for both continuous and for intermittent operation at a capacity not less than that specified.
- C. The exact length of the washer/compactor unit will depend on the equipment selected. Ample room and facilities shall be provided for inspection, repairs, lubrication, and adjustments.
- D. The washer/compactor shall convey, wash, and compact screenings in a neat, quiet, dependable and nuisance free manner.
- E. The compatibility of the washer/compactor equipment with all other related equipment shall be the responsibility of the Contractor.
- F. The equipment shall be of high quality and of design and construction which, as a whole, will ensure satisfactory operation at all times under the conditions specified and satisfy the following requirements:
 - 1. There shall be no projecting set screws or other parts to endanger workmen. All devices required for the compliance with safety laws shall be provided.
 - 2. Sharp corners of all cut or sheared edges shall be smoothed.
 - 3. Provision shall be made for ample and convenient lubrication of all machinery without danger of injury to the operators.
 - 4. All shafting shall be of ample diameter and provided with suitable bearings for the service required. Suitable means for making adjustment on parts subject to wear shall be provided where necessary.
 - 5. Installations shall be easy to maintain and keep clean. The equipment shall be capable of withstanding a daily washdown using high-pressure water.

- G. The washer/compactor shall be assembled to the greatest extent possible in the manufacturer's shop to ensure proper fitting of parts. Assembled sections shall then be match-marked for field erection and disassembled prior to shipment. Deliveries shall be shipped in the maximum shipping lengths permitted.
- H. Furnish all required anchor bolts and other anchorage for the structure. Anchor bolts, nuts and washers shall be of Type 304 stainless steel unless otherwise specified.

2.02 COMPACTOR WASHER

A. Design Features

- 1. Compacting Action: The washer/compactor shall include a single or dual auger(s) to provide positive displacement action, shall be orientated on top of each other, and shall rotate in opposing directions. Dual auger(s) shall be intermeshed, have one (1) left-hand and one (1) right-hand lead, and shall have ability to rotate 9.8 rpm in opposing directions. Compactor auger(s) shall be designed with a limited float on top of a perforated plate, allowing them to accommodate irregular debris.
- 2. Washing Action: The washer/compactor shall include a wash port manifold prior to the compaction housing and deliver 3 to 10 gpm of wash water, assuming a supply pressure is 40 to 60 psi. The water source shall connect to a 1/2-inch NPT connection point, utilizing filtered effluent. Washing action shall be a flood wash type from a single 1/2-inch NPT supply. Drain connection shall be 3-inch NPT male connection.
- 3. Operation: Washer/Compactor shall be designed for continuous, automated operation. Washer/Compactor shall be equipped with a self-regulating, active pressure zone designed to accept non-standard wastewater debris in its original form, such as rocks, broken concrete, and metal (bolts, short pipe, etc.) up to 4 inches long. Washer/Compactor shall have the ability to process multiple pieces of clothing, variable volumes of debris, and unprocessed septage or grease. The Compactor shall move at normal operating speed of 2.4 to 9.8 rpm and be capable of operating intermittently to sync with upstream equipment.
- 4. Spray bars shall be incorporated on the underside of the sieve zone and shall spray the underside of sieve zone to prevent grease buildup following each screenings cycle.

2.03 MATERIALS

- A. Fabrications: All welded fabrications are to be made from 304 or 316 stainless steel. All welded connections and welding procedures shall comply with AWS Structural Welding Code – Sheet Steel, Section D1.3/D1.6.
- B. Select Parts: Select power transmission parts to be made from cast iron; however, shall conform to coating as follows.
- C. Standard Coating: Motor Gearbox assembly components shall be coated in accordance with the gearbox manufacturer's standard heavy duty coating system.

D. Non-metal: Parts not covered above shall be made from UHMW polyethylene.

E. Parts and Equipment:

1. Compactor Housing: The compactor housing shall be constructed of 304 stainless steel, be a minimum of 11 gauge, and connect to 3/8-inch-thick flanges.
2. Augers: Augers shall be of 304 stainless steel with 3/8-inch flights and have a 4-inch flight pitch. Augers shall be float mounted in a UHMW thrust and plane bearing arrangement that allows movement for accommodation of irregular debris.
3. Drive Assembly:
 - a. Each Washer Compactor unit shall operate independently and will have its own drive unit and driven components. The gearbox shall not be vented to the outside atmosphere.
 - b. The gearbox shall be grease lubricated and designed for five (5) years between recommended clean and re-grease services. The gearbox shall be right angle type and shall incorporate cycloidal and spiral bevel gearing. The gear reducer output shaft speed shall be 2.4 rpm minimum and controlled by a vector type inverter or greater service factor based on unit torque requirements.
 - c. The motor shall be mounted to the gear reducer by utilizing a quill, C-Face mounting style. The gear motor shall be AC induction type, 3 hp, 230/460 V, 3 phase, 60 Hz, TEFC, rated for Class I, Division 2 service.
4. Speed Reducer: Shall have a maximum output of 9.8 rpm, 179:1 reduction ratio with 19,040 in-lb of output torque.
5. Thrust Bearings (if Applicable): Shall be UHMW thrust type, self-lubricating and be capable of withstanding 2000 lbs of thrust load (each auger) at 9.8 rpm for life of machine.
6. Screw supports: Shall be UHMW plane type, self-lubricating and fastened into place using stainless steel fasteners.
7. Spur Gears: Shall be 17-4 PH stainless steel.

2.04 WASHER/COMPACTOR COMPONENTS

A. Wash Zone

1. The Wash Zone shall be tubular in design and shall incorporate a collection pan under the sieve zone.
2. The Wash Zone shall be constructed of 304 stainless steel plate with 1/4-inch diameter perforations.
3. The Wash Zone shall consist of a spray header with spray nozzles to provide cleaning of screenings before compacting. The Wash Zone shall include a solenoid

valve to control flow of water and a wye strainer to prevent fouling of the spray nozzles. All piping and valves between the water source and the wash zone shall be the responsibility of the Contractor.

B. Press Zone

1. The Press Zone shall be constructed of 304 stainless steel and shall be integrally connected to the wash and transport zones.
2. A Collection Pan shall be incorporated in the design and shall be located directly under the press zone.

C. Collection Pan

1. An integral Collection Pan shall be located directly under the sieve zone, wash zone, and press zone.
2. The Collection Pan shall be constructed of 304 stainless steel and attached to the compactor body with clamps.
3. Water shall periodically be introduced into the Collection Pan to flush organics and fines to the drain. The flush water system shall require a minimum of 10 gpm at 40 psi. Flush water shall flow to base of the collection pan to a 3-inch drain outlet. The outlet shall be plumbed to a floor sink.

D. Discharge Tube

1. The Discharge Tube shall be constructed of 304 stainless-steel. The Discharge Tube shall be shaped to prevent plugging.
2. The Discharge Tube shall direct and discharge screenings into the dumpster on the lower level and shall include a flexible heavy duty rubber skirt on the discharge end. The tube shall be supported using stainless steel pipe supports as required to prevent sagging.

E. Accessories

1. The washer/compactor unit shall be provided with an emergency shutdown pull cord and switch or push button. The pull cord shall run the full length of the conveyor. The safety switch shall immediately stop the system when the switch is actuated.
2. Washer/Compactor shall be equipped by the manufacturer with an electronic power or current monitor/trip. The detector shall connect directly to the motor cable and measure the motor input power and compensate for the internal losses in the motor. The detector will sense the output shaft power from the electric motor. The normal load level for the conveyor motor is to be set by an alarm level control. If the set load level is exceeded, the internal relay contact will change state. The output relay contact will be used for alarm and shutdown of the conveyor. The speed of trip on sensing an overload condition shall be adjustable between the range of 0.1 to 3 seconds.

F. Supports

1. The supporting framework shall be of AISI 304 or 316 stainless steel designed in conformance with the requirements of the latest revision of the AISC Standards for the Design, Fabrication and Erection of Structural Steel for Buildings. Support loads shall be based on a completely filled pipe plus dead weight of the equipment.
2. The supporting framework shall be self-supporting and designed to a minimum of twice the natural frequency of the unit under all loading conditions.
3. The ratio of the unbraced length to the 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 the Z-Z axis).
4. All structural members and connections shall be designed so that the unit stresses will not exceed AISC allowable stresses by more than 1/3 when subject to loading of twice the running torque of the drive motor.
5. Supports shall be provided near the drive unit (approximately 1 to 2-ft) and at a quantity of not less than one for every 12-ft (or part thereof) of length of pipe segment; provide a support adjacent to the transfer.
6. Supports shall be constructed of Type 316 stainless steel using welded construction with bolted connections to conveyor casings, feet, and support points. Field connections shall be bolted using reamed, sub punched holes and finished bolts as follows:
 - a. Supporting members attached to concrete shall be by Type 316 stainless steel anchor bolts. A minimum of two bolts shall be used per supporting member.
 - b. Supporting members attached to structural steel elements shall be by Type 316 stainless steel hex bolts with one flat washer and one lock washer. A minimum of two bolts shall be used at each connection point.

2.05 CONTROL PANELS

A. General

1. A main control panel shall be furnished for each bar screen, screw conveyor, and washer/compactor set to provide the required equipment control. The main control panel shall be located indoors in a climate-controlled environment, rated for NEMA12, and shall be a free-standing enclosure with 12" full depth leg kit. A local control panel shall be furnished for each bar screen and conveyor/washer/compactor set to provide local maintenance interface. All local control panel components located at the washer/compactor shall be rated for installation inside a Class 1 Division 2 envelope. Each washer/compactor shall be controlled by receiving start and stop signals from the PLC based on a timer interlocked with the bar screen and screw conveyor operation.

2. A local washer/compactor operator station will also be provided. Local control panel shall be housed in a NEMA 7/9 enclosure rated for Class 1 Div 2, or in a NEMA 4X stainless steel enclosure with pushbutton sealed contacts rated for Class 1 Div 2.
3. The control panel shall be suitable for use on a 480 Volt, 3-phase, 60 Hz power supply.

B. Control Description

1. The controls described herein apply to the conveyor/washer/compactor named in Paragraph 1.06.C. Any deviations from the control sequence described shall be approved by the Engineer.
2. The control panel shall be interlocked to the screw conveyor and bar screen. The washer/compactor shall begin operation upon start of the bar screen and shall continue operation for a predetermined period of time after the bar screen stops.

C. Main Control Panel Operator Controls

1. The main control panel shall be combined with the Mechanical Bar Screens control panel specified under Section 11331, Mechanical Bar Screens Without Bottom Sprockets. The following door mounted- controls and indicators shall be provided for the main control panel:
 - a. Washer/Compactor Hand-Off-Automatic (H-O-A) Selector Switch
 - b. Washer/Compactor Reset Pushbutton
 - c. Washer/Compactor Run Status Light
 - d. Washer/Compactor E-stop light
 - e. Washer/Compactor Fail Light

D. Local Operator Controls

1. The following controls shall be mounted in a common local NEMA 4X stainless steel operator station with the corresponding bar screen:
 - a. Hand-Off-Auto Selector Switch
 - b. Start Pushbuttons
 - c. Emergency Stop Pushbutton with lock out
2. Provide a NEMA 4X stainless steel control station.

E. Output Dry Contacts

1. The main control panel shall have the output dry contacts as specified under Section 11331, Mechanical Bar Screens Without Bottom Sprockets.

2.06 SURFACE PREPARATION

- A. Permanent or intermittently wetted parts shall be constructed of Type 304 or Type 316 stainless steel, as appropriate for the operations environment. These parts shall include

but are not limited to rake support arm, rake, and bar rack. All stainless steel components shall undergo a pickling and passivation process in accordance with ASTM A380.

- B. All non stainless bar screen components shall be coated in accordance with Section 09902, Finish Painting.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in strict accordance with the respective manufacturer's instructions and recommendations in the locations 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. Anchor bolts shall be furnished by the equipment manufacturer and set in accordance with the manufacturer's recommendations and setting drawings.
- B. The Contractor shall be responsible for the coordination of this equipment with the requirements of the screenings hopper for the compactor to obtain a complete, integrated, and satisfactory operating installation.

3.02 INSPECTION AND TESTING

- A. The manufacturer shall furnish the services of a factory representative, as provided under Paragraph 1.04.C above, who has complete knowledge of proper operation and maintenance to inspect the final installation and supervise a test run of the equipment. These services may be combined with those provided under Paragraph 1.04.C above.
- B. Upon completion of installation, the washer/compactor shall be operated by the Contractor in the presence of the Engineer to demonstrate the ability of the unit to operate smoothly and the drive unit to operate continuously without noise, vibration, or generation of excessive heat. The test shall also indicate no other apparent deficiencies in the system.
- C. When screenings become available, a Final Acceptance test shall be made under regular operating conditions to further demonstrate the ability of the conveyor to convey the screenings and discharge them to the compactor for a period of not less than 72 operating hours.
- D. Any deficiencies found in the equipment shall be remedied by the Contractor at no additional expense to the Owner.

END OF SECTION

SECTION 11350

ODOR CONTROL SYSTEMS

PART 1 GENERAL

1.01 SCOPE

- A. This section covers odor control equipment and accessories. Principal items to be furnished and installed as indicated on the data sheets included herein.
 - 1. Odor Control System DS01: Influent Structure
- B. The following equipment specification sections shall comprise of the following equipment:
 - 1. Section 11356 – Odor Control Fans
 - 2. Section 11355 – Biotrickling Filter Odor Control System
- C. The following items of work and equipment are covered under other sections:
 - 1. Piping and dampers between items of equipment
 - 2. Water supply and electric power supply to the equipment
 - 3. Drain and vent piping
- D. This section covers the furnishing and installation of odor control systems complete with accessories to be furnished and installed as part of the odor control system as indicated on the Drawings and specified herein. The requirements of this section shall apply to the indicated equipment and systems, including interconnecting piping, controls, and accessories required for a complete and properly operating system.
- E. All components of the odor control system shall be provided by a single Odor Control System Supplier who shall be responsible for the design, coordination, and function of the system.
- F. Odor control fans, odor control vessels, odor control dampers, fiberglass reinforced plastic pipe for air services, pipe supports, duct supports, and accessories, which are not an integral part of the odor control system supplier scope 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. All pipe, vessels, equipment and components of plastic construction shall contain ultraviolet inhibitors.
- B. Equipment shall be designed for long life under service conditions as required, including corrosive atmospheres and intermittent or continuous operation. All wearing parts and items requiring adjustment shall be readily accessible. All parts which are exposed to corrosive conditions shall be made from corrosion-resistant materials.
- C. Components which are shipped loose due to transportation limitations shall be assembled and disassembled by the manufacturer prior to shipment to assure that all components fit together and are adequately supported.
- D. Coordination
 - 1. All equipment provided under this section shall be furnished by or through a single Odor Control System Supplier who shall coordinate with the Contractor, the design, fabrication, delivery, installation, and testing of the odor control scrubber components. The System Supplier shall have the sole responsibility for coordination and performance of all components of the system with the performance and design criteria specified herein and on the Drawings.
 - 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. Each manufacturer of major equipment 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 have an available supply of replacement media and maintain a local parts supply. Information on equipment manufacturers' representatives shall be included with the submittals.
 - 4. All equipment specified or required for each odor control system shall fit in the space allocated on the Drawings. Space shall be reserved for maintenance access around equipment, as indicated on the Drawings or as recommended by the Odor Control System Supplier, whichever is greater.

E. Seismic Design Requirements

1. Seismic design requirements for products specified herein shall be as indicated in the Meteorological and Seismic Design Criteria section.

F. 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 Underwriters' Laboratories (UL) safety requirements.

G. 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 480volts, 60Hz, three phase unless otherwise indicated or required for a properly operating system.
2. Where control voltage lower than the power supply voltage is required, a suitable control power transformer shall be furnished. Both power and control equipment shall be insulated for not less than 600 volts even though operating voltages may be lower.

H. Metal Thickness

1. Metal thickness and gauges specified herein are minimum requirements. Gauges refer to US Standard gauge.

I. Mechanical Identification

1. Equipment, valves, panels, and control equipment shall be identified in accordance with the Special Provisions section and as specified herein. Piping identification shall be as specified in the Finish Painting section.
2. 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 each piece of equipment and each motor.

1.04 SUBMITTALS

A. Submittal organization

1. The submittal for each odor control system shall be supplied with the following information:
 - a. Odor Control System Supplier Name, Contact Name, Phone Number, Address, and email address

- b. System Supplier Contact Name Qualifications and Experience
 - c. Bill of Materials
 - d. System piping and instrumentation diagram (P&ID) with legend
 - e. Equipment and piping/duct layout starting from intakes to discharge of the final scrubber
 - f. Seismic design requirements
 - g. Odor control scrubber selection
 - h. Odor control fan selection
 - i. Odor control system controls selection
 - j. Control schematics
 - k. Spare parts
2. Specific required information for each piece of odor control equipment shall be provided as required in the respective odor control equipment specification.

B. Drawings and Data

1. Complete fabrication, 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 section. Device tag numbers indicated on the Drawings shall be referenced on the wiring and schematic diagrams where applicable.
2. 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.
3. 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. Wiring diagrams shall be detailed to the degree required for field construction and shall include all related wiring.
4. Sequence of operation for each system corresponding to the control schematics.
5. Detailed panel construction drawings, including description of all materials and finishes, complete internal wiring schematics, panel face layout, and complete data on all mounted components.

C. Operation and Maintenance Data and Manuals

1. Adequate operation and maintenance information shall be submitted in accordance with the Submittals section. Equipment designations used shall correspond to those indicated on the Drawings. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

D. Color Selection

1. Colors for factory finish of fans and odor control vessels shall be selected by Engineer from the manufacturer's full range of standard and custom colors. Samples shall be submitted for color selection in accordance with the Submittals section.

1.05 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 Materials, Transportation and Handling section.

PART 2 PRODUCTS

2.01 SYSTEM SUPPLIER

- A. Theodor control system shall be coordinated and supplied by a qualified System Supplier who is regularly engaged in the business of designing and assembling odor control systems for water treatment or wastewater treatment plant projects.

2.02 CONSTRUCTION

- A. Odor control equipment shall be of substantial construction with all parts designed for long life under working conditions including corrosive atmospheres and intermittent or continuous operation. All wearing parts and items requiring adjustment shall be readily accessible. Each unit shall be completely enclosed and dust tight when in operation. All parts which are exposed to corrosive conditions shall be made from corrosion-resistant materials or covered with suitable protective coatings.

2.03 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Each odor control system shall be designed for odor treatment at the design conditions specified in the attached Odor Control System Data Sheet(s).
 1. Odor Control System DS01: Influent Structure.
 2. Design criteria for calculating wind, snow and seismic loads shall be as indicated in the Meteorological and Seismic Design Criteria section.

B. Equipment Bases

1. Unless otherwise indicated or specified, all odor control equipment shall be installed on concrete bases at least 6 inches high. The odor control equipment shall be anchored to the concrete base with suitable anchor bolts.

C. Dimensional Restrictions

1. Layout dimensions will vary between manufacturers and the layout area and arrangement indicated on the Drawings is based on the first manufacturer listed.
2. 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.
3. 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 as indicated in the Meteorological and Seismic Design Criteria section. All equipment furnished for sites 2000 feet above sea level and greater shall be properly derated to operate and meet the specified capacities at the site conditions.

2.04 RECOMMENDED MANUFACTURERS

- A. Recommended manufacturers shall be as specified in the Odor Control System Data Sheet(s).

2.05 ODOR CONTROL FANS

- A. Odor control fans and accessories for each system shall be furnished and installed as indicated on the Odor Control Data Sheet(s) and the drawings. Each odor control fan and accessories shall meet the requirements of Section 11356 Odor Control Fans.

2.06 BIOTRICKLING FILTER ODOR CONTROL SYSTEMS

- A. Biotrickling filter odor control systems and accessories shall be furnished and installed as indicated in the Odor Control Data Sheet(s) and the drawings. Each odor control biotrickling filter and accessories shall meet the requirements of Section 11355 Biotrickling Filter Odor Control Systems.

2.07 ODOR CONTROL SYSTEM CONTROLS

- A. Control panels shall be furnished and installed for each odor control system and its associated equipment as indicated on the Drawings and as specified in the data sheets.
- B. Fan motor starters shall be located as indicated on the Drawings and in the data sheets.

C. All controls shall consist of electric equipment. Electrical devices and all other controls not specified herein shall be furnished under the Division 16 – Electrical specifications.

D. Control Panels

1. Each control panel shall be installed where indicated on the Drawings and in the data sheets. The odor control fans with motor starters located in the MCC as indicated on the Drawings and in the data sheets shall be controlled as indicated on the electrical schematic drawings.
2. Control panels shall be located a minimum of 3 feet away from all odor control equipment and appurtenances. Control panels shall be designed for mounting as required and shall be completely prewired and checked such that a single 480-volt power circuit. Each control panel shall provide electrical control for the fan and motor driven dampers.
3. Control panels shall conform to NEMAICS1, NEMAICS2, NEMAICS3, and NFPA70. Control panels shall be fiberglass construction and shall be rated NEMA 4X. Control panels located outside shall be included with a sun/heat shield. The control panels will be supplied with 480volts, 60Hz, three phase power. All electrical accessory devices and internal electrical wiring shall be furnished and installed. All controllers, selector relays, switching relays, interlock relays, manual switches, alarm and indicating lights, and other devices indicated to be panel mounted shall be mounted in or on the respective control panel.
4. Accessories, such as indicating lights and selector switches, shall be mounted on the front hinged covers of the panels. The accessories and panels shall be identified with engraved phenolic nameplates with 1/4-inch-high letters. Twenty-five percent extra terminals shall be provided in each control panel.
5. Control panels for each odor control fan shall have an On-Off-Remote switch on the panel front. When On is selected, the pump shall run using the local controls. When Remote is selected, start/stop control shall be by a normally open contact input to the panel. Indicating lights shall be provided on the panel front for Run, Off, and Fail. These indicating lights shall be red, green, and amber respectively.
6. Where high differential pressure switches are indicated on the drawings or specified to be provided for the odor control fan(s), a discreet signal shall be sent to the odor control fan motor starter.
7. Outputs shall be provided from panels for odor control fans as follows:
 - a. Running
 - b. Fail
 - c. High differential pressure
8. The signal controlling the Fail contact shall be generated by the odor control fan starter. Manual reset of the failure condition shall be required at the odor control fan motor starter.

E. Selector Switches

1. Selector switches shall be heavy-duty 30mm 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 10amperes continuous at 120volts 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. Selector switches shall be Micro Switch "TypePT", Cutler-Hammer "Type10250T Series", or General Electric "CR".

F. Indicating Lights

1. Indicating lights shall be heavy-duty, 30mm push-to-test oiltight type which utilize a low voltage lamp and a built-in transformer. Legends shall be engraved on the lens or on a legend faceplate. Lamps shall be easily replaceable from the front of the indicating light. Indicating lights shall be Micro Switch "TypePT", Cutler-Hammer "Type10250T Series", or General Electric "CR".

G. Accessory Components

1. All additional control components, such as electric relays, controllers, and position switches, shall be furnished as needed to ensure a complete, properly operating installation. Accessory components not mounted inside the control panel shall be furnished with equipment enclosures suitable for the environment and NEMA rating as indicated on the electrical Drawings.

H. Electrical Wiring

1. Detailed schematic wiring diagrams shall be submitted in accordance with the Submittals section. The wiring diagrams shall show the internal connections of the control panels and all field wiring to equipment remote from the control panels. The wiring diagrams shall be complete, showing all connections necessary to place the control systems in operation.

I. Nameplates

1. Phenolic nameplates shall be provided and permanently attached to the wall at each control device to indicate the equipment controlled. The letters used shall be the same as the symbols indicated herein and on the Drawings for the equipment. Each nameplate shall have white letters on a black background.

2.08 SEQUENCE OF OPERATIONS

- A. The sequence of operation for the odor control system shall be as indicated herein and in the Control Descriptions specification.

2.09 ELECTRICAL

- A. Motor starters and controls shall be furnished and installed under the Motor Control Centers section, except for equipment specified or furnished with prewired integral

starters. Disconnects for equipment shall be furnished and installed under the Motor Control Centers section, except where specified with integral disconnects.

- B. All electrical controls shall have enclosures suitable for the environment and NEMA rating as indicated on the electrical Drawings for wiring in conduit. Equipment installed outdoors shall have NEMA Type 4X enclosures.
- C. Prewired electric motors installed in packaged equipment are not required to have clamp type grounding terminals in the conduit box or oversized conduit boxes.
- D. All electrical equipment located within 3 feet of the odor control system malodorous air stream, scrubbers, and other leakage sources such as piping, dampers, and fans shall be rated for a NEC Class 1, Division 2, Group D atmosphere in accordance with NFPA 820.

PART 3 EXECUTION

3.01 INSPECTION

- A. All equipment and accessories 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.
- 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, piping, and ductwork relative to any existing equipment, structural members, piping, ductwork, lighting, conduit, etc. to avoid conflicts with such items.
- 2. 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. 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. 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. When grouted bases are used, the space beneath baseplates shall be grouted as specified in the Grout section.
- C. Each fan shall be leveled, aligned, and positioned to fit connecting piping. Installation procedures for fans and accessories shall be as recommended by the equipment manufacturers. Prior to being placed in operation, each fan shall be inspected by a representative of the manufacturer.
- D. Control Panels.
 - 1. Control panels shall be mounted so that selector switches and indicating lights on the panel are located approximately 4'-6" above the finished floor.

3.04 ADJUSTING

- A. Contractor shall make all adjustments to the adsorption system as directed by the equipment manufacturer.
- B. Applied Pipe Stress Test.
 - 1. After final alignment and bolting, all flanged connections shall be tested for applied piping stresses by loosening the flange bolts. No stresses shall be transmitted to the scrubber flanges. If any movement or opening of the joints is observed, piping shall be adjusted to proper fit.
- C. System Balancing
 - 1. Testing and balancing for the odor control systems shall conform to the requirements of the Testing, Adjusting, and Balancing section.
 - 2. An approved Testing and Balancing report shall be submitted for each odor control system prior to odor control equipment testing.

3.05 FIELD QUALITY CONTROL

- A. The equipment manufacturer shall provide functional testing assistance when indicated.
- B. A factory representative who has a complete knowledge of the proper operation and maintenance shall be provided as specified herein. Qualifications of the representative shall be submitted for approval. Workday requirements listed are exclusive of travel time and do not relieve the Contractor of obligation to provide sufficient service to place

equipment in satisfactory operation. The factory representative shall provide a minimum of two training sessions (typically early morning and late evening) to accommodate plant staff. Owner and Engineer shall be notified in writing a minimum of fourteen calendar days prior to the scheduled training.

Services Provided by Factory Representative	Minimum ^(a) No. of Trips	Minimum Time On Site Per Trip (hours)
Supervise installation	1	8
Inspect and approve installation ^(b)	1	4
Supervise initial adjustment ^(c)	1	4
Conduct performance testing ^(c)	1	8
Instruct Owner and Engineer in proper start-up and O&M ^{(c) (d)}	1	4

(a) The System Manufacturer's factory representative shall be present at frequent enough intervals to ensure proper installation, testing, and initial operation of the equipment.

(b) The System Manufacturer's factory representative shall provide to the Engineer a written certification that the system has been installed in accordance with the manufacturer's recommendations.

(c) May be done on the same trip upon completion of prior item if acceptable to the Engineer.

(d) Instruction may be given upon completion of performance testing, provided that the test is successful, and the O&M manuals have been submitted to and accepted by the Engineer.

C. Inspection, Start-up, and Acceptance Testing

1. Acceptance testing shall not commence until the Testing and Balancing Report for the entire ductwork system is submitted and approved by the Engineer.
2. The services of a System Manufacturer's representative who has 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 shall be provided.
3. The System Manufacturer's representative shall inspect the equipment, before start-up and performance testing, to ensure that installation is according to manufacturer recommendations. Any damage to the equipment, installation, and alignment defects, objectionable noise and vibration shall be documented and corrected before start-up. 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.
4. For start-up of each odor control system, the System Manufacturer's representative shall coordinate with the Contractor to ensure the air flow system is balanced, all necessary utility connections are provided and working, sampling taps are provided for performance testing, and acclimation time of the odor control system is minimized. All necessary corrections and adjustments shall be made to achieve stable operation before starting performance testing.

5. To the extent possible, performance testing shall be conducted at process conditions conducive to high H₂S concentrations.
6. To pass the acceptance test, each odor control system shall meet hydrogen sulfide criteria set forth herein.
7. If any system fails the acceptance test, the System Manufacturer shall conduct up two additional rounds of testing at no expense to the Owner. If the system does not pass after the additional testing, the System Manufacturer shall make whatever provisions are required to meet the criteria as defined herein at no expense to the Owner. Failure to pass the acceptance test within three months of the initial acceptance test may result in forfeiture of the final payment of all work, at the sole discretion of the Owner.

D. Performance Testing Protocol

1. The equipment manufacturer shall provide performance and other testing services when indicated.
2. Prior to performance testing, the odor control system supplier shall provide an outline of performance testing protocol including types of measuring equipment to be used as well as duration and sequence of measurements. Performance testing will not proceed until the Engineer has approved both the testing protocol and a Testing and Balance report submitted in accordance with the Testing, Adjusting, and Balancing Odor Control Systems section.
3. At a minimum, the following should be included in the performance testing protocol:
 - a. The performance test for H₂S and odor shall be based upon OdaLog data collected over 7 weekdays. H₂S shall be logged continuously at 1-minute intervals at the inlet and outlet of the system with OdaLogs by Detection Instruments. The inlet OdaLog shall be rated to 200 ppm, the outlet OdaLog shall be rated to from 0.01 - 2 ppm. A Low Range Sampling System (LRSS-2) system shall be used with the H₂S monitors; all equipment shall be provided by Detection Instruments with calibration documentation.
 - b. Inlet and outlet odor samples shall be collected in ten-liter pre-conditioned sampling bags using a vacuum chamber with two bags per chamber; the sampling train shall be kept out of the direct sunlight at all times. A minimum of one inlet and one outlet sample, taken concurrently on each day of period shall be collected. The samples shall be shipped overnight early delivery to St Croix Sensory for analysis of detection to threshold ((D/T) per EN13725-2003.
 - c. Data on air flow and differential pressure across each odor control system shall be collected over a six (6) hour period in one-hour intervals on each day of testing.
4. Results of the performance tests shall be provided to Engineer in a written report. The report shall include the raw test data and a graphical plot for each of the tests showing inlet and outlet H₂S. The graph shall also show H₂S removal efficiency and

odor removal over the duration of the test. The report shall also include operating data including airflow.

5. An electronic PDF copy of the report shall be submitted to Engineer. The information collected will be used as a basis for determining acceptability of the System Manufacturer's results. In the case of a conflict, interpretations and calculations made by Engineer will govern.
6. If the equipment fails to meet the performance requirements, operational adjustments to the system and repeat testing may be allowed at the discretion of the Engineer. Subsequent failure of the equipment to meet the performance and design requirements specified will require equipment modifications to be made by and at the expense of Contractor. Costs of additional testing and subsequent observation by Engineer will be borne entirely by Contractor.

E. Applied Pipe Stress Test

1. After final alignment and bolting, all flanged connections shall be tested for applied piping stresses by loosening the flange bolts. No stresses shall be transmitted to the two stage biofilter flanges. If any movement or opening of the joints is observed, piping shall be adjusted to proper fit.

F. Installation Check

1. The equipment manufacturer shall provide a certificate of proper installation when indicated.
2. 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 Equipment Startup and Testing 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.
3. The System 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.
4. All costs for these services shall be included in the Contract Price. The Contractor shall include a minimum of 2 day(s) and 2 trip(s) to the site for installation and check. Additional trips to the site made necessary by improperly installed equipment shall be at the cost of the Contractor.

3.06 CLEANING

- A. At the completion of 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 at no additional cost to Owner.

- B. The inside of all pipe, dampers, and fittings shall be smooth, clean, and free from blisters, sand or dirt when erected. All lines shall be thoroughly air purged before placing in service.
- C. Fabricated Piping Assemblies
 - 1. Fabricated piping assemblies shall be cleaned to remove all loose foreign materials such as scale, sand, weld splatter particles, or cutting chips by hand or mechanical cleaning.
- D. Installed Piping
 - 1. All installed piping shall be cleaned and free from debris and any loose foreign materials, as may be introduced during field installation. Installed piping shall be cleaned by hand or by flushing.

3.07 TRAINING

- A. After completion of the field testing, operator instruction and training on equipment and system operation shall be provided. 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.
- C. Two training sessions shall be provided. One session shall occur during the day shift and one session shall occur during the swing shift. Each session shall be adequate to cover all listed material. Each session shall be a minimum of 4 hours.
- D. 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.
- E. Training shall be in accordance with the demonstration and training specification.

3.08 SERVICE PLAN

- A. The equipment identified in this Specification shall be supplied with a Service Plan. As part of that Service Plan, an experienced, competent, and authorized representative of the Odor Control System Supplier shall perform yearly 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, and address any questions from the Owner. The supply and installation of replacement parts is not included as part of the Maintenance Plan.

SECTION 11350-DS01 – ODOR CONTROL SYSTEMS

Odor Control System DS01 – Influent Structure		
General		
Odor source(s).	Screen Channels, Grit Basin, Dumpster Room, Pump Station #4	
P&ID drawing.	P-10	
Mechanical drawing(s).	MA-17, MA-18, MA-19, MA-20	
Pipe material	FRP – Section 15066 HDPE – Section 02634	
Dampers	FRP – Section 11357	
Design Requirements		
Odor control system type	Biotrickling Filter	
Installed location.	Outdoor	
Ambient temperature range.	0-100	°F
Ambient relative humidity range.	40-65	%
Inlet air temperature range.	0-100	°F
Inlet air relative humidity range.	40-85	%
Elevation	1300	feet above sea level
Odorous compounds		
Hydrogen sulfide (H ₂ S)		
Average	25	ppm
Maximum	75	ppm
Hydrogen Sulfide Removal Efficiency at inlet air temperature 100°F or higher		
Average H ₂ S conditions	99% or < 0.5ppm	% or ppm, whichever is less stringent
Maximum H ₂ S conditions	99% or < 0.5ppm	% or ppm, whichever is less stringent
Odor Control Fans – specified in Section 11356		
Quantity	1	
Tag number	1500-FAN-ODOR	
Capacity per fan	8300	cfm
Design ESP	5.25	inches w.c.
Wheel type	Backward inclined	
Wheel diameter, min	22	inches
Arrangement	9	
Drive type	V-belt	
Maximum motor speed	3600	RPM
Motor size	15	hp
Motor starter location	Influent Electrical Room MCC	
Local control panel quantity	1	

Odor Control System DS01 – Influent Structure		
Flow direction	Push-through	
Fan construction	FRP	
Vibration isolators required	No	
Fan inlet box required	Yes	
Acoustical enclosure required	Yes	
Acceptable manufacturers – FRP	New York Blower, KCH, Duall, or Hartzell	
Biotrickling Filter Odor Control Systems – specified in Section 11355		
Quantity	1	
Tag number	1510-BIOF-ODOR	
Capacity per scrubber	8300	cfm
Orientation	Vertical	
Maximum vessel diameter	14	feet
Maximum vessel height excluding exhaust stack	25	feet
Maximum vessel operating weight	55,000	pounds
Insulation Required	Yes	
Recirculation pumps		
Quantity	1	
Tag number	1520-PMP-RECIRC	
Minimum capacity per pump*	15	gpm
Maximum motor size*	7.5	Hp
*When recirculation equipment is provided, Odor Control System Supplier shall be responsible for calculating the final recirculation pumping capacity and motor power as needed in accordance with section 11355.		
Nutrient System Required	Yes	
Makeup Water Available		
Water Type	Plant Effluent Water	
System Flow Requirements	As Required	gpm
Acceptable Odor Control System Suppliers	Bioair, ECS, Daniel Company	

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SECTION 11355

ODOR CONTROL BIOTRICKLING FILTERS

PART 1 GENERAL

1.01 SCOPE

- A. This section covers the furnishing and installation of biotrickling filters complete with accessories to be furnished and installed as part of the odor control systems as indicated on the drawings, as specified herein and in the Odor Control Systems section and the associated data sheets.
 - 1. The Odor Control System Supplier shall be responsible for coordination of all biotrickling filter equipment, controls, biotrickling filter circulation piping, non-potable water supply piping to each unit, valves, fiberglass odor control air supply piping, odor control fan, pipe supports, plumbing drain locations and piping associated with the biotrickling filter, piping locations, equipment bases, and other items to provide a complete operating system.
 - 2. Odor control fans, odor control dampers, fiberglass reinforced plastic pipe for air service, piping, pipe supports, valves, and accessories, which are not an integral part of the biotrickling filter are not specified herein and are covered in other sections.
 - 3. All items of the odor control system shall be provided by a single Odor Control System Supplier who shall be responsible for the design, coordination, and function of the 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. General requirements shall be as stated in the Odor Control Systems section.

1.04 SUBMITTALS

A. Drawings and Data

1. Drawings and data shall comply to the requirements of the Odor Control Systems section.
2. The data and specifications for each biotrickling filter unit shall include, but shall not be limited to, the following:
 - a. Biotrickling Filter
 - 1) Name of manufacturer
 - 2) Type and model
 - 3) Vessel dimensions
 - 4) Size, elevation, and orientation of all connections
 - 5) Media manufacturer, type, and material
 - 6) Spray nozzle manufacturer, type, material, and free passage diameter
 - 7) Net weight
 - 8) Foundation bolting details
 - 9) All material types, thickness, and finishes
 - 10) Details of all control devices
 - 11) Resin type and chemical resistance
 - b. Recirculation Pumps (as required in the Odor Control Systems section)
 - 1) Name of manufacturer
 - 2) Type and model
 - 3) Rotative speed
 - 4) Size of suction and discharge connection
 - 5) Recirculation piping system head loss calculations including all losses for piping, valves, equipment, and accessories
 - 6) Calculations shall be sealed by a registered Professional Engineer in the state
 - 7) Complete performance curves showing capacity versus head, NPSH required, pump efficiency, and bhp
 - 8) Type of coupling
 - 9) Overall dimensions and total weight of complete pumping unit
 - 10) Detailed base fabrication drawings
 - c. Nutrient Tanks
 - 1) Name of manufacturer
 - 2) Inside diameter
 - 3) Overall height
 - 4) Size and orientation of all connections
 - 5) Net weight
 - 6) Foundation bolting details
 - 7) All material types, thickness, and finishes
 - 8) Details of all control devices
 - 9) Resin type and chemical resistance

d. Nutrient Pumps

- 1) Name of manufacturer
- 2) Type and model
- 3) Rotative speed
- 4) Size of suction and discharge connection
- 5) Performance curves
- 6) Overall dimensions

e. Motors

- 1) Name and manufacturer
- 2) Type and model
- 3) Bearing type and method of lubrication
- 4) Rated size of motor, hp, and service factor
- 5) Temperature rise and insulation rating
- 6) Full load rotative speed
- 7) Net weight
- 8) Efficiency at full, 3/4, and 1/2 loads
- 9) Full load current
- 10) Overall dimensions
- 11) Space heater wattage

f. Control Panels and 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. Wiring diagrams shall be detailed to the degree required 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 schematics, panel face layout, and complete data on all mounted components.

g. Water Box Cabinets

- 1) Name and manufacturer
- 2) Piping and valve arrangement
- 3) Size and orientation of all connections
- 4) Heater manufacturer
- 5) Wiring diagrams

h. Seismic Design Requirements

- 1) Confirmation of compliance with the requirements of the Meteorological and Seismic Design Criteria Section

1.05 QUALITY ASSURANCE

A. Manufacturer Experience

1. Manufacturer experience shall comply to the requirements of the Odor Control Systems section.

B. Performance Tests

1. Performance tests shall comply to the requirements of the Odor Control Systems section.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, storage, and handling shall comply to the requirements of the Odor Control Systems section.

1.07 EXTRA MATERIALS

- A. Extra materials shall be furnished for the equipment as follows:

<u>Extra Materials</u>	<u>Quantity</u>
Spray nozzles	3
Differential pressure gauges	1
Indicating light of each color	1
Strainers	1

- B. Extra materials shall be packaged in accordance with the Materials, Transportation and Handling section, 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.
- 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.
- B. Equipment shall be designed to withstand and operate at the wind conditions indicated in the Meteorological and Seismic Design Criteria section. The biotrickling filter units shall

be suitable for the service conditions as stated in the Odor Control Systems section and the data sheets and designed for continuous 24 hour per day operation.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

- A. All parts exposed to corrosive conditions shall be made from corrosive-resistant materials.
- B. The system shall be capable of removing hydrogen sulfide and other typical organic sewage odors from the air stream. The system shall be designed such that no physical sorption systems, chemical oxidation systems, or chemical masking systems are required.
- C. The biotrickling filter system shall utilize structured synthetic media that is resistant to acid conditions and supports the growth of a bacterial film. Hydrogen sulfide and other odorous contaminants shall be removed via mass transfer to the bacterial film with subsequent oxidation to non-odorous compounds. By-products of the oxidation process shall be removed by flushing with plant water.
- D. The biotrickling filter module shall consist of one or more foul air plenums, biofiltration media compartment, and an internal irrigation system to facilitate and extend media performance.
- E. The biotrickling filters shall be of modular construction with built-in provision for collection and drainage of any filtrate or other materials generated by the biotrickling filter.
- F. The performance and design requirements of each biotrickling filter unit shall be as specified in the Odor Control Systems section and the data sheets.

2.03 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers shall be as listed in The Odor Control Systems section and the data sheets.

2.04 MATERIALS

- A. Biotrickling Filter Media
 - 1. The biotrickling filter shall include a minimum of one layer of highly porous, structured, chemically resistant synthetic media material, with additional layers as recommended by the manufacturer to meet the performance and design requirements in the Odor Control Systems section. Random media (cubes, etc.) are not acceptable.
 - 2. Media shall be self-supporting; removable for inspection, cleaning, or replacement; and constructed to minimize the potential for short-circuiting or bypass of the air being treated. Organic materials such as compost, wood, wood mulch, tree bark, lava rock, or activated carbon are not acceptable.

3. A media support system shall be provided inside each tank. The support system shall consist of nonmetallic, removable grating supported from either the tank sides or the bottom.

2.05 BIOTRICKLING FILTER CONSTRUCTION

- A. Biotrickling filter units shall include vessel, media, support assembly, water panel, recirculation pumps, nutrient pumps, nutrient tank, connections, controls, instrumentation, and all accessories.

1. Biotrickling Filter Vessel

- a. Biotrickling filter vessels shall be constructed of fiberglass reinforced plastic in accordance with ASTM D3299 or ASTM D4097. All fiberglass reinforced plastic fabrications shall have a flame spread of 25 or less when tested in accordance with ASTM E84. The resin used shall be suitable for contact with water saturated air containing hydrogen sulfide and sulfuric acid at 5% at 180°F.
- b. The biotrickling filter shall include a flanged air inlet and outlet connections, access openings, and liquid piping connection flanges.
- c. The biotrickling filter shall include all connections and components which are required by the manufacturer's design.
- d. Each vessel shall be provided with lifting lugs and hold-down brackets for mounting on a concrete base.
- e. The biotrickling filter shall include one or more spray nozzles, recirculation system, access openings, a water sample tap off the drainpipe, and a 1" treated air sample tap with pipe extending down to approximately 5 feet above the concrete slab with a PVC shutoff valve.
- f. Air sample pipe, overflow pipe, and valve size and material shall be as recommended by the Odor Control System Supplier.
- g. Recirculation piping on the outside of each biotrickling filter shall be arranged so that the piping inside the biotrickling filter can be easily removed.

2. Resins

- a. The resin used shall be resistant to corrosion by wet hydrogen sulfide and other corrosive gases present in wastewater treatment plants.
- b. Resin used in the fabrication of vessels to be installed outdoors shall contain an ultraviolet inhibitor.
- c. A single, fire-retardant resin shall be used throughout. Flame spread ratio shall not exceed 25 when tested in a Steiner Test Tunnel in accordance with ASTM E84.
- d. Antimony or NYACOL additives shall not be used to achieve flame spread index.

- e. Acceptable resins shall be as recommended by the Odor Control System Supplier with a certified letter from the resin manufacturer confirming the resin's suitability for the service conditions.

3. Biotrickling Filter Discharge Stack

- a. Each biotrickling filter vessel shall be provided with either an appropriately sized no-loss discharge stack or manufacturers standard exhaust.
- b. No-loss discharge stack shall be constructed of the same material as the biotrickling filter vessel. Guy wires shall be furnished and installed to support the scrubber outlet as required. Guy wires shall be supported from the vessel.
- c. Each stack shall be provided with one inch diameter fitting for outlet air sampling.

4. Spray Nozzles

- a. One or more spray nozzles shall be installed above the media and shall be arranged and sized to ensure uniform distribution of scrubbing solution throughout the bed.
- b. The biotrickling filter shall be configured with sufficient fluid spray nozzles to provide sufficient recirculation of water.
- c. Recirculation piping shall enter the through a flanged connection designed for easy removal of piping and nozzles inside the biofilter without entering the vessel.
- d. Spray nozzles shall be Teflon, PVC, stainless steel, or polypropylene, with a minimum free passage diameter of 1/4 inch and shall be specifically designed to be clog resistant. Pressure loss across the nozzle at design capacity shall be no more than 10 psi. The spray nozzles shall be Teflon, polypropylene, or PVC.
- e. Upon installation, each spray nozzle shall be inspected and tested to ensure even distribution of recirculation water flow.

5. Connections

- a. All piping connections shall be flanged. Air inlet and outlet connections on each vessel shall conform to ANSI D3982; shall be furnished undrilled; and shall be field drilled to match bolt hole locations on connecting piping. Other flanges for connection to PVC or CPVC piping shall conform to ANSI/ASME B16.1, Class 125 diameter and drilling. The orientation of the piping connections, access openings, and other appurtenances shall be as indicated on the Drawings.
- b. Flanges shall be hand laid up to thickness specified in ASTM D3982 except that minimum thickness shall be 3/4 inch. Each flange face shall be ground flat, and a new 100 mil corrosion barrier shall be applied. The flange shall be anchored to a waxed table to ensure the flatness tolerance outlined above. The face shall be textured for use with full face Viton gaskets, 1/8-inch minimum thickness.

- c. Flange drilling for FRP piping for air service shall be as per ASTM D3982. All bolt holes shall be back spot faced for a washer seat. All flange bolts shall be torqued to values as recommended by manufacturer.
 - d. Flange drilling on vessel body (if required) shall be fully rated for the vessel design pressure.
 - e. Furnish all bolts, nuts, washers, and other fasteners required. Material of metallic fasteners shall be ASTM Type 316 stainless steel.
 - f. All nozzles, 4 inch and smaller, shall be reinforced with gussets.
 - g. All nozzles 6-in diameter and smaller shall be of the blade gusseted configuration meeting strength requirements of 1,500 ft-lbs of bending and 2,000 ft-lbs torque.
 - h. The gas outlets shall have its flange face perpendicular to the centerline of the vessel. Tolerance on angle of flange face with respect to centerline shall be 1/2 degree.
 - i. Nozzles overlays shall be as specified in ASTM D 3299 or ASTM D 4097.
 - j. The area on the back of all flanges around each bolt hole shall be the diameter of a standard washer and shall be flat and parallel to the flange face. This area shall be spot faced, if necessary, to meet this requirement.
 - k. Flanged nozzles shall be provided at a minimum on the odor control vessel as required in The Odor Control Systems section and the associated data sheets.
 - l. Nozzle locations shall be as recommended by the Odor Control System Supplier. All nozzles shall have a minimum size of 2 inches. Odor Control System Supplier shall use the nozzle sizes as required by their equipment. Additional nozzles may be added as required by the System Manufacturer.
6. Inspection Manholes
- a. At least two, 24-inch diameter inspection manholes with flanged covers shall be provided on each containment vessel. Inspection manholes shall be located on the side of the vessel, or between the top and side of the vessel per the Odor Control System Suppliers standard design.
 - b. The manhole covers shall be fully gasketed and shall be gastight at the fan design operating pressure and/or vacuum specified within The Odor Control Systems section, and the data sheets. Manhole flanges shall conform to ASTM D3299 Table 5.
7. Ladders and Guardrails
- a. external access ladder shall be provided on each vessel. The ladder shall be supported on and anchored to the finished floor and bracketed to the vessel shell. Safety guardrails and toe boards shall be provided around the top

circumference of the vessel. A self-closing safety gate shall be provided at the ladder access opening. The ladder and safety guardrails shall be fabricated of aluminum or FRP. No uncoated or exposed carbon steel parts or fastenings will be permitted. The ladder shall have a clear width of at least 16 inches, rungs at least 1 inch diameter, and spaced not more than 12 inches apart, and shall give a minimum clearance of at least 7 inches between the back of the ladder and the vessel wall. The ladder, access platform and vessel safety guardrails shall be constructed in conformance with OSHA Standard 1910.27.

8. Ladder Fall Protection System

- a. Each vessel with a total height of 12 or more feet above the finished floor shall be provided with a fall protection system in accordance with OSHA requirements. The fall protection system shall be installed directly on the ladder and constructed of stainless steel or other corrosion resistant materials where available. The fall protection system shall be provided with the appropriate number of cable guides as recommended by the system manufacturer, and one full body safety harness rated for not less than 300 pounds. Fall protection system shall be Capital Safety "Lad-Safe" or approved equal.

9. Vessel Insulation

- a. Each vessel shall be insulated when required in the Odor Control Systems section and data sheets.
- b. The insulation shall be two-pound density polyurethane foam board. The insulation shall be minimum 1 inch thick and shall be bonded to the structural vessel wall. An additional fiberglass protective laminate shall be built up over the insulation to protect against spillage and weathering. This exterior laminate shall be a minimum of 0.145 inches thick. A pigmented bronze protective layer shall be applied as the final exterior finish. The coating shall be resistant to moisture, mildew, ultraviolet radiation and fire and suitable for exposed outdoor installation. Additional reinforcing shall be provided as required to permit personnel walking surface on the top of the vessel.

2.06 ACCESSORIES

A. Differential Pressure Gauges

1. Differential pressure gauges shall be furnished for monitoring the pressure differential across each media bed. The gauges shall be permanently mounted and shall be furnished with a mounting bracket, tubing, and all required fittings. Unless otherwise indicated, the installation hardware shall be Type 316L stainless steel. Tubing shall be 1/2-inch PVC pipe, unless otherwise indicated, properly supported and braced for a permanent installation. Indicators mounted on the biotrickling filter shall be installed approximately 5 feet above the surrounding floor or concrete slab.
2. Each gauge shall be of the diaphragm actuated dial type with adjustable pointer, white dial and black figures and markings. Each gauge shall have a range such that under normal operating conditions, the reading is approximately in the middle of the

range. Accuracy shall be within 3 percent of full scale. Two shutoff cocks shall be furnished with each gauge.

3. Condensate drip tubing shall be provided on the high- and low-pressure lines to each gauge. The condensate drip lines shall extend a minimum 4 inches below the bottom elevation of the gauge and terminate with shutoff valves.
4. Gauges shall be installed to allow gravity drainage of condensate in the sensing lines back to the pipe or vessel.
5. The gauges shall be furnished with a transparent red overlay extending from the maximum allowable differential pressure reading to the end of the range.
6. All piping, connections, and valves required for proper installation and operation of the differential pressure gauges shall be provided by, or the provision of coordinated by, the Odor Control System Integrator.
7. Differential pressure gauges shall be Dwyer "Series 4000 Capsuhellic" with diaphragm seal made from a material suitable for exposure to a dry hydrogen sulfide air stream.

B. Sumps and Tanks

1. Biotrickling filter sumps, and nutrient tanks shall be the materials of construction, arrangement, size, and capacity as recommended by the Odor Control System Supplier.
2. Sumps and tanks shall be provided with float valves, drain water outlets, shutoff valves, supply/return water connections, non-potable water supply connections, access covers, and all accessories and valves as required for a complete and properly operating system.
3. When the water supply from the site has inadequate pressure or reliability to ensure uniform distribution of scrubbing solution throughout the bed a reservoir with booster pump shall be provided.
4. Makeup water will be available at the site as described in The Odor Control Systems section and the data sheets. The biotrickling filter supplier shall be responsible for determining whether a reservoir and pumping system is required.

C. Low Level Switch

1. One low level switch shall be provided and installed in the biotrickling filter sump. An ultrasonic point level sensor and level controller relay unit shall be provided for this level switch. The manufacturer shall select and provide the proper sensor material, sensor length, and mounting hardware required.
2. The low level switch setting shall be as recommended by the manufacturer.

D. High Level Switch

1. One high level switch shall be provided and installed in the biotrickling filter sump. An ultrasonic point level sensor and level controller relay unit shall be provided for this level switch. The manufacturer shall select and provide the proper sensor material, sensor length, and mounting hardware required.
2. The high-level switch setting shall be as recommended by the manufacturer.

E. Recirculation Pump System

1. The recirculation pump system shall be provided if required as part of the Odor Control System Supplier's standard design.
2. Recirculation pumps and accessories shall be furnished as required in the Odor Control Systems section, the associated data sheets, and on the Drawings to recirculate sump water to the biotrickling filter.
3. The recirculation pumps shall be a seal-less, magnetic-drive, centrifugal pump suitable for continuous operation. The materials of construction of the pumps shall be as recommended by the Odor Control System Supplier.
4. Each pump motor shall be suitable for 480-volt, 3 phase, 60 Hz electrical service and shall be provided with a NEMA rated enclosure suitable for the location.
5. The capacity of pumps shall be as recommended by the Odor Control System Supplier, but not less than required by the Odor Control Systems section and the data sheets.
6. The pump horsepower shall conform to the requirements of the Odor Control Systems section and the associated data sheets.
7. As indicated in the Odor Control Systems section datasheets, the Odor Control System Supplier shall be responsible for calculating the final recirculation pumping unit head loss and motor size.
8. The Odor Control System Supplier shall bear all costs for adjusting the electrical equipment and power supply as needed to accommodate any motor horsepower adjustment.

F. Recirculation Pump Accessories

1. Recirculation pumps shall be furnished with all accessories as indicated on the Drawings, and as recommended by the manufacturer for proper operation.
2. All accessories shall utilize materials resistant to the service fluid as recommended by the manufacturer.

G. pH Analyzer

1. One pH analyzer shall be furnished and installed in the discharge piping of the recirculation pumps or in the Water Box, as recommended by the manufacturer. The pH analyzer shall send its signal to the odor control system control panel. The pH analyzer shall be GF Signet 9900 and the probes shall be Signet 3-2756WT with 3719 wet tap assembly and 2760 preamp, or equal.

H. Flow Meter and Switch

1. One combination flow meter and flow switch shall be furnished and installed on the recirculation water line within the Water Box.

I. Pressure Gauges

1. Each recirculation pump shall be provided with a pressure gauge in the discharge piping. One pressure gauge shall be provided on the inlet to the biotrickling filter sump.
2. The gauges shall conform to ANSI/ASME B40.1 and shall be indicating dial type, with C-type phosphor bronze Bourdon tube, stainless steel rotary geared movement, phenolic open front turret case, adjustable pointer, stainless steel or phenolic ring, and acrylic plastic or shatterproof glass window. The dial shall be 4-1/2 inches in diameter, with white background and black markings. Pointer travel shall be not less than 200 degrees nor more than 270 degrees of arc. All gauges shall be Accuracy Grade A or better. The unit of measurement of pressure gauges shall be pounds per square inch. The range of each pressure gauge shall be from 0 to 100 psi. Each gauge shall be provided with 1/2-inch NPT connections, and with a threaded end ball-type shutoff valve as specified in the Valves and Appurtenances section. The gauges shall be connected to the piping as indicated on the Drawings.
3. Wye Strainers
 - a. Where indicated on the drawing, strainers shall be provided. Strainers shall be transparent PVC bodied Y-pattern with 8-mesh screen and compatible O-ring seals. Strainers shall be included with a blow down valve.

J. Nutrient System

1. One nutrient system shall be furnished for each biotrickling filter as indicated on the Drawings to feed nutrient to the biotrickling filter.
2. Nutrient Tank
 - a. One nutrient tank shall be furnished per system as required in The Odor Control Systems section, the data sheets, and as indicated on the Drawings.
 - b. All parts of the tanks shall be fabricated of linear or cross-linked polyethylene resin of sufficient weight for adequate support and protection. Acceptable manufacturers shall be as listed in the Odor Control Systems section datasheets.

- c. The tank shall be designed to store the nutrient solution under the conditions and requirements in the Odor Control Systems section and the data sheets.
 - d. The pump suction / drain connection shall be an integrally molded flange design.
 - e. The pump suction / drain connection shall be the only nozzle on the nutrient tank installed below the operating liquid level.
 - f. Unless otherwise indicated, fill, vent, and instrument connections shall be on top of the nutrient tank, and the overflow connection shall be at the top / side of the tank.
 - g. The tank shall be provided with freeze protection.
- 3. Low Level Switch
 - a. One low level switch shall be furnished and installed on the nutrient storage tank.
 - b. An ultrasonic point level sensor and level controller relay unit shall be provided for this level switch.
 - c. The manufacturer shall select and provide the proper sensor material, sensor length, and mounting hardware as required.
 - d. The low-level switch setting shall be as recommended by the manufacturer.
- 4. Nutrient Pumps
 - a. One nutrient pump shall be furnished and installed within the water box indicated on the Drawings.
 - b. The nutrient pumps shall pull suction from the nutrient tank and feed nutrient to the biotrickling filter. The capacity and discharge pressure of the nutrient pumps shall be as required by the biotrickling filter system.
 - c. The pump shall be per manufacturer's recommendation.
 - d. The odor control system control panel shall start and stop the nutrient pump. The nutrient pump shall be powered from the odor control system control panel.
- 5. Pressure Gauges
 - a. Each nutrient pump shall be provided with a pressure gauge and isolating diaphragm in the discharge piping.
 - b. Each gauge shall conform to ANSI/ASME B40.1 and shall be indicating dial type, with C-type phosphor bronze Bourdon tube, stainless steel rotary geared movement, phenolic open front turret case, adjustable pointer, stainless steel or phenolic ring, and acrylic plastic or shatterproof glass window. The dial shall be 4-1/2 inches in diameter, with white background and black markings. Pointer travel shall be not less than 200 degrees nor more than 270 degrees of arc. All

gauges shall be Accuracy Grade A or better. The unit of measurement of pressure gauges shall be pounds per square inch. The range of each pressure gauge shall be from 0 to 100 psi. Each gauge shall be provided with 1/2-inch NPT connections, and with a threaded end ball-type shutoff valve as specified in the Valves and Appurtenances section. The gauges shall be connected to the piping as indicated on the Drawings.

K. Water Box

1. A water box shall be provided with each biotrickling filter.
2. The cabinet shall regulate the plant water used for start-up and normal moisture control within the biotrickling filter.
3. The water control cabinet shall enclose at a minimum, isolation valves, pressure gauges, flow sensors, flow switches, and a nutrient feed pump.
4. The enclosure shall have a NEMA rating suitable for the location or shall be NEMA 4X FRP if located in an unclassified area.
5. Each water control cabinet shall be furnished with a main power disconnect switch and weather shield. The panel shall be mounted as shown on the Drawings, and factory tested to full operation with all other components prior to shipment. The cabinet shall contain the following components:
 - a. Nutrient metering pump
 - b. Recirculation system shutoff valve
 - c. Recirculation system pressure gauge
 - d. Make-up water shutoff valve
 - e. Make-up water strainer
 - f. Make-up water pressure gauge
 - g. Cabinet heater and air temperature switch
 - h. Flow switch
 - i. Pressure gauges
 - j. Rotameter
 - k. Isolation valves
6. The flow switch shall be as recommended by the odor control system supplier.
7. The rotameter shall consist of calibrated glass tubes provided with floats of materials as recommended by the manufacturer of the equipment. The rotameter shall be capable of indicating flow as recommended by the System Manufacturer on a 10-inch scale with a nominal pressure drop of 50 inches of water. The metering accuracy shall be within ± 2 percent of full scale over a 10 to 1 range.
8. The wye strainer shall be transparent PVC bodied Y-pattern with 8-mesh screen and O-ring seals. Strainer shall be included with a blown down valve.
9. The pressure gauges shall conform to ANSI/ASME B40.1 and shall be indicating dial type, with C-type phosphor bronze Bourdon tube, stainless steel rotary geared movement, phenolic open front turret case, adjustable pointer, stainless steel or

phenolic ring, and acrylic plastic or shatterproof glass window. The dial shall be 4-1/2 inches in diameter, with white background and black markings. Pointer travel shall be not less than 200 degrees nor more than 270 degrees of arc. All gauges shall be Accuracy Grade A or better. The unit of measurement of pressure gauges shall be pounds per square inch. The range of each pressure gauge shall be from 0 to 100 psi. Each gauge shall be provided with 1/2-inch NPT connections, and with a threaded end ball-type shutoff valve as specified in the Valves and Appurtenances section. The gauges shall be connected to the piping as indicated on the Drawings.

10. Piping and valves within the water box shall conform to the Valves and Appurtenances, Miscellaneous Ball Valves, Miscellaneous Plastic Pipe, Tubing, and Accessories, and Globe Valves sections as applicable.

L. Biotrickling Filter Blowdown

1. Each biotrickling filter will be operated with a continuous blowdown if recommended by the manufacturer.
2. The rate of blowdown shall be as determined by the Odor Control System Supplier and shall be controlled by a manual throttling valve in the makeup water supply line.
3. An overflow outlet with a water trap shall be provided. An overflow pipe shall connect the overflow outlet to the biotrickling filter drainpipe. The connection shall be located downstream of the shutoff valve in the drain piping.

M. Neoprene Pad

1. A 1/4" thick, 60 durometer neoprene rubber sheet must be placed underneath the biotrickling filter vessel.

N. Water Supply Pipe

1. A potable water supply pipe shall be sized by the Odor Control System Supplier and shall be provided to each water control panel. A pressure gauge, and main shutoff ball valve shall be provided on the supply line by the Contractor as indicated on the drawings.

O. ELECTRICAL

1. Electrical shall meet with requirements of the Odor Control Systems section.

P. CONTROLS

1. Controls shall meet the requirements of the Odor Control Systems section.

Q. MANUFACTURE AND FABRICATION

1. Anchor Bolts and Expansion Anchors
 - a. Anchor bolts, expansion anchors, nuts, and washers shall be as indicated in the Special Provisions section unless otherwise indicated on the Drawings.

2. Edge Grinding

- a. All cut or sheared edges shall be ground smooth to a 1/8-inch minimum radius for all material 1/4 inch thickness and larger. For material thickness less than 1/4 inch all cut or sheared edges shall be ground smooth to a radius equal to 1/2 the material thickness. Grinding of rolled edges on standard shapes with a minimum radius of 1/16 inch will not be required.

3. Surface Preparation

- a. All iron and steel surfaces 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.

4. Shop Painting

- a. 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.
- b. 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 a universal primer.
- c. Machined, polished, and nonferrous surfaces which are not to be painted shall be coated with rust-preventive compound as recommended by the equipment manufacturer.
- d. Biotrickling filter shall be painted to match the color of the adjacent building in accordance with the Finish Painting section.

5. Special Tools and Accessories

- a. 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.

PART 3 EXECUTION

3.01 INSPECTION

- A. Inspection shall meet the requirements of Section 11350 Odor Control Systems.

3.02 PREPARATION

- A. Preparation shall meet the requirements of Section 11350 Odor Control Systems.

3.03 INSTALLATION

- A. Installation shall meet the requirements of Section 11350 Odor Control Systems.

3.04 ADJUSTING

- A. Adjusting shall meet the requirements of the Section 11350 Odor Control Systems.

3.05 FIELD QUALITY CONTROL

- A. Field quality control shall meet the requirements of Section 11350 Odor Control Systems.

3.06 CLEANING

- A. Cleaning shall meet the requirements of Section 11350 Odor Control Systems.

3.07 TRAINING

- A. Training shall meet the requirements of Section 11350 Odor Control Systems.

END OF SECTION

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SECTION 11356

ODOR CONTROL FANS

PART 1 GENERAL

1.01 SCOPE

- A. This section covers the furnishing and installation of centrifugal fans complete with electric drive motor, base, and accessories as specified herein.
- 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 under this section shall be coordinated with other components of the applicable odor control system as specified in Section 11350 Odor Control Systems and data sheets.

1.04 SUBMITTALS

- A. General
 - 1. Submittals for each odor control fan shall meet the requirements of Section 11350, Odor Control Systems and the requirements stated herein.
 - 2. Drawings and Data
 - a. 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 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:

1) Fans

- a) Name of manufacturer
- b) Type and model
- c) Rotative speed
- d) Bearing type and lubrication
- e) Connection sizes
- f) Net weight
- g) Overall dimensions
- h) Anchor bolt details
- i. Performance curves for each fan with capacity in cubic feet per minute as the abscissa, and brake horsepower, static pressure, and fan efficiency as the ordinate
- j) Sound power output data for the fan housing and ducted outlet when operating at the specified volume flow rate. Sound data shall list dB re 10-12watts in each octave band, with midrange frequencies starting at 63 Hz and ending at 8,000 Hz; and dBA at 5 feet

2) Motors

- a) As specified in the Electric Motors section

3) Transition Pieces

- a) Name of manufacturer
- b) Materials of construction
- c) Pressure and vacuum rating
- d) Dimensions.

4) Inlet Boxes

- a) Materials of construction
- b) Dimensions
- c) Pressure loss performance ratings

5) Acoustical Enclosures

- a) Name of manufacturer
- b) Materials of construction
- c) Dimensions
- d) Accessories

6) Seismic Design Requirements

- a) Confirmation of compliance with the requirements of the Meteorological and Seismic Design Criteria section.

3. Operation and Maintenance Data and Manuals

- a. Operation and maintenance data and manuals shall meet the requirements stated in Section 11350 Odor Control Systems.

4. Color Selection

- a. Color selection shall meet the requirements stated in Section 11350 Odor Control Systems.

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 Experience

- 1. The requirements for manufacturer experience are stated in Section 11350 Odor Control Systems.

C. Fan Performance

- 1. Each fan shall bear the AMCA211 Certified Rating Seal for fan performance.

D. Fan Sound Rating

- 1. Each fan shall bear the AMCA311 Certified Sound Rating Seal for fan sound performance.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Shipping shall be in accordance with the requirements of Section 11350 Odor Control Systems.

1.07 EXTRA MATERIALS

- A. Extra materials for each fan shall be furnished for the equipment as follows:

1. Extra Materials	Quantity
a. Fan V-belts	1
b. Fan bearing assembly	1
c. Fan shaft seal assembly	1

- B. Extra materials shall be packaged in accordance with the Materials, Transportation and Handling section, 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.
- 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. Odor control fans shall be designed to operate at the elevation and seismic conditions indicated in the Meteorological and Seismic Design Criteria section. All equipment furnished for sites above 2000feet above sea level shall be properly derated to operate and meet the specified capacities at the site conditions. The fans shall be suitable for the service conditions stated in the data sheets in Section 11350 Odor Control Systems and designed for continuous 24hours per day operation.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

- A. All fan components of plastic construction shall contain ultraviolet inhibitors. Each fan shall be designed for the conditions indicated in the data sheets of Section 11350 Odor Control Systems.
- 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.

2.03 ACCEPTABLE MANUFACTURERS

- A. The fan manufacturer shall be licensed to display the logo of an AMCA member company. Fan manufacturers shall be as listed in the data sheets of Section 11350 Odor Control Systems.

2.04 MANUFACTURE AND FABRICATION

A. 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.

B. Unitary Base

1. Each fan, inlet elbow, and drive shall be mounted on a common unitary base provided by the fan manufacturer. The base shall have rounded corners, and all exposed seams and contact surfaces of steel plates and shapes shall be continuously welded and ground smooth. Each base shall be arranged to permit drive belt tension adjustment. An opening shall also be provided, if necessary, for electrical conduit to the drive unit.

C. Fan Construction

1. The fans shall be single-width, single-inlet type with backward inclined blade construction. Each fan shall be designed for the rotation and discharge direction indicated on the Drawings. Each fan shall meet the requirements stated in the data sheets of Section 11350 Odor Control Systems.
2. Fiberglass reinforced plastic (FRP) fans shall have housings and fan wheel constructed of FRP. The fan housing and wheel shall be made of chemical grade vinyl ester resin. Except as modified or supplemented herein, the fan shall comply with the applicable provisions of ASTM D4167. The fan shall be suitable for operation with temperatures up to 150°F without derating the safe operating speed of the fan. The entire housing and airstream surfaces shall be graphite impregnated and grounded to prohibit static buildup. The fan shall have an ASTM E-84 Class I flame spread rating. Fan housings and supports shall contain an ultraviolet inhibitor or coating. Lift and hold-down lugs shall be integrally molded into the fabrications. Housings shall have a plugged drain connection at the low point of the scroll and a gasketed access door. The fan shaft shall be completely encapsulated in an FRP sleeve where exposed to the airstream. A Viton shaft seal shall be furnished. All hardware exposed to the airstream shall be 316 stainless steel, embedded in FRP.
3. The supporting frame shall be of welded carbon steel or fiberglass reinforced plastic construction. All exterior and exposed metal surfaces of the support frames shall be sandblasted, primed, and shop coated with epoxy to a minimum dry film thickness of 10mils.
4. Bearings shall be self-aligning, antifriction type with external grease fittings and shall have an AFBMAL10 Life Rating of 100,000 hours at specified operating conditions.
5. Each fan wheel and shaft shall be statically and dynamically balanced at the factory before shipment. The first critical speed of the rotating assembly shall be not less than 125percent of the maximum recommended operating speed. Each fan shall be provided with shaft seals.

6. The fan inlet shall be straight or flanged. The fan outlet shall be flanged. Flanges shall be the fan manufacturer's standard dimensions and drilling.

D. Transitions

1. Fiberglass reinforced plastic transition pieces shall be furnished with each fan. Each transition shall be flanged on the fan end and shall adapt the flanged inlet/outlet connection of each fan to the flexible connector. Transition pieces shall have a minimum wall thickness of 1/4-inch and an outside diameter equal to that of the connecting fiberglass reinforced plastic pipe. Flanges shall have a thickness of at least 3/8-inch. Flange bolt holes shall be field drilled to match the applicable fan connection.

E. Pressure Differential Switches

1. Pressure differential switches shall be provided for each fan as indicated on the drawings. Pressure differential switches shall have an operating range selected so the setpoint is between 25 and 75percent of the scale range. Setpoints shall be set at 50percent of the fan static pressure rating indicated in the schedules on the Drawings. The switches shall be diaphragm type, operated by differential air pressure. The switches shall be single pole, double throw, and shall be rated 5 amperes at 120volts ac and a temperature range of -20°F to 125°F. The switches shall be provided with corrosion resistant mounting brackets. Pressure differential airflow switches shall be provided with explosionproof housings and shall be Dwyer Instruments "Series1950G".

F. Differential Pressure Gauges

1. Differential pressure gauges shall be furnished for monitoring the pressure differential across each fan as indicated on the drawings. The gauges shall be permanently mounted and shall be furnished with a mounting bracket, tubing, and all required fittings. Unless otherwise indicated, the installation hardware shall be Type 316L stainless steel. Tubing shall be 1/2-inch PVC pipe, unless otherwise indicated, properly supported and braced for a permanent installation.
2. Each gauge shall be of the diaphragm actuated dial type with adjustable pointer, white dial and black figures and markings. Each gauge shall have a range such that under normal operating conditions, the reading is approximately in the middle of the range. Accuracy shall be within 3percent of full scale. Two shutoff cocks shall be furnished with each gauge.
3. Condensate drip tubing shall be provided on the high- and low-pressure lines to each gauge. The condensate drip lines shall extend a minimum of 4-inches below the bottom elevation of the gauge and terminate with shutoff valves.
4. The gauges shall be furnished with a transparent red overlay extending from the maximum allowable differential pressure reading to the end of the range.
5. Differential pressure gauges shall be Dwyer "Series 4000 Capsuhellic" with diaphragm seal made from a material suitable for exposure to a dry hydrogen sulfide air stream.

G. Fan Inlet Boxes

1. Fan inlet boxes shall be provided by the fan manufacturer where indicated on data sheets in Section 11350 Odor Control Systems. Inlet boxes shall be made of either all fiberglass reinforced plastic construction with corrosion resistant vinyl ester resin or Type 316 stainless steel with coating to match the associated fan. Inlet box components shall be bolted together, and the box shall be bolted to the fan inlet with all stainless-steel hardware. A stainless-steel support leg assembly shall be provided and the fan base shall be extended to meet the support leg assembly.

H. Acoustical Enclosures

1. Acoustical enclosures shall be provided by the fan manufacturer where indicated on data sheets in Section 11350 Odor Control Systems. Acoustical enclosures shall be made of all fiberglass reinforced plastic construction with acoustical treatments. Enclosures shall come with access doors, and acoustical ventilating louvers sized for adequate cooling of the enclosed fan and motor. Enclosures shall provide full access to all fan components. Enclosures shall come with factory applied, gel coat, ultraviolet resistant finish coat. Enclosures shall reduce sound pressure levels a minimum of 10 dBA at a distance of three feet. All fastening and mounting hardware shall be stainless steel. Acoustic enclosures shall be as manufactured by Soundguard or equal.

I. Flexible Connections

1. Flexible connections in odor control gas piping shall be installed at the locations indicated on the Drawings and at other locations for proper installation as determined by the odor control systems supplier.
2. Flexible connections shall be fully molded type rated for a minimum 3psi 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 flexible connections 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 flexible connections shall have split stainless steel retaining rings and shall have ASTM D3982 diameter and drilling. Flexible connections shall be Red Valve "Duct Expansion Joints", Mercer Rubber Company, or Holz Rubber Company.

2.05 ELECTRICAL

1. Each odor control fan shall comply with the electrical requirements in Section 11350 Odor Control Systems.

2.06 DRIVE UNITS

A. V-Belt Drives

1. V-belt drives shall be provided and shall be coordinated with the requirements of the associated equipment as indicated on the data sheets in Section 11350 Odor Control Systems. Each V-belt drive shall include a sliding base or other suitable belt tension adjustment. V-belt drives shall have a service factor of at least 1.5 at maximum speed based on the nameplate horsepower of the drive motor. 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.
2. Unless otherwise indicated in the specific equipment paragraph, equipment with smaller than 10horsepower motors shall have adjustable pitch sheaves and equipment with 10horsepower 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.

B. Electric Motors.

1. The electric motors shall be designed as specified in Electric Motors section.
2. Minimum motor horsepower for each fan are listed in Section 11350 Odor Control Systems and data sheets. Larger motors shall be provided if required to meet the specified capacities for the equipment furnished. Motors shall be rated for installation in a NEC Class 1, Division 2, Group D environment.

2.07 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. Installation shall meet the requirements of Section 11350 Odor Control Systems.

3.02 PREPARATION

- A. Preparation shall meet the requirements of Section 11350 Odor Control Systems.

3.03 INSTALLATION

- A. Installation shall meet the requirements of Section 11350 Odor Control Systems.

3.04 ADJUSTING

- A. Adjusting shall meet the requirements of Section 11350 Odor Control Systems.

3.05 FIELD CONTROL

- A. Field control shall meet the requirements of Section 11350 Odor Control Systems.

3.06 CLEANING

- A. Cleaning shall meet the requirements of Section 11350 Odor Control Systems.

3.07 TRAINING

- A. Training shall meet the requirements of Section 11350 Odor Control Systems.

END OF SECTION

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SECTION 11357

ODOR CONTROL DAMPERS

PART 1 GENERAL

1.01 SCOPE

- A. This section covers the furnishing and installation of air dampers for odor control 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. Equipment furnished under this section shall be coordinated with other components of the applicable odor control system.
 - 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.

C. General Equipment Stipulations

1. The Special Provisions shall apply to all equipment and materials furnished under this section. If requirements in this specification differ from those in the Special Provisions, 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 Underwriters' Laboratories (UL) safety requirements.

E. Metal Thickness

1. Metal thickness and gages specified herein are minimum requirements. Gages refer to US Standard gage.

F. Mechanical Identification

1. All equipment tagged on the drawings, including dampers, 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, the rated capacity, head, speed, operating and power characteristics, label of tested compliances, and all other pertinent data shall be attached to each piece of equipment. Damper color coding shall be as specified in the Finish Painting section and match adjacent piping.

1.04 SUBMITTALS

A. Drawings and Data

1. Complete fabrication, assembly, and installation drawings, 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 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. Odor Control Dampers

- 1) Name of manufacturer
- 2) Type and model
- 3) Materials of construction
- 4) Pressure rating
- 5) Vacuum rating
- 6) Leakage and performance data

- 7) Overall dimensions
- 8) Flange dimensions and drilling
- 9) Total weight, including actuator
- 10) Required operating and break away torque

B. Operation and Maintenance Data and Manuals

1. Operation and maintenance information shall be submitted in accordance with the Submittals section. Equipment designations used shall correspond to those indicated on the Drawings. 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 QUALITY ASSURANCE

A. Manufacturer Experience

1. Unless specifically named in the Specifications, a 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, and shall provide a reference list with the names, addresses, and contact phone numbers for a minimum of 20 similar installations.

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.

1.07 EXTRA MATERIALS

- A. The following extra materials shall be furnished:

Item	Quantity
flange gaskets	2 each
seals	2 each
Blade Seal	2 each

1. Extra materials shall be packaged in accordance with the Materials, Transportation and Handling section requirements, 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.
2. 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 PERFORMANCE AND DESIGN REQUIREMENTS

- A. All equipment shall be designed and selected to meet the specified conditions.
- B. The dampers will be used in malodorous air fully saturated with water vapor and will contain hydrogen sulfide. All equipment and components of plastic construction shall contain ultraviolet inhibitors.
- C. 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.

2.02 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers shall be as listed in the respective product description paragraphs.

2.03 MANUFACTURE AND FABRICATION

- A. Odor Control Dampers
 - 1. Shall be of the single blade type complete with channel type frame, close fitting blade, full length axle, and bearings. Each damper shall have the same inside dimensions as the connecting piping. Axles shall be continuous through the damper.

Frame	Flame retardant, Vinyl Ester
Blade	Vinyl Ester
Axle	Vinyl Ester or Type 316 Stainless Steel
Blade Seal	EPDM
Shaft Seal	Viton
Flanges	Flanges shall comply with ASTM D3982

- 2. Dampers used for shutoff and isolation shall be furnished with a blade seal and shaft seal. Shutoff and isolation dampers shall bear the AMCA seal and shall have a maximum air leakage rate of 3 cfm per square foot at a pressure or vacuum of 10 inches of water column. Dampers used for balancing shall be furnished with a blade stop and shaft seal.
 - 3. Dampers shall be Swartwout, Belco, or Viron.

B. Backdraft Dampers.

1. Damper frames shall be constructed with a minimum face-to-face dimension of 12 inches [300 mm] and the same inside dimensions as the connecting piping. Axles shall be continuous through the damper. Flanges for air connections shall comply with ASTM D 3982.
2. Dampers shall be furnished with an adjustable counterbalance assembly and shall be suitable for horizontal or vertical installation as indicated on the Drawings. Round backdraft dampers shall have blade stops, shaft seals, and shall be Swartwout, Belco, or Viron.

C. Actuators and Accessories

1. Damper actuators and accessories shall be furnished and installed as indicated. All required linkages and accessories required for a complete installation shall be furnished.

D. Hand Actuators

1. Hand, crank lever actuator shall be all Type 316 stainless steel construction and shall have a locking quadrant suitable for positioning the blade at the fully open, the fully closed or any intermediate position. Dampers 24 inches and larger shall be provided with epoxy coated worm gear operator with hand crank.

E. Chainwheel Actuators

1. Actuators shall be installed for each damper installed at an elevation greater than 8 feet above the floor. Each chainwheel-operated damper shall be equipped with a chain guide which will permit rapid handling of the operating chain without "gagging" of the wheel and will also permit reasonable side pull on the chain. Suitable extensions shall be provided, if necessary, to prevent interference of the chain with adjacent piping or equipment. Operating chains shall be hot dip galvanized carbon steel and shall be looped to extend to within 4 feet of the floor or operating platform.

PART 3 EXECUTION

3.01 INSPECTION

- A. All equipment and accessories 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. For new work at existing facilities, Contractor shall be responsible for verifying all field dimensions and for verifying location of all equipment, piping, and ductwork relative

to any existing equipment, structural members, piping, ductwork, lighting, conduit, etc. to avoid conflicts with such items.

- B. 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.

3.03 INSTALLATION

- A. The dampers shall be positioned to fit in the connecting piping. Unless otherwise necessary for proper operation of the damper, the axles shall be installed in the horizontal position. The inside of the dampers shall be smooth, clean, and free from blisters and dirt when installed.

3.04 FIELD QUALITY CONTROL

A. Field Testing

1. After the installation of the equipment and systems has been completed, 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 CLEANING

- A. At the completion of 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 at no additional cost to Owner.

Odor Control Schedule				
Tag Number	Mechanical Drawing(s)/P&ID(s)	Nominal Size (in)	Type (Balancing or Isolation)	Balanced Airflow (cfm)
1540-DMP-ODOR	MA-17, MA-20, P-10	10	Balancing	800
1541-DMP-ODOR	MA-17, MA-20, P-10	8	Balancing	650
1542-DMP-ODOR	MA-17, P-10	8	Balancing	650
1543-DMP-ODOR	MA-19, MA-20, P-10	18	Balancing	3050
1544-DMP-ODOR	MA-19, MA-20, P-10	18	Balancing	3050
1545-DMP-ODOR	MA-18, MA-20, P-10	4	Balancing	100

1546-DMP- ODOR	MA-18, MA-20, P-10	30	Isolation	N/A
1547-DMP- ODOR	MA-18, P-10	10	Balancing / Gooseneck Vent	400
1548-DMP- ODOR	MA-18, P-10	10	Balancing / Gooseneck Vent	400

END OF SECTION

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SECTION 11366

SCUM BAFFLE EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This section covers furnishing a fixed scum baffle:

Number of units.

Scum Baffle. 2

- B. The scum baffle shall be designed to remove floating scum from the surface of the aeration basin and direct it into the scum pit.
- C. Each baffle shall be as specified herein and shall be designed for installation in the aeration basins having the dimensions indicated on the Drawings.
- D. Equipment furnished under this section shall be fabricated and assembled in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.
- E. Equipment shall be furnished complete with all components and accessories required for proper operation, including scum deflector blade; and any additional materials or construction required by the manufacturer's design.

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 under this section shall be fabricated and assembled in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.
- B. Equipment shall be furnished complete with all components and accessories required for proper operation, including scum deflector blade; and any additional materials or construction required by the manufacturer's design.
- C. Product Requirements:
 - 1. The Special Provisions shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the Special Provisions section, 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.

1.04 SUBMITTALS

- A. Drawings and Data:
 - 1. Complete assembly and installation drawings, together with detailed specifications and data covering materials, power drive assemblies, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the Submittals section. Drawings shall indicate all dimensions and structural member sizes, and shall be certified by an officer of the company manufacturing the equipment that the design is in compliance with all local laws and codes for the location where the equipment will be installed. Data and specifications for each unit shall include, but shall not be limited to, the following:
 - a. Shop painting
 - b. Structural drawings, including baffle drawings, anchor bolt details, and calculations sealed by a Professional Engineer registered in the State of the project
 - c. Confirmation of compliance with the requirements of the Meteorological and Seismic Design Criteria section

1.05 SPARE PARTS

- A. Not used.

PART 2 PRODUCTS

2.01 SERVICE CONDITIONS

A. Service conditions shall be as follows:

Seismic design requirements and site elevation	See Seismic and Meteorological Section
Type of wastewater treatment	<i>Mixed Liquor Surface Wasting</i>
Temperature range	-2 to 105 F
Equipment exposed to temperatures that could produce icing	Yes

2.02 STRUCTURAL DESIGN

- A. The design of the equipment shall consider surface preparation and painting requirements and shall comply with the recommendations of the SSPC. Inaccessible welds and welding of angles back-to-back shall be avoided.
- B. Submerged carbon steel or stainless-steel components shall not be fabricated from sections with a hollow cross-section, such as pipe or tubular section, only bars, plates, angles, channels, and other rolled sections shall be used.
- C. Anchor bolts shall be cast-in-place type, and shall be designed and detailed in accordance with all applicable provisions of ACI 318.

2.03 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Baffle equipment shall remove scum from the liquid surface in the basin.
- B. Equipment shall be for scum baffles and all other appurtenances necessary or shown on the Drawings.
- C. Basin Dimensions and Features
 - 1. The equipment shall be designed to operate in basins having the following dimensions and features:

Baffle length	<i>18.5 ft</i>
Baffle height	<i>2 ft</i>
Total sidewall depth	<i>14.5 ft</i>
Sidewall water depth at peak flow	<i>13.42 ft</i>
Height of baffle blade	<i>2 ft</i>
Average water velocity	<i>1 ft/s</i>
Maximum water velocity	<i>2 ft/s</i>
Allowable interior angle	<i>5-12 degrees</i>

D. Design Requirements

1. The equipment design requirements shall be as follows:

Annual average design flow per basin.	20.6 mgd
Maximum month flow per basin.	22.0 mgd
Peak flow per basin.	25.3 mgd

2.04 ACCEPTABLE MANUFACTURERS

- A. The scum baffle shall be manufactured by Protectolite Composites, Inc. or approved equal.

2.05 BOLTS AND NUTS

- A. The bolts, nuts, and washers shall be suitable for field assembly, and be provided for each item of equipment.
- B. All field assembly bolts, nuts, and washer in submerged locations shall be stainless steel. A washer shall be installed under each nut.

Assembly Bolts and Nuts.

Stainless Steel

Bolts ASTM F593, Alloy Group 1 or 2;
Nuts ASTM F594, Alloy Group 1 or 2.

Flat Washers

ANSI B18.22.1; of the same material
as the bolts and nuts.

- C. Anchor bolts shall comply with the Special Provisions section.
- D. Anti-seize compound will be applied to the threads of all stainless-steel bolts before assembly.

2.06 CONSTRUCTION

A. Scum Baffles

1. Each basin shall be equipped with a scum baffle that directs floating scum into a pit for removal. Skimming equipment shall be designed to span the basin as indicated on the Drawings
2. Each basin shall be equipped with one scum baffle. Each baffle shall collect scum the full distance between the dividing wall and the scum pit. The entire weight of the skimmer baffle shall be supported at the external wall. Designs which rely on the internal flow baffle wall for support will not be acceptable.
3. Baffles shall be made of FRP with FRP supports and 316 stainless steel hardware and anchorage.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with the Quality Requirements section and as specified herein.
- B. Baffle plates shall be adjusted to a level position after installation. All stainless-steel bolts shall be tightened with a torque wrench. Torque values for all stainless-steel bolts shall be in accordance with the manufacturer's recommendations. The recommended values shall prevent undershearing and/or seizing of stainless-steel bolts.

3.02 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 the Equipment Testing and Start-Up 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.
 - 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.

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SECTION 11370

POSITIVE DISPLACEMENT BLOWERS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Install, test, and make ready for operation, positive displacement blowers, motors, and appurtenances, as shown on the Drawings and specified herein. Furnish all labor, materials, equipment, and incidentals required for complete installation, proper operation, and successful field testing of the blowers.
- B. Furnish electric motors as part of the work of this Section, and per all applicable portions of Section 01171, Electric Motors.
- C. Furnish and install blowers with all necessary accessory equipment, including:
 - 1. Main drive motor
 - 2. Compressor
 - 3. Base frame with forklift slots and package vibration isolators
 - 4. Expansion joints at inlet and discharge
 - 5. Discharge check valve
 - 6. Discharge isolation valve (butterfly valve)
 - 7. Gauges for discharge air temperature and pressure
 - 8. Pressure transducer for discharge pressure
 - 9. Inlet air filter with differential pressure indicator
 - 10. Inlet pulsation dampener (silencer)
 - 11. Discharge pulsation dampener (silencer)
 - 12. Spring-loaded pressure relief valve
 - 13. Sound Attenuating Enclosures
- D. All necessary and desirable accessory equipment and auxiliaries, whether named in this Section or not, shall be furnished and installed as required for an installation incorporating the highest standards for this type of service. Manufacturer shall provide supervisory services during installation, factory testing, field inspection and instruction of the operating personnel in the proper care, operation, and maintenance of the equipment.
- E. Equipment furnished and installed under this Section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations of the equipment Manufacturer as approved by the Engineer.

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 09902 – Finish Painting
- E. Section 11377 – Coarse Bubble Diffuser System
- F. Section 15051 – Piping General Requirements
- G. Section 15064 – Stainless Steel Pipe and Alloy Pipe Tubing and Accessories
- H. Section 15100 – Valves and Appurtenances
- I. Division 16 – Electrical

1.04 REFERENCE STANDARDS

- A. Design manufacturing and assembly of elements of the equipment specified herein shall be in accordance with the following:
 - 1. ASTM International (ASTM)
 - 2. American Gear Manufacturers Association (AGMA)
 - 3. American Institute of Steel Construction (AISC)
 - 4. American Iron and Steel Institute (AISI)

5. American Society of Mechanical Engineers (ASME)
 - a. ASME PTC 9 – Displacement Compressors
6. American National Standards Institute (ANSI)
7. American Water Works Association (AWWA)
8. American Welding Society (AWS)
9. Anti-Friction Bearing Manufacturers Association (AFBMA)
10. Hydraulic Institute (HI) Standards
11. Institute of Electrical and Electronics Engineers (IEEE)
12. National Electric Code (NEC)
13. National Electrical manufacturers Association (NEMA)
14. Occupational Safety and Health Administration (OSHA)
15. Steel Structures Painting Council (SSPC)
16. Underwriters Laboratory (UL)

- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 SYSTEM DESCRIPTION

A. General

1. The blowers will supply air to diffusers within the Post-Aeration Basin.
2. The blowers designated as PAB-01, PAB-02, and PAB-03 will operate on a staged basis based on oxygen demand in the Post-Aeration Basin. The role of spare will alternate automatically among the three (3) blowers. All three (3) blowers shall be identical in size.

B. Conditions of Installation

1. The blowers will be located outdoors.
2. The blower will be designed to perform as specified under the following range of ambient conditions:
 - a. Site Elevation: 1,100-1,280 feet above Mean Sea Level
 - b. Atmospheric Pressure: 14.0 psia to 14.7 psia
 - c. Ambient Temperature: 10 °F to 105 °F
 - d. Ambient Relative Humidity: 20 to 100%

C. Design Requirements

1. The blowers for the Post-Aeration Basin shall be designed for the following minimum performance at the under the identified ambient conditions:
 - a. Capacity (total, minimum): 1,174 scfm
 - b. Differential Pressure: 21.9 psia (7.3 psig)
 - c. Inlet Temperature: 105 °F
 - d. Inlet Relative Humidity: 85%
 - e. Motor Hp (maximum): 60

D. Performance Requirements

1. Over the specified range of ambient conditions, the blower shall operate smoothly, without abnormal noise, vibration, or heat.
2. The blower shall operate over its factory-defined range of operation, and the specified range of ambient conditions, without exceeding the motor's brake horsepower.
3. The blower shall be machined and be both statically and dynamically balanced so as to limit the vibration in any plane to a maximum of 1.5 mils (peak to peak displacement).
4. The operating blower shall not be louder than 75 dBa at a distance of three feet from any part of the blower.
5. The blower shall limit heat generation and gain to the level specified over the defined capacity operating range.
6. Without surging, the blower shall be capable of moving air against the specified discharge pressure.

1.06 SUBMITTALS

- A. Submit to the Engineer for review in accordance with Section 01300, Submittals, complete shop drawings, manufacturer's specifications, and data on all materials required to establish compliance with this Section. Submittals shall include the following:
 1. Certified shop and installation drawings showing equipment, instrumentation, materials of construction, details of construction, dimensions, and anchor bolt locations. These drawings shall include the following as a minimum:
 - a. Dimensioned and scaled general arrangement drawings for each blower unit assembly
 - b. Exploded view drawings cross-referenced to a replacement parts list that includes part number and material of construction information

- c. Point-to-point wiring diagrams for each blower unit assembly identifying all wire and terminal numbers uniquely
 - d. Dimensioned and scaled motor outline drawings identifying location of all field wiring termination cabinets
 - e. Process and instrumentation diagram drawings
 - f. Wiring-schematic ladder logic diagrams for the control panel
 - g. Control panel resident hardwiring diagrams that identify all internal devices, wire tag numbers, terminal tag numbers and interconnections with external devices and signals
 - h. Dimensioned and scaled control panel outline drawings identifying the location of all internal and external panel mounted equipment and devices along with a description of such equipment and devices
2. Exact size, type, and/or manufacturer's model number of the equipment or instrumentation being provided
3. The total weight of equipment including the weight of all major items or components
4. A complete bill of materials for all equipment supplied and a complete list of required materials, not supplied, but necessary to complete the installation of the supplied equipment
5. A list of manufacturer's recommended spare parts, pricing and ordering information including name and phone number of nearest service center. Include gaskets, seals, bearings, and lubrication products on the list
6. The recommended summer and winter grades of lubricants along with alternative references to equal products of other manufacturers. Lubricants shall be NSF 61 approved.
7. Description of shop surface preparation, shop prime painting, and shop finish painting systems. Include color samples of all available shop finish paint colors
8. Center of gravity and lifting point locations for all free-standing equipment
9. Compressor, Motor, and base frame information as follows:
 - a. Manufacturer's name and address
 - b. Manufacturer's model number
 - c. Shaft coupling information including make, model number, dimensions, and materials of construction and alignment tolerances
 - d. Bearing information including make, model number, dimensions, materials of construction, installation tolerances, and bearing life in hour

- e. Lubrication system information including design flow, pressure, and temperature limitations as well as size and materials of construction information
 - f. Data to be included on nameplates
10. Preliminary blower performance data showing expected performance of blower unit at the inlet conditions specified. Submit curves for each of the following performance indices showing how each is affected by variations in atmospheric pressure (14.0 psia to 14.7 psia), ambient air temperature (10 to 105 degrees F), and relative humidity (20 to 100%) at the specified inlet condition:
- a. Inlet Filter Airflow (acfm)
 - b. Inlet Filter Pressure Drop (psig)
 - c. Discharge Pressure (psia)
 - d. Discharge Temperature (degrees F)
 - e. Brake Horsepower Requirement
 - f. Overall Blower Isentropic Efficiency (percent)
 - g. Operating Sound Pressure Levels at 3'-0" Distance (sum of all octave bands on dBA scale)
11. Motor design and product information as specified in Section 01171, Electric Motors.
12. Monitoring and control system information as follows:
- a. Descriptive literature bulletins and/or catalogs for all supplied field instrumentation
13. Valve and operator information as follows:
- a. Manufacturer
 - b. Model number
 - c. Size and weight
 - d. Dimensions
 - e. Details and materials of construction
 - f. Headloss at rated flow for non-throttling valves
 - g. Headloss curves for throttling valves showing flow versus valve position for a given upstream pressure
14. Intake air filter assembly information as follows:
- a. Manufacturer
 - b. Model number
 - c. Size and weight
 - d. Dimensions
 - e. Intake airflow capacity
 - f. Pressure drop across entire assembly versus intake airflow curve
 - g. Filter element type and removal efficiency by particle size
 - h. Materials of construction

15. Reports for the factory inspection and testing required in Part 3, including but not limited to:
 - a. Compressor performance tests
 - b. Motor tests
16. Reports for the field acceptance testing required in Part 3
17. Equipment installation certificates
18. Complete installation manuals for all systems and components being furnished
19. Complete operations and maintenance manuals for all systems and components being furnished
20. List of blower unit and blower unit motor repair facilities within the United States including addresses, contact names and phone numbers

1.07 QUALITY ASSURANCE

- A. The blower and appurtenances manufacturer/supplier shall have manufactured blower units in the United States which are similar in design, type, and service, and comparable in size, head, and capacity to those specified to be furnished. Such comparable units shall have been in operation for a period of not less than five years. The motor manufacturer shall have had at least 10 years prior experience in the design and manufacture of the motors specified herein. Blower manufacturer shall provide a list of similar installations including pressure, flow, horsepower, speed, and contact name and phone number.
- B. Both the blower and motor manufacturer shall currently have maintenance and repair facilities established which have been in operation in the United States for a period of not less than three years. Such facilities shall be fully equipped and staffed with qualified personnel for making repairs to damaged blowers and motors; and shall carry or have direct access to a full line of spare parts. Blower Manufacturer shall provide a list of blower and motor repair facilities including addresses, contact names and phone numbers.
- C. All steel, cast iron, and ductile iron fabrications shall conform to applicable AWWA, ANSI, ASME, and etc. standards. Heat treatment of metal is required for reduction of stresses due to welding, bending, forming, etc.
- D. Blower unit shall be the manufactured product of Atlas Copco, Universal Blower PAC, Aerzen, or approved equal. All blowers shall be by the same manufacturer.
- E. To ensure unit reliability, the blower manufacturer shall supply the blower, motor, and the appurtenances listed in Part 1.01.

- F. The blower manufacturer shall be fully responsible for the design, arrangement, and operation of all connected rotating components of each blower, as assembled and installed, to ensure that:
 - 1. No harmful nor damaging vibrations occur at any speed within blowers' operating ranges. No vibration dampening will be permitted.
 - 2. The blowers do not generate noise that is harmful, damaging, in excess of OSHA limits.
- G. Prior to shipping, the manufacturer shall factory test and inspect the blowers as follows. The manufacturer shall tell the Engineer in writing that the herein described tests were done correctly, and that the required results were obtained. The manufacturer shall check the propeller, motor rating, and electrical connections for compliance with the purchase order. The manufacturer shall not ship blowers until the Engineer has received and approved of the test results.
- H. The Contractor shall assume responsibility for the satisfactory installation and operation of the entire blower system including blowers, motors, and peripherals as specified in this Specification section.
- I. Furnish only food-grade or NSF certified oil, grease, and lubricants.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.
- B. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.
- C. All mechanical and electrical equipment shall be coated, wrapped and otherwise protected from rain, drippings of any sort, dust, dirt, mud, flood and condensed water vapor during shipment and while installed in place during construction. The protective coverings shall remain in place until the work areas are substantially free of all construction dust and debris.
- D. Full details of proposed protective measures shall be submitted for approval to the Engineer prior to shipment. Follow manufacturer's instructions for long-term storage and maintain warranty on equipment.
- E. The finished surfaces of all exposed flanges shall be protected by wooden blank flanges, strongly built, and securely bolted thereto.
- F. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- G. Care must be taken during unloading and handling of equipment to ensure against undue strain to the blower and motor. Do not use lifting straps or chains under the blower or motor. Lift from under the main frame, base or use base mounted lifting lugs (if provided).

1.09 MANUFACTURER/SUPPLIER PROVIDED MANUALS AND SERVICES

- A. Operating and maintenance manuals shall be furnished to the Owner as provided in Section 01782, Operation and Maintenance Manual. The manual shall be prepared specifically for this installation and shall include all required cut sheets, dimensional drawings, equipment parts lists, descriptions, maintenance recommendations, troubleshooting recommendations, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.
- B. Services of blower and appurtenances manufacturer/supplier:
 1. Provide the services of a factory certified service engineer specifically trained in the installation, start-up, testing, operation and maintenance of the equipment as herein specified. Such services shall be provided by a representative who is a direct, full-time employee of the blower and appurtenances manufacturer/supplier. Services of the blower and appurtenances manufacturer/supplier shall be in accordance with this Section and Section 01810, Equipment Testing and Start-Up.
 2. Owner's training shall be provided and include operational and maintenance instruction. Training shall be given at times convenient to the operational team being trained.
 3. Man-hour requirements tabulated below are exclusive of travel time and do not relieve the blower and appurtenances manufacturer/supplier of obligation to provide sufficient services to place equipment into satisfactory operation.

Services Provided by Factory Certified Service Engineer	Minimum Number of Trips	Minimum time On-Site Per Trip (Hours)
a. Start-Up and testing of blower units	1	40
b. Train Owner's Operation and Maintenance Personnel	1	8

1.10 MAINTENANCE

- A. Provide one (1) set of all special tools that are required for normal operation and maintenance. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended.
- B. Provide all of the blower unit and appurtenance manufacturer/supplier's recommended spare parts. In addition, the following spare parts shall be provided regardless of blower and appurtenances manufacturer/supplier recommendations:
 1. Two (2) spare sets of compressor inlet and outlet bearings, seals, O-rings, and gaskets for one blower
 2. Two (2) complete sets of all bearings, seals, O-rings, and gaskets for one motor
 3. Two (2) complete sets of air filter elements for one blower

- 4. Lubricants required for first oil change on each blower
- C. Pack all spare parts in containers and clearly identify as to their contents. Protect and pack all items for long periods of storage.
- D. Provide a list of all spare and replacement parts with individual prices and locations where they are available.

1.11 WARRANTY

- A. Provide from the equipment manufacturer an unconditional extended warranty for a period of 12 months from start up or 18 months from shipping of the equipment by the Owner. The warranty shall stipulate that the equipment furnished is suitable for the purpose intended and free from defects of material and workmanship for the duration of the extended warranty. In the event the equipment fails to perform as specified, promptly repair or replace the defective equipment without additional cost to the Owner.

PART 2 PRODUCTS

2.01 GENERAL

- A. This Section is intended to give a general description of what is required but does not cover all details.
- B. Contractor shall furnish all materials, equipment, and appurtenances, whether specifically mentioned in this Section or not, as necessary to incorporate the highest industry standards for similar blower installations.
- C. The blower units shall be designed and built for 24-hour continuous duty service at any and all points within the defined operating capacity range, without overheating, without overloading the main drive motor, without surging, and without excessive vibration or strain. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially constructed to meet the specified requirements.
- D. Blower packages shall be designed to minimize the life-cycle costs and maximize plant reliability. The design and the selection of the components shall be based on a minimum useful life of 15 years and a Mean Time Between Overhauls of 5 years of continuous operation. Bearing life must be submitted by manufacturer of service life, based on specified conditions.
- E. No special foundations shall be required. The blower packages will be installed directly on a concrete slab without grouting the base frame. There shall only be 4 easily accessible anchor points.
- F. The blower and appurtenances manufacturer/supplier shall be fully responsible for the design, arrangement, and operation of all blower unit connected components including inlet air filter assembly, base frame, etc.; to ensure that neither harmful nor damaging vibrations occur at any and all points within the defined operating capacity range.

- G. All structural steel used in the fabrication of the equipment shall conform to the requirements of ASTM A36. Design and fabrication of structural steel members shall be in accordance with AISC "Specification for Design, Fabrication and Erection of Structural Steel for Buildings." All welding shall conform to the latest standards of AWS.
- H. To the extent possible, the Manufacturer's scope of supply shall be factory-assembled, factory-tested as described in Part 1. The Manufacturer shall ship this equipment assembled.
- I. The Manufacturer shall supply enough power and signal cable for equipment operation at the location shown in the Drawings.
- J. All electrical materials and equipment shall be UL listed, NEMA rated, and in conformance with applicable Specifications of Division 16.
- K. The rated horsepower of the drive unit shall be such that the unit will not be overloaded, nor the service factor reduced when the blower is operated at any point on the compressor's capacity curve.
- L. The Manufacturer shall provide all necessary bolts, plates, nuts, and washers to facilitate the installation of the blower and the control panel. All bolting and hardware shall be Type 316 stainless steel.

2.02 NAMEPLATES

- A. Equipment information stainless steel nameplates shall be provided for each major piece of equipment including compressor, main drive motor, valves, inlet air filter, control panel, etc. At a minimum, the following information shall be included on each equipment information nameplate:
 - 1. Manufacturer's name, make, model number, serial number, and date of manufacture
 - 2. Electrical voltage requirements and ampere draw at rated voltage
- B. In addition to the above, the blower unit's compressor shall include the following information on its equipment information nameplate:
 - 1. Rated capacity (scfm)
 - 2. Rated discharge pressure (psia)
 - 3. Brake horsepower requirement at rated capacity and discharge pressure
 - 4. Lubrication oil requirements
- C. In addition to the above, the blower unit main drive motor shall include the following information on its equipment information nameplate:
 - 1. All information required by NEMA MG1 20.60.1
 - 2. Efficiency at rated horsepower output
 - 3. Power factor at rated horsepower output
 - 4. Winding insulation system designation and type
 - 5. Bearing model and serial numbers

2.03 COMPRESSOR (BLOWER)

- A. Blowers shall be rotary, positive displacement blowers, providing oil-free air, suitable for heavy-duty continuous industrial service and complete with accessories as described. Each blower shall be sized such that operating speed at the above specified conditions does not exceed 90% of the maximum blower design speed as recommended by the blower manufacturer.
- B. Rotary lobe style blowers shall include dynamically balanced 2-lobe or 3-lobe rotors, each constructed of high strength ductile iron or AISI 1043 carbon steel. Each rotor support shaft shall be cast as an integral part of the rotor to prevent loss of rotor timing due to rotor spinning on its support shaft. The blower drive shaft shall be of heavy-duty design cast integrally with the drive rotor.
 - 1. Each rotor shall be of the "stiff" design with first lateral critical speed at least 120% of the maximum allowable operating speed.
 - 2. The rotors shall operate without rubbing nor shall they require lubrication.
 - 3. The rotors shall be statically and dynamically balanced per ISO1940/ANSI S2.19 G6.3.
- C. Hybrid style blowers shall include rotors constructed of high strength ductile iron or AISI 1043 carbon steel. Each rotor support shaft shall be cast as an integral part of the rotor to prevent loss of rotor timing due to rotor spinning on its support shaft. The blower drive shaft shall be of heavy-duty design cast integrally with the drive rotor.
 - 1. Each rotor shall be of the "stiff" design with first lateral critical speed at least 120% of the maximum allowable operating speed.
 - 2. The rotors shall operate without rubbing nor shall they require lubrication.
 - 3. The rotors shall be statically and dynamically balanced per ISO1940/ANSI S2.19 G6.3.

2.04 SEALS AND LUBRICATION

- A. Positive oil seals shall ensure no contamination of the process air stream by lubricating oil. All shaft surfaces in contact with sealing members shall be polished to reduce seal wear and risk of leakage.
- B. The timing gears and the bearings shall be splash lubricated. Grease lubrication shall be not acceptable.

2.05 BEARINGS

- A. Each rotor/shaft shall be supported by anti-friction bearings and fixed to control the axial location of the rotor/shaft in the unit.
- B. Regardless of theoretical bearing life calculations, the bearings shall be sized for a minimum expected life of 5 years between overhauls.

- C. The applied design conditions shall yield a bearing load and minimal L-10 bearing life calculation of 166,000 hrs. Calculated bearing life shall be submitted, based on specified operating conditions.

2.06 ROTOR AND TIMING GEARS

- A. Rotor housings shall be machined from a single casting of ASTM A-48 Class 30 grey iron. The housing shall be externally ribbed for maximum strength. Two (2) piece housings, subject to misalignment and loss of operating clearances, shall not be allowed. End covers shall be machined from single castings of ASTM A-48 Class 30 grey iron. Endplates shall be machined from single casting of grey iron. For ease of service and lower repair costs, housings with integral endplates are not allowed.
- B. Timing rotors shall be timed by a pair of single helical AGMA 12 quality gears with hardened and ground teeth; minimum AGMA service factor of 1.70. Spur cut gears are unacceptable.

2.07 MAIN DRIVE MOTOR

- A. Blower package shall be supplied with a TEFC NEMA Premium Efficiency motor that shall operate on 460 Volts, 3 Phase, 60 Hertz current, 3600 RPM. Operation of motors above 60 Hertz shall not be allowed under any circumstance.
- B. Motors shall be horizontal, foot mounted, rigid base, Torque NEMA B, Temperature rise Class B, TEFC IP55, watertight and dust tight enclosure.
- C. Class F, inverter rated insulation, Class H applied varnish, 3:1 constant torque VFD-duty.
- D. Regreasable bearings, positive pressure lubrication system with automatic drawn plugs – pressure compensated (frame sizes 254T and larger).
- E. All frame sizes shall be domestic NEMA standard frame sizes, suitable for overhung belt drive and with the conduit box on top of the motor. IEC frame motors shall not be allowed.
- F. The motor will be mounted on a pivoting base to provide automatic tensioning of the belts. The motor nominal rating after any corrections for ambient conditions shall be 10% above the maximum operating horsepower.
- G. The motor shall have a 1.25 service factor for sizes up to 100 HP and a 1.15 service factor for sizes above 100 HP.
- H. Motor windings shall be supplied with a normally closed thermostat, one per phase, wired in series to form a fail-safe motor protection circuit for the external fault circuit of the motor controller on all frame sizes at or above 324T. Thermostat shall be a Klaxon Precision Thermostat by Sensata Technologies.
- I. Motors shall be equipped with an Aegis ring to mitigate the effects of stray motor currents.
- J. Blower manufacturer shall be responsible for coordinating the starting torque requirement of the blower and the motor.

- K. The use of the TEFC motor to cool the blower system or circulate the enclosure air shall not be allowed.
- L. Regardless of VFD supply, the manufacturer shall publish the VFD program settings in the submittal documentation to verify operation is within the intended RPM range of the motor.
- M. Under no circumstances shall operation above 60Hz be permitted to achieve the required flow rate. Motor operation shall be limited to a maximum of 60Hz by the motor controller.

2.08 V-BELT DRIVE (IF APPLICABLE)

- A. Direct-coupled compressors and motors are an acceptable alternative to belt-driven motors. Engineer shall review and approve any drive designs submitted.
- B. Each package shall be supplied with a V-belt drive that shall be of the high-capacity type, oil, and heat resistant.
 - 1. Drive shall be designed for a minimum service factor of 1.4 times operating power (bHp), or 1.1 times the motor nameplate Hp, whichever is larger to allow a minimum of 1.4-service factor based on the maximum blower bHp.
 - 2. Belt tensioning shall be automatic without the use of any spring devices or interaction on the part of the operator. Slide rails or spring tensioners shall not be used as a tensioning device.
 - 3. Sheaves shall be dynamically balanced regardless of the operating speed and hydraulically mounted on the compressor drive shaft. Sheaves shall mount to the blower and motor shafts with QD type bushings.
 - 4. The automatic tensioning system shall yield a v-belt life of 16,000 hrs of operation.
- C. Belt Guard:
 - 1. The belt drive shall be guarded in compliance with OSHA regulations.
 - 2. Portions of the guard shall be easily removable allowing for belt inspection and replacement.
 - 3. Guard material shall be perforated fabricated steel.

2.09 BASE FRAME

- A. The blower unit shall be mounted on a common structural or fabricated steel base plate of adequate size to support the compressor and main drive motor. Base frame shall be machined flat. Corners shall be rounded smooth; welds shall be ground. Base frame shall be free of warping or cupping. Base shall include Forklift Slots to be integral for ease of installation and maintenance. Base shall include spring loaded auto-tension device for ease of drive installation and maintenance.

- B. The blower shall have isolation mounts to minimize transmitted vibrations from blowers to the surrounding structure. Each package shall be supplied with vibration isolating feet with a minimum efficiency of 80%.
- C. Blower unit base frame shall serve as the mounting platform for the field wiring termination cabinet for the compressor and motor bearing temperature sensors. Cabinet shall be NEMA 12 painted steel sized to adequately contain all required terminations. Terminal blocks, base frame mounted conduit, and wires shall be as specified in Division 16.

2.10 ACCESSORIES

A. Discharge Isolation Valves

- 1. Each blower unit shall be provided with a discharge butterfly valve.
- 2. Discharge valves shall be a cast-iron, wafer style, resilient seated, air service butterfly valve. The temperature rating of the seat must exceed the maximum anticipated discharge temperature. Valve shall have a manual actuated gear operator and handwheel.

B. Check Valves

- 1. Each package shall be supplied with one check valve that shall be installed on the discharge line.
- 2. The check valve shall be of the full-bore low pressure-drop, flapper type design with a steel body, and steel flap embedded in EPDM with full-contact seal.
- 3. Pressure losses produced by the check valve shall be included in the entire package performance calculation.

C. Enlargement Joints

- 1. The package shall be provided with a flexible ANSI style discharge connector. Flexible connectors shall prevent the transmission of noise and vibrations from the blower package into the piping. Flexible discharge connectors shall be Proco Style 240, Type EE, EPDM, with a standard ANSI flange discharge connection, rated for 300 °F at 20 psig or approved equal.

D. Inlet Filter/Silencer

- 1. The blower shall be provided with an inlet filter and silencer mounted directly to the inlet flange of the blower.
- 2. The filter media efficiency shall meet the requirements of ASHRAE 52.2 MERV7 50-70% @3-10 microns corresponding to EN779 G4.
- 3. The silencer portion shall be located upstream of the inlet filter.

4. The filter element shall be designed to trap dirt on the inside so that upon changing, dirt does not fall into the machinery. Filters where dirt accumulates on the external surface of the filter shall not be permitted.
5. Filter and silencer performance losses (clean element) shall be included in the entire package performance calculation.

E. Discharge Silencer

1. Each package shall be supplied with one combination base frame / discharge silencer.
2. The silencer shall be a chamber type design for maximum sound attenuation and shall not use internally any absorption materials of any kind (fibrous or otherwise). Internal absorption material has been shown to degrade, reduce the attenuation quality of the silencer, and internally foul diffusers. Silencers that utilize internal absorption material shall not be permitted.
3. The silencer shall be fabricated of a single shell of pressure vessel quality steel with continuous welds.
4. The silencer must be subject to a pressure test for tightness and strength at a minimum of 1.65 times the maximum design pressure.
5. The silencer shall have a machined flanged inlet connection and bolt directly to the discharge flange of the rotary lobe compressor, with no intermediary or interconnecting pieces. Threaded connection between the compressor stage and the discharge silencer is subject to leakage and misalignment and shall not be permitted.
6. Discharge silencer performance losses shall be included in the entire package pressure calculation. Blower accessories shall be supplied by the manufacturer of the blower stage.
7. The base frame shall be constructed from welded carbon steel that shall be designed to maintain alignment of the blower internal components and the drive during operation.
8. The base frame shall be designed to resist distortion while being installed on vibration isolating mounts.
9. The manufacturer shall supply a stainless-steel grounding lug fully welded to the base.

F. Pressure Relief Valve

1. Each package shall be supplied with a single pressure safety valve on the discharge side of the blower mounted downstream of the discharge silencer and upstream of the check valve.

2. The safety valve shall be set to protect the machine from exceeding its maximum pressure rating and shall be sized to pass 100% of the design flow.
3. The valve shall be field adjustable, spring loaded, and have a certificate of conformity to PED if operating above 15 psig.
4. The pressure safety valve shall be housed inside and attenuated by the sound enclosure. The safety valve shall relieve hot air into a segmented and sealed section of the sound enclosure so that the hot air cannot reenter the inlet of the machine. Weighted relief valves inside the enclosure shall not be permitted. Diaphragm electronically actuated relief valves shall not be permitted.

G. Local Control Panels

1. Blower package shall be supplied with the following control functions and features:
 - a. Intuitive TFT color touch screen display
 - b. Display, monitoring, alarm, and shutdown of inlet pressure, discharge pressure, discharge temperature, enclosure cooling fan thermal overload, main drive motor thermal overload, oil temperature and oil pressure
 - c. Display run hours
 - d. Log errors and first out indication
 - e. Track and log maintenance
 - f. E-Stop button mounted on front of blower enclosure
 - g. Operation of enclosure cooling fan motor starter and oil demister
 - h. Ability to transfer measured values, fault, and status messages, as well as remaining times of the service intervals to the customer control system via Modbus RTU.
 - i. Permissive control function of customer start and stop signals to a motor controller
 - j. The local control panel shall be provided with the following digital outputs:
 - 1) Common alarm
 - 2) Common fault
 - 3) Ready to run
 - 4) Transfer of external start/stop command
 - 5) Status remote
 - 6) Alternatively, these outputs can be obtained using the communication protocol

- k. The local control panel shall be provided with the following digital inputs:
 - 1) Remote start/stop
 - 2) Motor controller fault
 - 3) Customer E-stop
 - 4) Alternatively, these inputs can be supplied using the communication protocol
- l. Control Enclosure:
 - 1) IP54 suitable for indoor/outdoor installation
 - 2) Factory installed, integral to sound enclosure
- m. Control Supply Power:
 - 1) 460 VAC, 10 Amp feed with 24 VDC transformer
- n. Monitoring Sensors:
 - 1) Inlet Pressure Transducer
 - 2) Discharge Pressure Transducer
 - 3) PT 1,000 Discharge Temperature RTD
 - 4) PT 1,000 Oil Temperature RTD
- H. Each blower shall receive its initial oil filling at the factory. Oil to be fully synthetic and rated for 16,000 hours of operation between change intervals.
- I. Drain Trap
 - 1. The blower shall be equipped with a drain trap valve as shown herein. Drain trap valves shall be designed to collect and automatically drain accumulated water resulting from the air compression process. The drain trap valve shall be located at the low point of the blower casing at the discharge end of the blower. Drain trap valve body, float, and other integral components shall be of Type 304 stainless steel construction. O-rings shall be of Buna-N construction and shall be capable of withstanding operating temperatures as high as 250 degrees F. Drain trap valve shall be the manufactured product of Spirax/Sarco (Model No. FA-150) or equal.
- J. Sound Attenuating Weatherproof Enclosure
 - 1. Each package shall be supplied with a sound enclosure covering the entire blower package.
 - 2. The enclosure shall provide suitable protection for outdoor installation under wind loads of 50mph and snow loads of 25lbs/ft².
 - 3. Details shall be as follows:
 - a. Enclosure Panels shall be made of powder coated galvanized steel sheet.

- b. The enclosure and the blower package shall both be mounted on a skid / oil-drip pan designed for meeting environment protection standards and for easy transportation and installation.
- c. A grounding strap shall be installed between the blower base and the package skid to bypass any vibration isolating mounts for grounding continuity.
- d. Quick release panels, each less than 50 lb (as mandated by MSHA) must provide easy and quick access for routine maintenance of the blower and the package components.
- e. Enclosure Cooling / Ventilation Fan:
 - 1) Ventilation fan shall be provided for cooling the sound enclosure.
 - 2) The fan shall be sized for sufficient heat removal from the sound enclosure, even when the blower is operated with a VFD.
 - 3) The enclosure cooling fan shall be a dedicated device. The use of the TEFC drive motor to cool the blower or circulate the sound enclosure shall not be allowed.
- f. To prevent possible operator damage, electrical components, instrumentation, and instrument connections shall not be mounted or interface with moving panels of the sound enclosure.
- g. Blower oil sumps shall be piped to a common fill and drain, located at the front of the package for easy maintenance. An oil level indicator shall be mounted on the outside of the enclosure, which gives an accurate oil level indication while the blower is in operation. All oil lines shall be industrial-quality hydraulic hose and fittings.

2.11 SURFACE PREPARATION AND SHOP PAINTING

- A. All equipment furnished shall be shop primed and finish painted as specified by the Manufacturer. An adequate supply of touch-up paint shall be supplied by the Manufacturer.
- B. The finished Layer thickness as per EN ISO 2178 shall be 60 - 100µm for indoor installations.
- C. The finished Layer thickness as per EN ISO 2178 shall be 80 - 120µm for outdoor installations.
- D. Machined surfaces, flange faces & threaded holes are to be masked to protect from paint.
- E. Unpainted steel surfaces are to be protected with rust preventive suitable for 4 weeks outdoor storage.

PART 3 EXECUTION

3.01 FACTORY INSPECTION AND TESTING

- A. Factory performance tests shall be conducted for the complete blower unit furnished under this Section. Tests shall be in accordance with the latest applicable ASME Power Test Code 10-2022. Tests shall determine actual air deliveries, differential pressures, speeds, and electrical input energy requirements for the conditions described. Sufficient test point readings shall be made to establish the head capacity, efficiency, and brake horsepower curves for the blower. Submit six copies of certified blower performance curves to the Engineer at least 14 days prior to shipment.
- B. A functional control check shall be performed on any control panel and instruments provided.

3.02 INSTALLATION

- A. The blower unit and appurtenances shall be installed by the Contractor in accordance with the blower and appurtenances manufacturer/ supplier's instructions and recommendations. The blower and appurtenances manufacturer/supplier shall furnish the services of a factory-certified service engineer who is a direct, full-time employee of the blower and appurtenances manufacturer/supplier to oversee all installation efforts as specified herein.
- B. The Owner and/or Owner's representative may have the alignment of all blower units verified using laser alignment technology. Blower unit shall not be considered acceptable until the equipment is verified level and aligned as approved by the Owner and/or Owners' representative.
- C. The blower pad must be located on the equivalent of compacted soil substructure, which shall allow the pad to remain flat, rigid, and free of resonant frequencies within the operating range of the equipment. The blower must be anchored using bolts intended specifically for dynamic loading. The unit must be installed and leveled per the manufacturer's instructions supplied in the O&M manual.

3.03 FIELD TESTING

- A. After installation of all equipment has been completed, and as soon as conditions permit, conduct an acceptance test of the blower/motor unit under actual operating conditions to determine that the operation is satisfactory and free from excessive vibration and noise. The tests for the blower shall consist of 6 hours of operation, during which time the base load shall be carried by the blower for a period of 4 hours. Submit for the Engineer's approval a copy of the proposed log sheet on which shall be recorded all pertinent data. Readings shall be taken and recorded at 60-minute intervals during the 6-hour test period. The blower manufacturer's field service engineer shall be present during the field test. All expenses for a satisfactory field test shall be paid by the Contractor. The test shall be performed in the presence of the Owner and the Engineer.

B. The data shall include the following:

1. Time of day
2. Power frequency
3. Power voltage
4. Power amperage
5. Kilowatts drawn
6. Inlet pressure
7. Inlet temperature
8. Discharge pressure
9. Discharge temperature
10. Capacity
11. Speed
12. Noise level (dBA)
13. Temperature of motor and compressor bearings
14. Vibration of blower base frame

C. Noise and vibration tests shall be conducted to ensure that the noise level in the Blower Room does not exceed 80 dBA free field when measured 3 feet from the equipment being tested and that there is no harmful vibration in the blower units or in the system piping. Vibration shall not exceed specified limits.

D. At least 30 days prior to scheduled testing, submit test procedures to the Engineer for review. Furnish all power, water, facilities, labor, supplies, and test instruments required to conduct final acceptance tests. All alarm and shutdown devices shall be tested and calibrated during the acceptance test.

END OF SECTION

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SECTION 11377

COARSE BUBBLE DIFFUSED AERATION SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, material, equipment, and incidentals required to design, manufacture, install, complete and ready for operation and field test a fixed-header, Coarse Bubble Aeration System as specified herein.
- B. The Diffused Aeration System Manufacturer/Supplier, herein called the Supplier, shall be responsible for equipment delivery, verification of system installation, start-up, conducting acceptance testing and operation. The Contractor shall be responsible for unloading, storage, and installation of the diffused aeration equipment per directions of the Supplier.
- C. The Coarse Bubble Aeration System will aerate the wastewater from the UV channel as it passes through the post-aeration basin, increasing the dissolved oxygen concentration to meet regulatory requirements. The system shall be capable of providing the performance required, while complying with specific requirements as specified herein.
- D. This Specification is intended to give a general description of what is required but does not cover all details. It is, however, intended to cover the furnishing, shop testing, delivery, installation assistance and field testing of all materials, equipment, and all appurtenances required to complete the work of this section, whether specifically mentioned in these Specifications or not.
- E. Provide installation instruction and onsite installation assistance to the Contractor as specified herein.
- F. Provide operations and maintenance manuals and onsite operation and maintenance training to the Owner's personnel as specified herein.
- G. Provide spare parts and tools to maintain provided equipment 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. Section 01600 – Materials, Transportation and Handling
- C. Section 01170 – Special Provisions
- D. Section 01782 – Operation and Maintenance Data
- E. Section 11370 – Positive Displacement Blowers
- F. Section 15064 – Stainless Steel Pipe and Alloy Pipe Tubing and Accessories

1.04 SUBMITTALS

- A. See Section 01300, Submittals for submittal procedures. Submittals shall include at least the following:
 - 1. Certified shop and installation drawings showing all important details of construction, dimensions, and anchor bolt locations.
 - 2. Complete details of each air header system showing number, location, type, and details of support, length of header sections, materials and construction, anchor bolt size, number, and location.
 - 3. Descriptive literature, bulletins, and catalogs of all the equipment, materials, etc. Clearly indicate on the submittal cut-sheets and catalogs the exact size, type, and/or manufacturer's model number of the equipment.
 - 4. The total weight of each diffuser grid assembly.
 - 5. A complete bill of materials for all equipment.
 - 6. A list of the Supplier's recommended spare parts, including gaskets, packing, diffusers etc. on the list. Include pricing, ordering information, and the name, address, and phone number of the nearest service center from which spare parts to be included.
 - 7. Design Data:
 - a. Complete air flow headloss calculations for the equipment from the bottom for the drop pipe to the furthest diffuser bubble release point.
 - b. Complete design calculations showing uniform air distribution through lateral piping and diffuser elements.

- c. Complete calculations and drawings demonstrating that the entire system, including diffuser header and associated piping, meet herein specified requirements for accommodation of thermal expansions and contractions.

B. Test Reports

1. Submit certified copies of the results of all tests required in PART 3 of this section.

C. Section 01782, Operation and Maintenance Data

1.05 REFERENCE STANDARDS

A. ASTM International (ASTM), latest edition:

1. ASTM A240 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
2. ASTM A312 Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipe.
3. ASTM A530 Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe.
4. ASTM 554 Standard Specification for Welded Stainless Steel Mechanical Tubing.
5. ASTM A774 Standard Specification for As-welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperature.
6. ASTM A778 Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products

- B. 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. The equipment covered by this Specification shall be the product of a single reputable and qualified manufacturer who is of proven ability, having long experience in the production of such equipment. The equipment furnished shall be constructed and installed in accordance with the best practices and methods. This Section calls attention to certain features but does not purport to cover all details entering into the construction of the equipment.
- B. The system shall be designed and manufactured in such a manner that all diffuser elements are within 1.0 inch of the elevation as required.

- C. 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. Whereas it is not necessary to submit these qualifications, all procedure and operator qualifications shall be available for review by Engineer upon request.
- D. The equipment specified herein shall be stainless steel fixed headers Coarse Air Aeration Mixing System as manufactured by Environmental Dynamics International, WBCB304SS Diffusers as manufactured by SSI Aeration, Sanitaire Wide Band Diffusers as manufactured by Sanitaire, or approved equal.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 01600, Materials, Transportation and Handling.
- B. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- C. Store products in accordance with the Manufacturer's recommendation and protect from construction traffic and damage.
- D. If any defective item is discovered after it has been installed, it shall be removed and replaced at the Contractor's own expense.

1.08 SYSTEM DESCRIPTION

- A. The Contractor shall build a new post-aeration basin with two parallel basins as shown on the Drawings. The Coarse Bubble Aeration System specified herein shall aerate each post-aeration basin. The System will thus require at least two air drops.
- B. Post Aeration System Layout

1. Basin Design:

Basin Geometry	Rectangular
Number of Basins	Two (2)
Length	50 ft
Width	12 ft
SWD	15 ft

- 2. The Supplier shall be responsible for the coarse bubble diffused aeration equipment and associated piping in each individual section of both basins. Each air diffuser grid assembly shall be connected to a stainless-steel drop leg from the air supply header as show on the Drawings. The Supplier shall be responsible for each stainless-steel drop leg.
- 3. The coarse bubble aeration system shall be positioned to achieve a center roll mixing action in each section of each basin, and in the influent channel.

- C. Aeration System Design: At the peak hour plant, the Coarse Bubble Aeration System shall comply with the following conditions:

REQUIREMENTS	Peak Hour Plant⁽¹⁾	UNIT
Wastewater Flow per Basin	15	MGD
Effluent Dissolved Oxygen (DO)	7.0	MG/L
Actual Oxygen Requirement (AOR)	1,751	LBS/DAY
Minimum Total Air to Coarse Bubble Aeration System	1,174	SCFM
Minimum Supply Pressure at Top of Dropleg	6.7	PSIG
Minimum Total Standard Oxygen Transfer Efficiency (SOTE)	13.3	%
Treatable Standard Oxygen Required (SOR)	3,914	LBS/DAY
Minimum Blower Efficiency	70%	%
Standard Aeration Efficiency (# SOR / BHP-hr)	3.18	(# SOR / BHP-HR)

(1) Flow is based on 2045 projections.

1.09 SPARE PARTS AND SPECIAL TOOLS

- A. All special tools and spare parts required for normal operation and maintenance of the equipment shall be furnished by the coarse bubble aeration equipment manufacturer, as provided in Section 01170, Special Provisions. Tools shall be furnished in a suitable steel case, clearly and indelibly marked on the exterior to indicate the equipment for which the tools are intended.
- B. Spare parts, as recommended by the manufacturer, shall be furnished and shall include at least one (1) spare diffuser.
- C. All spare parts shall be suitable packaged and clearly identified with indelible marking on the containers. Each label shall indicate manufacturer's name, equipment name, part nomenclature, part number, address of nearest distributor, and current list price.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Ship equipment, material, and spare parts complete and ready for installation except where partial disassembly is required by transportation regulations or for protection of components.
- B. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

1.11 MANUFACTURER MANUALS & SERVICES

- A. The Supplier shall provide approved installation manuals to the Contractor. A minimum of three approved installation manuals shall be shipped to the Contractor upon Owner's approval of the submitted installation manual.

- B. Operating and maintenance manuals shall be furnished to the Owner as provided in Section 01782, Operation and Maintenance Data. The manual shall be prepared specifically for this installation and shall include all required cut sheets, drawings, equipment lists, descriptions, maintenance recommendations, troubleshooting recommendations, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment. In addition to the requirements of Section 01782, Operation and Maintenance Data, the manuals shall include the following at a minimum:
1. Complete parts list cross-referenced to an exploded view assembly drawing
 2. Step-by-step disassembly and reassembly instructions including tolerances
 3. Dimensional drawings of all provided equipment with component weights

1.12 Services of Supplier

- A. Provide the services of a factory certified service engineer specifically trained in the installation, start-up, testing, operation and maintenance of the equipment as herein specified. Such services shall be provided by a representative who is a direct, full-time employee of the diffused aeration system manufacturer.
- B. The Supplier shall advise, consult and instruct the Contractor on installation procedures and adjustments and inspect the equipment during installation (i.e., provide installation oversight). Installation shall include, but is not limited to, alignment, leveling, grouting, connection to piping, etc.
- C. The Supplier shall be responsible for the initial check-out of the equipment. Additionally, the Supplier shall perform a final check-out to verify that the equipment has been properly assembled and that the equipment is ready for service. Finally, the Supplier shall assist the Contractor in the initial start-up of the equipment.
- D. Owner's training shall be provided and include operational instruction. Training shall be given at times convenient to the operational staff in light of 12-hour operational shifts and duties while on shift. Accordingly, some operational training will have to be conducted during hours outside a normal Monday through Friday, 8:00 am to 5:00 pm, work day. Operational training shall include the following at a minimum:
1. Theory of operation
 2. Troubleshooting guidance
 3. Recognizing normal and abnormal operating conditions
 4. Step-by-step start-up and shut-down procedures
 5. Discussion of operational limitations
 6. Owner's training shall also include maintenance instructions. Maintenance training shall be conducted during the hours of 8:00 am to 5:00 pm, Monday through Friday, with exact schedule being determined in light of ongoing maintenance team duties. Maintenance training shall include the following, at a minimum:
 - a. Step-by-step, "hands-on" assembly and disassembly procedural instructions.
 - b. Replacement part identification and ordering procedures.
 - c. Recommended routine maintenance procedures.
 - d. Troubleshooting procedures.

7. Person-hour requirements tabulated below are exclusive of travel time and do not relieve the Supplier of obligation to provide sufficient services to place equipment into satisfactory operation.

Services Provided by Factory Certified Service Engineer	Minimum Number of Trips	Minimum Time On-site Per Trip (Hours)
a. Installation Oversight	1	8
b. Equipment Start-up	1	8
c. Owner Operation and Maintenance Training	1	8

8. The Supplier shall be responsible for coordinating required manufacturer's services with the Contractor's construction schedule.

1.13 WARRANTY

- A. Upon completion of installation (in accordance with approved installation manual), successful start-up by installing contractor, successful completion of Owner's training, and upon acceptance by Owner, provide diffuser manufacturer's one-year warranty after installation or 18 months after delivery, whichever occurs first, for all material and equipment furnished under this Specification Section. Warranty shall stipulate that the equipment furnished is suitable for the purpose intended and free from defects of material and workmanship for the duration of the warranty. In the event the equipment fails to perform as specified, promptly repair or replace the defective equipment without additional cost to the Owner. All warranties shall be transferred to the Owner from the Contractor at acceptance. Other warranty provisions are included in Section 01783, Product Warranties.

PART 2 PRODUCTS

2.01 GENERAL

- A. Each coarse bubble diffused aeration assembly shall be comprised of:
1. Stainless steel drop leg, distribution header(s) and diffusers
 2. Stainless steel manifold and supports (if required)
 3. Stainless steel supports and anchor bolts
 4. Stainless steel expansion and flanged joints (if required)
 5. Bolts, nuts and gaskets for aeration system flange connections
 6. All accessories required for proper installation and functioning of the Coarse Bubble Aeration System
- B. The entire system shall allow for expansion and contraction under the following conditions:
1. Winter Condition, empty basin: 0 deg. F
 2. Summer Conditions, empty basin: 100 deg. F
 3. Operations with air supply at 220 deg. F, basin full
 4. Operations with air supply at 220 deg. F, water level 1-foot above diffuser

2.02 DIFFUSERS

A. Design:

1. Furnish the number of diffusers for each location as required to meet the level of performance specified in Section 1.08.
2. Diffusers shall be designed to provide full wide band aeration. Air shall be released uniformly along a minimum air band of 2 feet beyond the air header.
3. Each diffuser shall consist of one inverted air reservoir, deflector, air exit ports, and balancing nozzle. The balancing nozzle shall be sized to provide the proper headloss to assure uniform air distribution throughout the aeration system.
4. The diffuser exit ports shall be located on each side of the diffuser in horizontal planes on two levels to discharge air into liquid.
5. The deflector shall be located below the open bottom of the inverted air reservoir, shall direct the liquid being aerated along the inverted air reservoir's outer walls, shall prevent rags or other string like material from entering the diffuser, and shall be supported by connecting directly to the diffuser.
6. Connection of the diffuser to the header shall be welded and require only one (1) fitting. The use of a combination of fittings will not be permitted.

B. Materials of Construction:

1. Each wide band diffuser shall be constructed of Type 304L stainless steel (ASTM A240).
2. Each wide band diffuser shall be equipped with an end cap of Type 304L stainless steel welded to the diffuser.

2.03 DIFFUSED AERATION PIPING

A. Design:

1. Provide a diffused aeration piping system including air manifold piping and air distribution header to distribute air from the aeration air supply pipe to the diffusers. Note that the Contractor shall be responsible for supply and installation of the aeration air supply pipe, as specified in Specification Section 15064.
2. Diffused aeration piping shall be provided complete with all valves, fittings, specials, flanges, couplings, expansion joints, slip joints, anchors, gaskets, bolts and nuts, pipe supports, end caps, connections, appurtenances, and accessories which are required for proper installation and functioning of the diffused aeration system.

3. Air Manifold Piping and Air Distribution Headers:

- a. Air manifold piping and air distribution headers shall be constructed of Type 304L stainless steel in accordance with Specification Section 15064, Stainless Steel-Pipe and Alloy Pipe Tubing and Accessories.
- b. A plain end shall be provided for the air manifold pipe to connect to the drop pipe from the air supply header. Connection to the drop pipe shall be with Series 18-8 stainless steel band, or equivalent, coupling. See Drawings for size of each drop pipe connection.
- c. The bottom elevation of each air distribution header shall be the same throughout the basin. Each distribution header shall have an end cap of Type 304L stainless steel with an NPT male pipe thread connection.
- d. The air distribution header shall be designed to include an expansion-contraction system consisting of expansion joints and fixed supports. Fixed supports shall be designed to anchor the header against longitudinal movement at the support. Intermediate supports between fixed supports and expansion joints shall allow for longitudinal movement. The system shall be designed in accordance with the parameters listed in paragraph 2.01 B.
- e. The diffuser connectors shall be factory welded to the bottom of the air distribution header. The connectors shall be of such length and so positioned to allow air to exit the diffuser to clear the air header. All connectors shall be installed on a common horizontal plane. Diffuser connectors and piping shall be of adequate strength to withstand a vertical load applied at the threaded end of the connector, which results in a bending moment of 1,000 inch-pounds at the diffuser connector without any permanent deformation. Reinforce the connector header joint as required to resist the bending moment.

B. Materials of Construction:

1. All welded parts and assemblies shall be fabricated from sheets and plates of Type 304 L Stainless steel with a 2D finish conforming to ASTM A240.
2. All non-welded parts and pieces shall be fabricated from sheets and plates of Type 304 stainless steel conforming to ASTM A240.
3. Stainless steel piping shall be fabricated in accordance with ASTM A778 and stainless-steel fittings in accordance with ASTM A774.
4. All assembly and anchor bolts shall be 18-8 Series Stainless steel. Nuts and washers may be either 18-8 series stainless steel or silicon bronze.
5. All gaskets shall be 45 to 55 durometer neoprene.

2.04 SUPPORTS AND ANCHORS

1. Pipe supports shall be fabricated in accordance with the details specified herein and shall be provided complete with all bases, anchor bolts and nuts, plates, rods, and other accessories required for proper installation.
2. All supports shall be provided with a mechanism to provide for a minimum of ± 2 inches vertical and $\pm 1/2$ -inch lateral adjustment for alignment of the header. The adjusting and aligning mechanism shall be infinitely adjustable within its limits to allow precise leveling of the air distribution header and diffuser assemblies without removing the header from the support.
3. Provide one (1) support for each section of the air distribution header with an integral device for rotational adjustment during installation. All adjusting devices and mechanisms shall provide locking to secure the piping in position after final adjustment and alignment.
4. The air distribution header:
 - a. Supports shall be located at approximately 1/4-inch span to coincide with the zero bending moment point.
 - b. Supports shall be the Supplier's standard support system and shall be comprised of fixed and intermediate supports as required by the configuration.
 - c. Maximum spacing of supports shall not exceed 12 feet.
5. Simple Supports:
 - a. Shall allow for longitudinal header movement and restrain the header from buoyant uplift forces.
 - b. The stainless-steel hold-down mechanism and clamp shall provide a wide contoured bearing surface for the air distribution header.
 - c. Hold-down mechanism shall be designed to withstand the associated uplift force of the piping and diffuser assemblies with a minimum design factor of safety equal to 10.
6. Fixed Supports:
 - a. Shall limit movement to prevent blow-out of expansion joints.
 - b. Shall transmit expansion forces directly from the header to the fixed support stand.

B. Materials of Construction

1. All nuts, bolts, and washers, including anchor bolts shall be furnished in 18-8 series stainless steel.

2.05 STAINLESS STEEL FABRICATION

A. Welding:

1. All welding shall be done in the factory using the shielded arc, inert gas, MIG or TIG method.
2. Filler wire shall be added to all welds to provide for a cross section and weld metal thickness equal to or greater than the parent metal.
3. Butt welds shall fully penetrate to the interior surface and gas shielding shall be provided to the interior and exterior of the joint.
4. Interior weld beads shall be smooth and evenly distributed with an interior projection not exceeding 1/16-inch beyond the inside diameter of the air pipe or fitting.
5. Face rings and flanges shall be continuously welded on both sides.
6. Field welding will not be permitted.

B. Corrosion Protection and Finishing:

1. All welded stainless-steel fabrications shall be passivated by using the following procedures.
 - a. Wire brush all outside welded areas to remove weld splatter. Brushes shall be of stainless steel and used only on stainless steel.
 - b. Remove all carbon deposits, greases and oils by pickling and neutralization to aid the regeneration of a uniform corrosion resistant, chromium oxide film. Completely immerse all stainless-steel assemblies and parts after welding and brushing in a pickling solution as described in Section 6.2.11 of ASTM A380-88. The solution shall be a nitric hydrofluoric solution as defined in Table A.2.1 of Annex A2 of ASTM A380. Provide a final thorough rinse using ordinary industrial or potable water and dry in conformance per Section 8.3 of ASTM A380.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation of the coarse bubble diffused aeration equipment shall be performed by the Contractor.
- B. The Supplier's representative shall provide written installation instructions to the Contractor and answer any related questions that the Contractor may have during the installation.
- C. Support anchors shall be laid and installed in accordance with equipment manufacturer's recommendations and anchor setting plan.

- D. Aeration system shall be leveled such that all diffusers connected to a header are within plus or minus 3/8 inch of a common horizontal plane.

3.02 INSPECTION

- A. Furnish a factory representative experienced in the erection, operation, and maintenance of the equipment. The representative shall be present during the initial installation of the diffusion equipment to ensure that satisfactory procedures are followed and shall provide periodic supervision and inspection. The equipment manufacturer's representative shall in addition, be present to supervise testing and startup of the aeration system and shall provide any other assistance to the Contractor necessary to guarantee satisfactory performance of the equipment.

3.03 INSTALLATION ACCEPTANCE FIELD TESTS

- A. After the installation of all aeration system equipment in the post-aeration tank being tested, the equipment specified herein shall be subject to field acceptance tests as specified herein.
- B. Mounting Tests. Support and tie-down provisions of the air distribution header shall be tested to ensure that they have a factor of safety of 10 against calculated buoyant forces.
 - 1. Upon installation of the supports and prior to installation of piping, all of the supports of each type shall be tested. Testing shall include no less than ten percent (10%) of the supports of each type, chosen at random to be witness tested by the Owners field representative. Each support chosen for test shall be attached to a lever that shall be placed on a fulcrum. A static load shall be applied to the opposite end producing a vertical extracting force on the support tie-down equal to ten times (10X) the calculated maximum buoyant force to which the support tie-downs will be subjected in normal operation as detailed above. The application of the test load shall be such that the entire pipe support, including pipe hold down strap, is tested.
- C. Inspection of Piping. The piping shall be inspected for proper joints, supports and tie-downs, end plugs and drain relief valves.
- D. Level Test. Each post-aeration basin shall be flooded with clear water to the top of the coarse bubble diffusers. The level of the diffusers shall then be checked to see that they are at the same elevation within plus or minus 1/4-inch. Should it be necessary to correct the elevation of any diffuser assembly as a result of this check, such action shall be taken prior to proceeding further.
- E. Uniformity and Leakage Test. Each post-aeration tank shall be flooded with protected water to a depth of 1-foot above the top of the coarse bubble diffusers. The air supply will be turned on to air flow rates as approved by the Engineer and air supplied evenly to all headers. The surface of the water will then be visually inspected to see that air flow is uniformly distributed across the tanks and that no air leaks are present within the piping system. If in the opinion of the Owners field representative, there are areas of consistent low or high air quantity release, or leaks within the piping system, make all necessary adjustments to correct these deficiencies.

- F. Cost of Testing. All of the above field tests, including the filling, dewatering, and cleaning of the aeration tanks, shall be conducted at the expense of the Contractor. The costs of all retesting, if required, shall be borne by the Supplier.

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SECTION 11631

COMPRESSED AIR MIXING SYSTEMS

PART 1 GENERAL

1.01 SCOPE

A. Locations of the mixing systems are as follows:

1. BNR Basins

a. The BNR Basins compressed air mixing system will be installed within specific zones in the following locations:

Basin Tag Numbers	Mixing System Grid Location	Compressor Air System Location
AN 1-1	BNR Basin No. 1, Anaerobic Zone 1	Influent Electrical Building
AN 2-1	BNR Basin No. 2, Anaerobic Zone 1	
AN 1-2	BNR Basin No. 1, Anaerobic Zone 2	Influent Electrical Building
AN 2-2	BNR Basin No. 2, Anaerobic Zone 2	
AN 1-3	BNR Basin No. 1, Anaerobic Zone 3	Influent Electrical Building
AN 2-3	BNR Basin No. 2, Anaerobic Zone 3	
AX 1-1	BNR Basin No. 1, Anoxic Zone 1	Influent Electrical Building
AX 2-1	BNR Basin No. 2, Anoxic Zone 1	
AX 1-2	BNR Basin No. 1, Anoxic Zone 2	Influent Electrical Building
AX 2-2	BNR Basin No. 2, Anoxic Zone 2	
AX 1-3	BNR Basin No. 1, Anoxic Zone 3	Influent Electrical Building
AX 2-3	BNR Basin No. 2, Anoxic Zone 3	
MLF 1-1	BNR Basin No. 1, Mixed Liquor Fermenter 1	Influent Electrical Building
MLF 2-1	BNR Basin No. 2, Mixed Liquor Fermenter 1	
MLF 1-2	BNR Basin No. 1, Mixed Liquor Fermenter 2	Influent Electrical Building
MLF 2-2	BNR Basin No. 2, Mixed Liquor Fermenter 2	
MLF 1-3	BNR Basin No. 1, Mixed Liquor Fermenter 3	Influent Electrical Building
MLF 2-3	BNR Basin No. 2, Mixed Liquor Fermenter 3	

B. The Mixing System Supplier (MSS) is responsible for furnishing the system components, complete with air compressor packages and associated accessories, instrumentation, and controls; air receiver; master control panel (MCP); valve panels (VPs); in-basin nozzles; air piping and fittings from VPs to nozzles; and appurtenances necessary for a complete and operable system. All other air piping shall be supplied by Contractor.

C. The system shall intermittently and sequentially inject compressed air through nozzles located on the basin bottom to create large bubbles which effectively mix the basin wastewater in each of the identified zones with negligible oxygen transfer from the mixing system to the wastewater and no moving parts located within the basin.

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. The compressed air mixing system shall be provided complete with all accessories, special tools, and spare parts required for a complete and operable system.
- B. The mixing system shall be designed to have sufficient mixing capacity to thoroughly mix the entire contents of the different zones of each basin and to keep all solids in suspension at continuously variable depths. The MSS shall ensure nozzle count and density are sufficient to completely mix the cells.
- C. Seismic Design Requirements
 - 1. Seismic design requirements for products specified herein shall be as indicated in the Meteorological and Seismic Design Criteria section.
- D. Power Supply
 - 1. Unless otherwise indicated, power supply to the equipment shall be 480 volts, 60 Hz, 3 phase. Power supply for controls shall be 120 VAC. The control power transformers on the primary side shall be powered from the 480-volt, 60 Hz 3 phase power supply.
- E. Equipment Identification
 - 1. Each item of equipment and each part shipped separately shall be tagged and identified with indelible markings for the intended service. Tag number shall be clearly marked on all shipping labels and on the outside of all containers.
 - 2. Equipment shall be identified using 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 each piece of equipment.

F. Definitions

1. Header Supply Pipe: Piping between a valve panel and respective nozzle headers.
2. Nozzle Header: Continuous (i.e., not branched) horizontal piping with nozzle offsets or drop legs, with single inlet connection to header supply pipe and outlet offset or drop leg connections to nozzles.
3. Nozzle Offset: Piping branching off nozzle header trunk piping and which connects to nozzles.
4. Nozzle Drop Leg: Vertical piping branching off nozzle header trunk piping and which connects to nozzles.
5. Nozzle: Floor-anchored, large bubble-emitting device consisting of a bottom plate, aperture spacers, and top plate with pipe stub for connection to air piping. Air is released through an aperture between the top and bottom plate.
6. Air Distribution Piping: Piping and fittings that convey air from each solenoid valve in a Valve Panel to its respective air release plate(s) on the basin floor.
7. Air Supply Piping: Piping and fittings that convey air from the air compressors to the air receiver and from the air receiver to the valve panel(s).
8. Valve Panel (VP): Control panel that houses solenoid actuated air valves, instrumentation, and appurtenances that control the firing of integral solenoid valves, which intermittently emit air bursts to their respective air distribution piping and air release plates.
9. Air Control Valve (ACV): Solenoid actuated valve in the VP that controls air flow (on or off) to its respective air distribution piping and nozzle(s).
10. Master Control Panel (MCP): Control panel that allows the operator to change the settings of the VPs, as well as the ability to control compressor operation and overlap via a touch screen operator interface terminal (OIT).

1.04 SUBMITTALS

A. Drawings and Data:

1. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to, the submittal requirements specified in the Submittals section.
2. General:
 - a. Complete fabrication and assembly drawings
 - b. Airflow, air pressure and pipe sizing design criteria
 - c. Shop drawing data for accessory items
 - d. Certified setting plans, with tolerances, for anchor bolts
 - e. Field inspection reports
 - f. Qualifications of field service engineer

- g. Recommendations for short and long-term storage
- h. Testing procedures
- i. Special tools
- j. Number of service person-days provided and per diem field service rate
- k. Color selection chart for air receiver
- l. Air control valve data sheets
- m. Nozzle and in- basin piping layout drawings
- n. A letter from the MSS stating the existing equipment that will be utilized and what equipment needs to be replaced
- o. Flow rates for the system and each basin

3. Panels (VPs and MCP):

- a. Panel arrangement drawings with dimensions
- b. Panel components bill of materials and manufacturer's data sheets
- c. PLC manufacturer, model, and programming software
- d. PLC register identification list
- e. OIT manufacturer, model, and programming software
- f. Proposed OIT graphic, status, and alarm screens
- g. Wiring and schematic diagram
- h. Rated input kVA of each panel
- i. Control devices (indicating lights, switches, relays, etc.)

B. Operation and Maintenance Data and Manuals

- 1. 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 the Materials, Transportation and Handling section. Handling and storage shall be in accordance with Materials, Transportation and Handling section.

1.06 SPARE PARTS

- A. Provide spare parts that are identical to and interchangeable with similar parts installed.
 - 1. The following spare parts and accessories shall be furnished in substantial wooden boxes with identifying labels and delivered to the vicinity of the project site or the Owner as directed:

<u>Spare Parts</u>	<u>Quantity</u>
Air control valves and valve assemblies.	3
Throttling valve rebuild kit.	1
Valve plug and cable assembly.	1
Pilot valve.	5
Fuses, each size and each rating.	6
Lamps for indicating lights.	1 full set

Any other standard parts recommended by the MSS.

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PART 2 PRODUCTS

2.01 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Air distribution and balancing shall be sufficient to maintain suspended solids in a state of suspension over entire depth of basins at stated minimum airflow requirements. Compressed air mixing system equipment and piping shall be sized to thoroughly mix the contents of the basins for which the systems are designed. Refer to the Compressed Air Mixing Systems Datasheet and Drawings for the sizes of zones.
- B. The MSS shall coordinate with the Contractor on the piping between the compressed air system and the VP. The MSS shall size the piping (and pressure regulating valves, if applicable).
- C. The MCP shall interpolate field instrument signals and modify its output to control the air compressors within an operating pressure band of at least 20 psi.
- D. Acceptable Manufacturers:
 - 1. The compressed air mixing system shall be manufactured by EnviroMix, Inc. or Pulsed Hydraulics Inc. without exception.

2.02 FABRICATION AND MATERIALS

- A. The piping used for the air mixing system shall be Type 304L stainless steel unless otherwise noted.
 - 1. Shop fabricate welded metal parts and assemblies from stainless steel, ASTM A240/A240M, Type 304L, unless specified otherwise. Shop fabricate non-welded parts and pieces from sheets and plates of stainless steel, ASTM A240/A240M, Type 304 or from bars of stainless steel ASTM A276, Type 304, unless specified otherwise.
- B. Air Supply and Air Distribution Piping
 - 1. Schedule 10S or 40S, Type 304 stainless steel press technology system (Victaulic, Viega, or equal), comprised of stainless-steel press technology fittings, couplings, and pipe shall be provided, unless specified otherwise. Provide threaded connections only where required. Threaded connections shall be Schedule 40S for connection to equipment, valves or appurtenances.
 - a. Contractor supplied piping should refer to Stainless Steel Pipe and Alloy Tubing, and Accessories section.
 - b. Couplings and fittings for this system shall be press technology products formed of Type 304/304L stainless steel tubing including a self-contained O-ring seal(s) molded of synthetic FKM or HNBR rubber.

- c. Contractor shall purchase pressing tool and jaws to be transferred to the Owner at the end of the project. Equipment shall be transferred in suitable condition to be used for future repairs or maintenance.
- d. Pipe shall be type 304/304L ASTM A312 stainless steel.

C. Nozzles

- 1. Nozzles shall be fabricated from 1/8" or 1/4" stainless steel, ASTM A240/A240M, Type 304 with a minimum thickness of 1/8".
 - a. For threaded piping systems, the pipe stub on top plate shall be made of Schedule 40S, Type 304 stainless steel, threaded on the top end for connection to the air distribution piping. For piping systems with press fittings, the pipe stub on top plate shall be made of Schedule 10S, Type 304 stainless steel, with the top end prepared for a press coupling. Plate pipe stubs shall be provided with removable end caps to minimize internal contamination and damage to ends between factory fabrication and field installation.
 - b. Nozzle connections to concrete floor shall have adequate strength to withstand vertical thrust of mixing air. Adhesive anchor bolts shall be Hilti HIT-RE 500 or Engineer-acceptable equal. Epoxy adhesive shall be provided by the Contractor. A minimum of two anchor bolts shall be installed per nozzle, one each on opposite sides of the air piping connection. Each anchor bolt shall be provided with a lower leveling nut and washer, upper leveling washer and nut, and upper nylon-insert lock nut.
 - c. Nozzles not directly anchored to the tank floor shall not be permitted. If only two anchor bolts are used, then after leveling the plate on the anchor bolts, grout shall be used to fill any voids between the lower plate and the tank floor. At least one side of the nozzle plate shall be in direct contact with the tank floor to minimize any difference in elevation between the tank floor and air release plate aperture and minimize the amount of grout needed. Nozzles with 3 or more anchor bolts shall not require grout fill.

D. Appurtenances

- 1. Nuts, bolts, washers, and other non-welded parts shall be stainless steel, ASTM A240/A240M, Type 304. Threaded assemblies shall be chemically treated or lubricated prior to assembling to prevent galling.
 - a. Lifting Lugs shall be suitably attached for equipment assemblies and components weighing over 100 pounds.

E. Welding

- 1. Shop weld with filler wire using MIG, TIG or shield-arc, or plasma-arc welding inert gas processes. Provide a cross-section equal to or greater than parent metal.
 - a. Provide full penetration butt welds to interior surface with gas shielding to interior and exterior of joint.

- b. Provide smooth, even distribution interior weld beads with an interior projection not exceeding 1/16 inch beyond inner diameter of nozzle header or fittings.
- c. Field welding is not permitted.

2.03 POWER SUPPLY AND INSTRUMENT SIGNAL

- A. Power supply to all control system equipment will be 120 volts, 60 Hz, single phase.
 - 1. Unless otherwise indicated, power supply to the instrumentation will be unregulated 120 volts ac. Unless otherwise indicated, all transmitted electronic analog instrument signals shall be 4-20 mA dc and shall be linear with the measured variable.
- B. Facility Distribution System
 - 1. Equipment not indicated to be powered from an uninterruptible power source shall be suitable for being supplied from the facility distribution system and shall be capable of withstanding voltage variations of 10 percent and harmonics up to the limits of IEEE 519 without affecting operation. Mixing System Supplier shall provide voltage conditioning or filtering equipment if necessary to meet the requirements specified.
- C. Power Supplies
 - 1. Power supplies for voltages other than those listed above shall be an integral part of the equipment furnished. Internal power supplies shall be regulated, current limiting, and self-protected.
- D. Surge Withstand
 - 1. All equipment shall meet all surge withstand capability tests as defined in ANSI C37.90 without damage to the equipment.

2.04 SERVICE CONDITIONS AND ENVIRONMENTAL REQUIREMENTS

- A. The equipment provided for the instrumentation and control system shall be suitable for use at a wastewater treatment facility with the potential for hydrogen sulfide corrosion.
 - 1. All equipment shall be designed and selected to operate without degradation in performance throughout the environmental conditions of a wastewater treatment plant. Equipment shall be designed to prevent the generation of electromagnetic and radio frequency interference and shall be in compliance with FCC Rules and Regulations, Part 15, for Class A computing devices.
- B. Ambient Temperature and Elevation:
 - 1. All system equipment located in non-airconditioned indoor and outdoor areas shall be suitable for an ambient temperature range of -2°F to 105°F and a relative humidity of 10 to 95 percent, noncondensing. Heaters and air conditioning/cooling equipment shall be provided in the Influent Electrical Building where the compressors and

receivers will be installed. Design ambient room temperature will be 60 to 101 degrees F.

- a. All equipment and instruments shall be designed to operate at the site elevation of 1120 ft.

2. Deep Cycle Control

- a. The control system shall be equipped with an operating mode that extends the solids retention time of the anaerobic or fermentation zone, resulting in volatile fatty acids production. Control parameters shall allow user to cycle periods of mixing and periods without mixing up to a period of 24 hours, compared to anoxic mixing cycles of approximately 20-30 seconds between air bursts.

C. Deleterious Effects

1. All system equipment will be installed in areas without anti-static floor construction and without any provisions for control of particulates or corrosive gases other than ordinary office-type HVAC filtering. Mixing System Supplier shall furnish any additional air cleaning equipment or other protective measures necessary for proper operation of the system.
 - a. All input/output hardware shall meet or exceed, without false operation, all requirements of NEMA ICS-1-109.60, Electrical Noise Tests.

D. Noise Level

1. The equivalent "A" weighted sound level for any system equipment located in the compressor room, except printers, shall not exceed 86 dBA. Sound reduction enclosures shall be provided where necessary to comply with these limits.

E. Lightning Protection

1. In addition to other environmental protection specified herein, the entire system shall be provided with lightning protection. Lightning protection measures shall include the following:
 - a. Grounding
 - 1) All major components of the system shall have a low resistance ground connection. Grounding system provisions indicated on the Drawings shall be modified as recommended by the Mixing System Supplier.

F. Surge Suppressors

1. Surge and lightning suppressors shall be non-faulting, non-interrupting, and shall protect against line-to-line and line-to-ground surges. Devices shall be solid-state metal oxide varistor (MOV) or silicon junction type, with a response time of less than 50 nanoseconds. Surge protective devices shall be applied for the following:

- a. All 120 VAC power connections to RTUs, PLCs, DCUs, instruments and control room equipment. Surge arresters shall be Transtector "ACP-100-HW Series", Power Integrity Corporation "ZTA Series", Phoenix Contact "Mains PlugTrab", or MCG Surge Protection "400 Series".
- b. All serial, PLC data highway, and remote I/O network termination points where any part of the circuit is routed outside of the building envelope. Surge protection devices shall be Transtector "DRDC Series" (RS-232); Transtector "FSP Series" (RS-422), Phoenix Contact "PlugTrab Series" or Citel "E280 Series".

2.05 MASTER CONTROL PANEL (MCP)

- A. All equipment furnished under this section shall be expressly selected by the Mixing System Supplier for its superior quality for the intended purpose and shall comply with the following requirements. The MCP enclosure shall be NEMA 4X stainless steel.
 1. Nameplates shall be provided on the face of the MCP and on each individual control or pilot device. 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, the rated capacity, head, speed, operating and power characteristics, label of tested compliances, and all other pertinent data shall be attached to each piece of equipment.
- B. Interchangeability
 1. The programmable logic controller systems shall be Allen-Bradley CompactLogix or MicroLogix (at least a MicroLogix 1400) series without exception. The PLC shall be provided with a backup controller, as described later in this section. Processors, local and remote input/output hardware, communications modules, and specialty modules such as coprocessors and ASCII modules shall be interchangeable among all I/O panels and systems. PLC modules and hardware by other manufacturers will be acceptable only if the PLC manufacturer does not offer suitable modules and hardware for the same functions.
- C. Initial, Spare, and Future Memory (RAM)
 1. Mixing System Supplier shall provide adequate memory for the amount of I/O, control algorithms, and communications in the initial system
 - a. The programmable logic controller shall include provisions for future expansion and shall have 100 percent spare memory capacity and 100 percent spare data capacity installed. The spare memory capacity shall be documented by submitting to the Engineer, during factory testing, a statement indicating the amounts of memory of all types being utilized and the total amount available in each system. The statement shall include an estimate of the total program and data memory necessary, including spare memory, based on the I/O hardware for the system, and previous programming experience.

D. Spare I/O

1. The PLC input/output enclosure shall be provided with at least 20 percent spare inputs and outputs of each type. Spare I/O shall be installed, wired, and interfaced properly to the terminal strip. The spare I/O shall be in addition to any I/O installed and reserved for future process signals as may be indicated on the I/O list. In addition, each PLC input/output enclosure shall be capable of accommodating 20 percent of additional input/output capacity of each type as originally assembled, without the need for additional expansion racks, communication adapters, cables, or PLC power supplies.

E. Signal Power Supplies

1. Regulated dc power supplies shall be provided in each PLC enclosure for analog inputs, digital outputs, and digital inputs. Power supplies shall be suitable for an input voltage variation of ± 10 percent, and the supply output shall be fused or protected against short-circuiting. Output voltage regulation shall be as required by the instrumentation equipment supplied under another section.
 - a. The loop power supply shall be separate from the power supply circuit for the processor and racks.
 - b. The power source for all digital inputs from field devices shall be separately fused for each digital input module. Unless otherwise noted, all field devices will be provided with dry contacts that close to provide an input to the PLC.

F. Appurtenances

1. The PLC processor and I/O hardware shall be provided as complete systems, as shown on the block diagram drawings. The PLC shall include all necessary hardware and software for a complete working system. All special rack or panel mounted power supplies, special interconnecting and programming cables, special grounding hardware, or isolation devices shall be furnished for proper operation of the equipment. Signal converters, signal boosters, amplifiers, special power supplies, special cable, special grounding, intrinsically safe relays and current repeaters, surge suppression devices, and isolation devices shall be furnished and installed for proper operation of the equipment.

G. Service Conditions

1. PLCs will be installed in non-air-conditioned rooms.

H. Programming Capabilities

1. The processor shall include the following capabilities for programming, debugging of programs, and troubleshooting.
 - a. Off-line programming
 - b. On-line programming
 - c. On-line status of coils and registers
 - d. Input/output forcing

I. Hardware Configuration

1. Processors shall be configured for standard rack mounting. Each programmable logic controller processor shall include integral communications ports for the programming device, remote input/output, HMI device, or remote communications interfaces.

J. Panel Terminations

1. All PLC input/output signals for field connections shall be terminated through panel enclosure terminal strips. Direct connection of field wiring to the I/O terminals is not acceptable.

K. Ethernet Switch

1. An industrial rated (panel-mounted) managed Ethernet switch shall be provided inside the MCP to provide connectivity between the PLC, operator interface terminal, and Plant Control System. The switch shall support both 10 and 100 Mbit/s operation and provide for store and forward switching mode. The switch shall have five (5) 10/100Base-T ports with RJ-45 sockets and shall support auto-crossing, auto-negotiation and auto-polarity. Maximum distance between devices shall be 100m. Switches shall be GarretCom Magnum 6K Series, Hirschmann RS-20 Series, Moxa 508A Series, N-Tron 708FX Series, SIXNET SL-8MG Series, Phoenix Contact 7000 Series, or equal.

L. Uninterruptible Power Supply (UPS)

1. The Master Control Panel and Master Power Panel shall be provided with a 20A 120VAC supply from an Uninterruptible Power Supply (UPS) located in the Influent Electrical Building electrical room. The UPS circuit shall be used to power the PLC, OIT and all network hardware located in the panel to keep it in operation during a utility power failure. Upon return of utility power, the system shall return to the mode of operation it was in prior to the utility failure.
2. A separate control power circuit shall be used for items that do not need to be powered during a utility power failure, such as heaters, lights, fans.

M. Operator Interface Terminal (OIT)

1. Operator interface terminal (OIT) shall have color active matrix displays, nominally 6.4 inches diagonally (at least), a minimum resolution of 640x480, and a brightness of 300 nits with a contrast ratio of 250:1. OITs shall be rated NEMA 4X with an operating ambient temperature range of 60° to 101°F. They shall be provided with a keypad or touch screen for data entry. OITs shall use non-volatile flash memory or other EEPROM memory that does not depend upon a battery to retain memory on a panel power outage. Additional graphic displays shall be programmed to provide the functionality specified herein. OITs shall be by Allen Bradley, Siemens, General Digital, GE Fanuc, or equal.
 - a. OIT shall provide graphic screens that shall be used by the operators to access all functions and setpoints necessary for comprehensive control. The MSS shall

be responsible for developing and configuring the custom graphic displays. Each piece of major process equipment that is monitored and controlled by the control system shall be displayed on the graphic screens. Graphic screens shall be representations of the equipment and piping. The screens must accurately show all devices and equipment that is part of the control loops. The MSS shall use the configuration standards and conventions to be established by direct coordination with the Owner that shall describe and define such items as proposed graphic display process line colors/representations; color standards for "on", "off", "opened", "closed", and "alarm" conditions; alarm handling conventions; how items will be selected for control; methods for navigation between displays; address usage/naming conventions; and security setup. Proposed displays shall be submitted to the Engineer and Owner for approval.

N. Coordination

1. The MSS shall be responsible to fully configure and program the PLC and OIT to perform all control and interlock functions and to coordinate communication of system status and alarm signals to the existing Plant Control System (PCS) with the Owner.
 - a. The PLC and OIT will be connected to the existing Plant Control System network. Cable and conduit shall be furnished and installed by Contractor as shown on the Drawings. The Owner will be responsible for configuration of new HMI screens of the mixing system equipment. The MSS shall be responsible for all PLC I/O configuration, scaling, and data exchange that shall be needed between the furnished equipment/instrumentation, PLC, OIT, and coordinating the interface requirements with the Owner who will be configuring the Plant Control System.
 - b. The MCP shall communicate with the Plant Control System via Ethernet communication. The control system shall be configured to send the mixing system status and alarm data to the Plant Control System. The manufacturer shall assemble the data into data packets that can be easily transferred over the Ethernet link. The manufacturer shall provide a list of signals and addresses of the status and alarm data included in these data transfers with the Owner. I/P addresses for the MCP control system hardware shall be issued by the Owner.
 - c. The MSS's technical personnel shall participate in at least two telephone conference calls with the Owner, Engineer, and Contractor's System Integrator (programming PLCs). The first call shall be held prior to commencement of programming. After the call, the MSS shall provide a submittal acknowledging the agreed upon standards and conventions. This document must outline programming styles, methods, standard algorithms, color schemes, alarm schemes, data storage, and reporting methods to be used for the PLC programming. A second conference call shall be included in the MSS's scope to be scheduled prior to shipment of the equipment to the site.
 - d. Coordination of the conference calls shall be the joint responsibility of Contractor and the MSS.

- e. At a minimum, the following data shall be sent to or received from the Plant Control System for the BNR Compressed Air Mixing System.
- 2. Discrete Data Sent To Plant Control System (from Influent Electrical Building PLC)
 - a. BNR Basin No. 1 Mixed Liquor Fermenter Zone No. 1 Mixing
 - b. BNR Basin No. 1 Mixed Liquor Fermenter Zone No. 2 Mixing
 - c. BNR Basin No. 1 Mixed Liquor Fermenter Zone No. 3 Mixing
 - d. BNR Basin No. 1 Anaerobic Zone No. 1 Mixing
 - e. BNR Basin No. 1 Anaerobic Zone No. 2 Mixing
 - f. BNR Basin No. 1 Anaerobic Zone No. 3 Mixing
 - g. BNR Basin No. 1 Anoxic Zone No. 1 Mixing
 - h. BNR Basin No. 1 Anoxic Zone No. 2 Mixing
 - i. BNR Basin No. 1 Anoxic Zone No. 3 Mixing
 - j. BNR Basin No. 2 Anaerobic Zone No. 1 Mixing
 - k. BNR Basin No. 2 Anaerobic Zone No. 2 Mixing
 - l. BNR Basin No. 2 Anaerobic Zone No. 3 Mixing
 - m. BNR Basin No. 2 Anoxic Zone No. 1 Mixing
 - n. BNR Basin No. 2 Anoxic Zone No. 2 Mixing
 - o. BNR Basin No. 2 Anoxic Zone No. 3 Mixing
 - p. BNR Basin No. 2 Mixed Liquor Fermenter Zone No. 1 Mixing
 - q. BNR Basin No. 2 Mixed Liquor Fermenter Zone No. 2 Mixing
 - r. BNR Basin No. 2 Mixed Liquor Fermenter Zone No. 3 Mixing
 - s. BNR Mixing System Compressor No. 1 Running
 - t. BNR Mixing System Compressor No. 1 Fault
 - u. BNR Mixing System Compressor No. 1 In Auto
 - v. BNR Mixing System Compressor No. 1 Selected As Lead
 - w. BNR Mixing System Compressor No. 2 Running
 - x. BNR Mixing System Compressor No. 2 Fault
 - y. BNR Mixing System Compressor No. 2 In Auto
 - z. BNR Mixing System Compressor No. 2 Selected As Lead
 - aa. BNR Mixing System General Mixing System Alarm
 - bb. BNR Mixing System MCP Loss of Power Alarm
 - cc. BNR Mixing System in Automatic Control Mode
 - dd. BNR Mixing System Communication Heartbeat
 - 3. Discrete Data Sent From Plant Control System
 - a. BNR Mixing System Heartbeat
 - 4. Analog Data Sent To Plant Control System
 - a. BNR Basin Zone AN 1-1 Frequency
 - b. BNR Basin Zone AN 1-1 Duration
 - c. BNR Basin Zone AN 1-2 Frequency
 - d. BNR Basin Zone AN 1-2 Duration
 - e. BNR Basin Zone AN 1-3 Frequency
 - f. BNR Basin Zone AN 1-3 Duration
 - g. BNR Basin Zone AX 1-1 Frequency
 - h. BNR Basin Zone AX 1-1 Duration
 - i. BNR Basin Zone AX 1-2 Frequency

- j. BNR Basin Zone AX 1-2 Duration
- k. BNR Basin Zone AX 1-3 Frequency
- l. BNR Basin Zone AX 1-3 Duration
- m. BNR Basin Zone MLF 1-1 Frequency
- n. BNR Basin Zone MLF 1-1 Duration
- o. BNR Basin Zone MLF 1-2 Frequency
- p. BNR Basin Zone MLF 1-2 Duration
- q. BNR Basin Zone MLF 1-3 Frequency
- r. BNR Basin Zone MLF 1-3 Duration
- s. BNR Basin Zone AN 2-1 Frequency
- t. BNR Basin Zone AN 2-1 Duration
- u. BNR Basin Zone AN 2-2 Frequency
- v. BNR Basin Zone AN 2-2 Duration
- w. BNR Basin Zone AN 2-3 Frequency
- x. BNR Basin Zone AN 2-3 Duration
- y. BNR Basin Zone AX 2-1 Frequency
- z. BNR Basin Zone AX 2-1 Duration
- aa. BNR Basin Zone AX 2-2 Frequency
- bb. BNR Basin Zone AX 2-2 Duration
- cc. BNR Basin Zone AX 2-3 Frequency
- dd. BNR Basin Zone AX 2-3 Duration
- ee. BNR Basin Zone MLF 2-1 Frequency
- ff. BNR Basin Zone MLF 2-1 Duration
- gg. BNR Basin Zone MLF 2-2 Frequency
- hh. BNR Basin Zone MLF 2-2 Duration
- ii. BNR Basin Zone MLF 2-3 Frequency
- jj. BNR Basin Zone MLF 2-3 Duration

5. Analog Data Sent From Plant Control System

- a. BNR Basin Zone AN 1-1 Frequency Setpoint
- b. BNR Basin Zone AN 1-1 Duration Setpoint
- c. BNR Basin Zone AN 1-2 Frequency Setpoint
- d. BNR Basin Zone AN 1-2 Duration Setpoint
- e. BNR Basin Zone AN 1-3 Frequency Setpoint
- f. BNR Basin Zone AN 1-3 Duration Setpoint
- g. BNR Basin Zone AX 1-1 Frequency Setpoint
- h. BNR Basin Zone AX 1-1 Duration Setpoint
- i. BNR Basin Zone AX 1-2 Frequency Setpoint
- j. BNR Basin Zone AX 1-2 Duration Setpoint
- k. BNR Basin Zone AX 1-3 Frequency Setpoint
- l. BNR Basin Zone AX 1-3 Duration Setpoint
- m. BNR Basin Zone MLF 1-1 Duration Setpoint
- n. BNR Basin Zone MLF 1-1 Duration Setpoint
- o. BNR Basin Zone MLF 1-2 Duration Setpoint
- p. BNR Basin Zone MLF 1-2 Duration Setpoint
- q. BNR Basin Zone MLF 1-3 Duration Setpoint
- r. BNR Basin Zone MLF 1-3 Duration Setpoint
- s. BNR Basin Zone AN 2-1 Frequency Setpoint
- t. BNR Basin Zone AN 2-1 Duration Setpoint
- u. BNR Basin Zone AN 2-2 Frequency Setpoint

- v. BNR Basin Zone AN 2-2 Duration Setpoint
- w. BNR Basin Zone AN 2-3 Frequency Setpoint
- x. BNR Basin Zone AN 2-3 Duration Setpoint
- y. BNR Basin Zone AX 2-1 Frequency Setpoint
- z. BNR Basin Zone AX 2-1 Duration Setpoint
- aa. BNR Basin Zone AX 2-2 Frequency Setpoint
- bb. BNR Basin Zone AX 2-2 Duration Setpoint
- cc. BNR Basin Zone AX 2-3 Frequency Setpoint
- dd. BNR Basin Zone AX 2-3 Duration Setpoint
- ee. BNR Basin Zone MLF 2-1 Duration Setpoint
- ff. BNR Basin Zone MLF 2-1 Duration Setpoint
- gg. BNR Basin Zone MLF 2-2 Duration Setpoint
- hh. BNR Basin Zone MLF 2-2 Duration Setpoint
- ii. BNR Basin Zone MLF 2-3 Duration Setpoint
- jj. BNR Basin Zone MLF 2-3 Duration Setpoint

O. Programming Software

1. MSS shall furnish one licensed copy of OIT programming software for the Owner. The software shall be suitable for running on a laptop computer running Windows operating system software. A full legal set of programming software documentation shall accompany each copy of the software. Each copy of the programming software shall include all necessary device drivers and add-on software packages.

2.06 VALVE PANELS

A. VP enclosures shall be NEMA 4X 304 stainless steel.

1. Panels shall accept a single source 120 VAC power connection. Lightning and surge protection as well as power conditioning shall be provided on the incoming line power.
2. A stainless-steel nameplate shall be provided on the VP. The nameplate shall be securely fastened in a conspicuous place and clearly inscribed with the manufacturer's name, year of manufacture, and serial number.
3. Panel nameplates for each individual control or pilot devices shall be made of laminated phenolic material with engraved letters approximately 3/16-inch-high extending through the black face into the white layer and shall be secured firmly to the device.
4. Each panel shall be provided with water separator upstream of the valve actuator supply. Water separator shall be TSUNAMI Compressed Air Solutions Model 21999 or equal. Separator shall be provided with an automatic electric no-loss drain. The electric no-loss drain shall be powered from the valve panel. Drain line shall be field routed to grade and shall be insulated and heat traced. If water separator installed outdoor, shall be insulated and heat traced.

2.07 PANEL FABRICATION REQUIREMENTS

- A. Each panel shall contain heavy-duty oiltight start-stop push buttons or switches with engraved nameplates indicating function for control. Status indication light shall be red alarm stack light furnished with LED lamp. Each panel shall be provided with a switched 120V LED light strip mounted to the inside top of the panel capable of illuminating the panel for maintenance purposes.
- B. Power distribution wiring on the line side of panel fuses shall be minimum 12 AWG. Secondary power distribution wiring shall be minimum 14 AWG. Wiring for ac power distribution, dc power distribution, intrinsically safe, and control circuits shall have different colors and shall agree with the color-coding legend on the Mixing System Supplier's panel wiring diagrams. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, insulated for not less than 600 volts, with a moisture resistant and flame-retardant covering rated for not less than 90°C.
- 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 routed in Panduit or similar nonmetallic slotted ducts. Ducts shall be readily accessible within the panel, with removable covers, and with space equal to at least 10 percent of the depth of the duct remaining available for future use after completion of installation and field wiring. Sufficient space shall be provided between cable groups or ducts and terminal blocks for easy installation or removal of cables.
- D. Terminal blocks shall be suitable for 12 AWG wire and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with marking strips, covers, and pressure connectors. Terminals shall be labeled to agree with the identification on the Mixing System Supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits, plus one ground for each shielded cable. At least 5 percent spare terminals shall be provided. Not less than 8 inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space.

2.08 CONTROL AND OPERATION

- A. All control features shall be adjustable from the MCP provided by the MSS. Control features shall be adjustable at any time during the operation of the system. Control features shall be initially set according to manufacturer recommendations.
- B. Mixing Parameters
 - 1. Manual or automatic operation of the mixing system shall be possible. In manual mode, the sequence, duration, frequency, and throttling valve position shall be operator adjustable. In automatic mode, the system will make operational adjustments according to process instrumentation feedback and manual hand switch position feedback, and a series of user adjustable set point.

a. Minimum control features shall include the following:

Firing sequence	Selection of air control valve firing.
Duration	Selection of the length of time the air control valve is open during a firing.
Frequency	Selection of the frequency of each air control valve within a VP firing event
Air demand	The throttling valve in the VP shall modulate to maintain a constant air volume release as depth varies. A pressure transducer provided on the air control valve manifold shall provide signal feedback to the MCP. The water elevations are anticipated to vary 15-inches or less.

C. Low-Level Mixing (NOT USED)

D. Startup Modes

1. The MCP shall enable startup modes that utilize the manufacturer default settings, firing parameters set during the preceding mixing system operation, as well as new settings entered through the OIT.

E. Backup Control

1. In the event the primary controller is disabled, control shall be automatically taken by a backup controller. The backup controller shall automatically relinquish control when the primary controller is enabled. Mixing parameters shall be factory programmed and made available to the Engineer and Owner

F. Alarms

1. Each VP shall come equipped with an internal pressure transducer, that will be wired to the MCP and the communicated to the Plant PLC via ethernet.
 - a. When either the Low System Pressure or Valve Fail to Open alarms occur within a VP, red general alarm light shall be illuminated on the VP. The specific alarm shall be indicated and shall remain until the fault is corrected or the system is turned off.

G. Heartbeat Function

1. The PLC shall have a register with a bit that toggles at a regular interval to act as a heartbeat for confirmation of continued PLC operation and network communication.

H. Compressor Control

1. Compressors shall operate in a lead, lag scheme as described in the Mixing System Rotary Screw Air Compressors section.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install items in accordance with approved shop drawings, manufacturer's printed instructions, and as indicated.

3.02 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 the Equipment Testing and Start-Up section, 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 (NOT USED)

3.03 FIELD TESTING

- A. Field testing shall be in accordance with the Equipment Testing and Start-Up section. At the completion of the field testing the Contractor shall submit a detailed report indicating the testing procedures and results from the field test.
 - 1. All mixing components shall be field tested with the respective basins full to the maximum water surface elevation. One BNR Basin of the three trains shall be selected, and tests shall be conducted in each applicable zone of the selected basin.
 - 2. Exposed air piping shall be tested by Contractor for leaks using soapy water on all joints and applying 100 psi test pressure. Buried air piping shall be tested using this method before the trench is filled. Air piping in the tanks may be tested by submersing the piping in non-potable water and pressurizing the piping to 100 psi, in lieu of using soapy water on all joints. Temporary plugs shall be installed in place of the air release plates to pressure test air distribution piping. Following a successful pressure test, temporary plugs shall be removed and the piping shall be connected to the air release plates.
 - 3. The Contractor shall operate each mixing system at the maximum water surface elevation in the basins for a continuous period of not less than 72 hours. The Contractor shall correct and resolve all operating problems, deficiencies, etc., determined as a result of the tests. After the above testing is complete, field mixing performance testing may commence.

4. Prior to the field mixing performance testing, the aeration basin shall have been in normal operating mode for at least two days with mixed liquor TSS in the typical operating range. No flow shall enter or exit the respective basin for two hours prior to and during the test. All personnel and equipment necessary to conduct and supervise all testing shall be provided by the MSS. The testing shall be conducted in the presence of the Engineer. Normal TSS levels are as follows:
 - a. BNR Basins: 1,500 to 5,000mg/L
5. TSS concentration shall be measured and recorded using a Royce "RT-711" probe, or equivalent handheld TSS analyzer.
6. In the first mixing test, each sample site shall be a minimum of 24" away from the tank wall. With the basin filled to the normal operating sidewater depth, four sample sites for each of the mixing zones shall be tested with three vertical samples (24" from the surface, tank sidewall midpoint, and 24" from the tank bottom) at each site.
7. In the second mixing test, the mixing system shall be shut off for a period of at least eight hours. The mixing system shall be turned on and allowed to run for two hours. After the two-hour period, the TSS shall be measured as indicated above.
8. The minimum and maximum TSS values shall be excluded from the following calculations for each mixing zone. The MSS must demonstrate that the compressed gas mixing system operated in the mixed liquor fermenter and anaerobic zones is designed to biologically remove phosphorus having an ORP less than -250mV continuously as shown through statistical analysis of ORP samples yielding a Cv of 10% or less. The Coefficient of Variation (Cv) shall be calculated for each test as follows:

$$Cv = \frac{100 \times \text{Standard deviation of 10 samples}}{\text{Mean value of 10 samples}}$$

9. If the measured Cv is less than or equal to 10 percent, then the mixing system performance shall be acceptable for the mixing zone.
10. If the Cv is greater than 10 percent, then the mixing system performance shall be unacceptable for the mixing zone and the Manufacturer shall make all necessary improvements at no additional cost to the Owner without increasing operating horsepower above the design compressor capacity. The testing procedure shall be repeated at no additional cost to the Owner until the Cv is less than or equal to 10 percent.
11. A visual test shall also be performed to confirm system is functioning correctly.

3.04 ALTERATIONS

- A. Any alterations to the structure, piping, supports, anchors, accessories, or appurtenances indicated on the Drawings that are required for installation and operation of the compressed air mixing equipment, regardless of type or manufacturer, shall be made by and at the sole expense of the equipment manufacturer. All costs in connection

with any modifications shall be included in the bid and the contract based thereon. All changes and modifications shall be acceptable to Engineer.

3.05 TRAINING

- A. The manufacturer's representative shall provide training of Owner's personnel as described in Demonstration and Training specification. All costs for training services shall be included in the Contract Price.
- B. Contractor shall include the following minimum training provided by the manufacturer's representative. This does not include travel hours or expenses.
 - 1. Number of Shifts: 2
 - 2. Minimum Hours of Training per Shift: 4
 - 3. Minimum Total Hours of Training: 8

3.06 SERVICE PLAN

- A. The equipment identified in this Specification shall be supplied with a Service Plan. As part of that Service Plan, an experienced, competent, and authorized representative of the MSS shall perform yearly 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, and address any questions from the Owner. The supply and installation of replacement parts is not included as part of the Maintenance Plan.

END OF SECTION

SECTION 11631.01

MIXING SYSTEM ROTARY SCREW AIR COMPRESSORS

PART 1 GENERAL

1.01 SCOPE

- A. This section covers the furnishing of the compressed air system with rotary screw compressors to be installed as indicated on the Drawings and as required herein. The system shall be sized and provided by the Mixing System Supplier (MSS) in accordance with Compressed Air Mixing Systems section. Compressed air mixing will be located in the Influent Electrical Building and will serve the BNR Basins. The compressed air system shall be sized to provide enough air to the entire BNR system.
- B. Each compressor unit shall be furnished complete with all accessories and appurtenances specified or otherwise required for proper operation.
- C. Each compressor and drive unit along with standard accessories shall be mounted on a common baseplate with an acoustical enclosure as indicated 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 GENERAL

- A. Equipment furnished under this section shall be fabricated and assembled in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.
- B. General Equipment Stipulations
 - 1. The Special Provisions section shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the Special Provisions section, the requirements specified herein shall take precedence.

C. Seismic Design Requirements

1. Seismic design requirements for products specified herein shall be as indicated in the Meteorological and Seismic Design Criteria section.

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 these specifications and any state law or local ordinance, the latter shall govern.
2. All work shall comply with Underwriters' Laboratories (UL) safety requirements.

E. Power Supply

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

F. Dimensional Restrictions

1. Layout dimensions will vary between manufacturers and the layout area indicated on the Drawings is based on typical values. The supplier shall review the 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 each compressor unit and 3.5 feet clear access space on the side with the control panel.

G. Tagging

1. Each item of equipment and each part shipped separately shall be tagged and identified with indelible markings for the intended service. Tag number shall be clearly marked on all shipping labels and on the outside of all containers.

H. Identification

1. All equipment tagged on the drawings, except for submerged equipment shall be provided with number plates bearing the equipment tag number identified on the Drawings.
2. Number plates shall be beveled, 1/8 inch 3 mm thick laminated black phenolic plastic engraving stock with white core. Lettering on number plates shall be capitalized block letters 3/4 inch 20 mm high.
3. Number plate height shall be twice the letter height. Number plate length shall be as needed, with suitable margins all around.
4. Lettering shall be placed in one row where practicable; however, where necessary due to excessive length, lettering shall be placed on more than one row and centered.

5. Number plates shall be attached with stainless steel panhead screws, rivets, or drive screws.
6. When a number plate cannot be installed due to the physical size, space, or mounting surface geometry of the equipment, the Contractor shall provide a 12-gauge 2 mm stainless-steel tag with engraved or imprinted equipment tag number. Lettering on tags shall be 1/4-inch, 6.5 mm high. Tags shall be rectangular with smooth edges and shall be fastened to the equipment with stainless steel mechanical fasteners or with a stainless-steel chain.

1.04 SUBMITTALS

A. Drawings and Data

1. Complete assembly and installation drawings, together with detailed specifications and data covering materials, drive unit, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the Submittals section. Electrical schematics, wiring diagrams, and panel layout drawings for compressor controls shall be included. The following data shall be submitted:

a. Compressor Packages

- 1) Statement from the manufacturer verifying the minimum specified system cycle time will not result in excessive oil carryover greater than published values.
- 2) Manufacturer
- 3) Type and model
- 4) Compressor rotative speed
- 5) Dimensions
- 6) Weight including motor
- 7) Performance data at variable discharge pressures, including brake horsepower
- 8) The required operating pressure and maximum rated compressor pressure
- 9) Bearing data
- 10) Filter and silencer details
- 11) Accessory details
- 12) Piping schematic showing pipe sizes and instrument and valve locations
- 13) Control equipment
- 14) Sequence of operation
- 15) Heat rejection data
- 16) Cooling air flow data
- 17) Flow and pressure capabilities and set points
- 18) Noise level at 3 feet away from unit
- 19) Calculation showing system pressure requirements
- 20) Refrigerant air dryer

b. Refrigerant air dryer

- 1) Material of construction

- 2) Model
- 3) Dimensions
- 4) Connection sizes and locations
- 5) Capacity
- 6) Pressure drop at rated capacity
- 7) Pressure rating
- 8) Dew point
- 9) Motor size if applicable
- 10) Clear space required for air circulation and maintenance access

c. Receiver:

- 1) Manufacturer
- 2) Materials of construction
- 3) Capacity
- 4) Pressure rating
- 5) Integral instrumentation product data
- 6) Dimensions
- 7) Connection size and locations
- 8) Color selection chart
- 9) Verification of ASME Code stamp

d. Coalescing Oil Removal Filter

- 1) Manufacturer
- 2) Materials of construction
- 3) Model
- 4) Capacity
- 5) Pressure drop at rated capacity
- 6) Efficiency

e. Oil Mist Eliminator:

- 1) Manufacturer
- 2) Materials of construction
- 3) Model
- 4) Capacity
- 5) Pressure drop at rated capacity
- 6) Pressure rating
- 7) Connection sizes and locations
- 8) Guaranteed element life
- 9) Efficiency

f. Accessories:

- 1) Manufacturer
- 2) Materials of construction
- 3) Model
- 4) Pressure rating
- 5) Size

g. Motors:

- 1) As specified in the Electric Motors section

h. Seismic Design Requirements

- 1) Seismic design requirements for products specified herein shall be as indicated in the Meteorological and Seismic Design Criteria section.

B. Operation and Maintenance Manuals

1. Operation and maintenance manuals shall be supplied as required in 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 SPARE PARTS

- A. The following spare parts and accessories shall be furnished in substantial wooden boxes with identifying labels and delivered to the vicinity of the project site or the Owner as directed:

<u>Spare Parts</u>	<u>Quantity</u>
Intake air filters, per compressor.	2
Lubricant filters, per compressor.	2
Air-oil separator filter elements, per compressor.	1

PART 2 PRODUCTS

2.01 SERVICE CONDITIONS

- A. The compressed air package and accessories shall be suitable for the following service conditions:

Seismic design requirements and site elevation.	See Meteorological and Seismic Design Criteria Section
Barometric pressure.	14.21 psia
Location.	Indoor
Inlet ambient air temperature range.	60° F to 104° F
Design relative humidity at maximum ambient air temperature.	50%

- B. Parts shall be interchangeable between units of similar size and capacity to extent practical.
- C. All equipment furnished shall be designed to meet all specified conditions and to operate satisfactorily at the specified elevation.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

- A. The compressed air equipment shall be designed for the operating conditions and requirements as listed in Mixing System Rotary Screw Air Compressors Schedule at the end of this section.

2.03 MATERIALS

- A. Compressor:
 - 1. Rotors: Steel or high strength ductile iron
 - 2. Housing: Cast iron
 - 3. Bearings: ABMA L10 rating of 40,000 hours minimum
 - a. Radial: Roller
 - b. Thrust: Per manufacturer's recommendation
 - c. Baseplate: Cast iron or fabricated steel
 - 4. Rust-Preventive Compound: As recommended by manufacturer

2.04 PACKAGE CONSTRUCTION

- A. Each compressor package shall consist of, but not necessarily be limited to, an inlet air filter, compressor, motor, air/oil separator reservoir, oil cooler, aftercooler, separator, integral refrigerant dryer, controls, control panel, enclosure, base, valves, piping, and unloading system. An inlet valve shall not be provided and the compressor shall run in a load/unload manner.
- B. The oil cooler and aftercooler shall be air cooled and shall reduce the discharge air temperature to within 15 degrees of the specified summer indoor air temperature.
- C. The refrigerant dryer shall have a maximum dew point of 40 F.
- D. The air compressor package components shall be standard products of the manufacturers. The packages shall be completely factory assembled requiring only field connection of electrical power, air, and condensate drain piping.
- E. A centrifugal moisture separator shall be provided on each aftercooler. The moisture separator shall be provided with an electric "No-Loss" type condensate drain trap powered by the compressor power panel.
- F. Compressors:
 - 1. The compressors shall be of the single stage, positive displacement, oil-flooded, rotary screw type.
 - 2. Compressor rotors shall have integral shafts and shall be dynamically balanced. Rotors and housings shall be precision machined for accurate bearing positioning

and running clearances. The male rotor shall be connected to the drive motor with a flexible coupling, belt drive, or gear drive in a manner which will ensure permanent alignment.

3. Positive pressure lubrication shall be provided. Lubricant shall be provided as recommended by the manufacturer. A lubricant filter shall be provided with a 10 micron absolute rating.
4. An air/oil separator reservoir shall be provided. The reservoir shall be designed and constructed in accordance with the ASME Code for Unfired Pressure Vessels and shall bear the code stamp. The reservoir shall include two-stage filtration to remove oil from air stream. Oil carry-over downstream of the separator shall not exceed 3 ppm by weight.
5. Compressors shall be manufactured by Sullivan Palatek without exception.

G. Baseplate

1. Each baseplate shall be designed for no measurable deflection with the equipment mounted thereon and the baseplate supported around its perimeter. Each base shall be designed so that all equipment bolted to it can be removed without access to the underside of the plate. Structural stiffeners shall be located under the compressors at the compressor anchor points.

H. Enclosures

1. Each compressor and all its accessories and appurtenances shall be completely enclosed within an acoustic enclosure. The enclosures shall be sheet metal with acoustic lining designed to reduce noise levels at 3.3 feet to 86 dB. The enclosure shall provide easy access to all maintenance items within the enclosure, utilizing hinged access doors or removable panels.

I. Refrigerant Air Dryer

1. Refrigerant air dryers shall be of the air-cooled, noncycling refrigerant type capable of providing a 33° F to 39° F pressure dew point at the dryer exit when operating continuously at the design conditions.
2. Sized for full flow, pressure, and temperature operating range of each compressor
3. Aftercooler Cold Temperature Difference (CTD) selected based on design of downstream air drying components and ambient conditions.
4. Dryers shall consist of a refrigerant-to-air heat exchanger, separator, hermetically sealed refrigeration unit, and self-regulating hot gas bypass valve. Each dryer shall include an integral pre-cooling/reheat air-to-air heat exchanger. Dryers shall be furnished with manual motor "OnOff" switch, running light, and electric "No-Loss" type condensate drain trap. Each dryer shall be furnished with an evaporator performance gauge and an intake air thermometer.

5. Dry contact outputs from the dryer controls shall be provided for a "Compressed Air Dryer Common Alarm" or "High Pressure Dewpoint Alarm". Contacts shall be rated 5 amperes at 120 VAC.
6. The air dryer shall be rated for a 460 volts, 60 Hz, 3 phase power supply.

J. Filtration

1. Inlet Air Filters

- a. Inlet air filters shall have minimum 1 micron pore size with replaceable filter elements.

K. Valves and Piping

1. Valves and piping within the enclosure shall be the compressor manufacturer's standard. Relief valves shall be provided for equipment protection on the air and coolant systems.
2. All piping and tubing shall be run in vertical and horizontal planes and shall not contact the baseplate. Piping shall be arranged to ensure that undue stresses from thermal expansion are not transmitted to equipment components. All control and instrument tubing shall be continuously supported.
3. Compressor discharge piping shall be sloped to drain to the receiver to prevent condensate in the discharge piping from draining back to the compressor.
4. Oil and condensate drain lines from each compressor package shall be piped to the edge of the baseplate.
5. Each compressor shall be provided with a dry type intake filter. Intake filters shall have replaceable filter element(s). Particle arrestance shall be not less than 99 percent at 5 micron size.
6. MSS shall provide control, regulating, and relief valves as indicated on the Drawings, or that are integral to the design and performance of the Compressed Air Mixing System.
7. The system shall be provided with pressure reducing valves as shown on the Drawings. The valves shall be sized and provided by the MSS.

2.05 AIR RECEIVERS

- A. Air receivers shall be of all-welded construction with semi-ellipsoidal heads, with leg supports for vertical mounting on a concrete base. Receivers shall be designed and constructed in accordance with the ASME Code for Unfired Pressure Vessels and shall bear the code stamp.
- B. Receivers shall be furnished with openings for inlet, outlet, drain, compressor control, instrumentation, and vent piping connections. Additional openings shall be provided as needed. All receiver connections 2-1/2 inches or larger shall be flanged.

2. Motor starters shall be full voltage, non-reversing, circuit breaker combination magnetic motor starters sized as needed by equipment manufacturer. Starters shall be furnished with thermal overloads, dry type control power transformer if required by the manufacturer, and a magnetic motor circuit protector disconnect. Starters shall be mounted inside the control panel. Control power transformers shall be sized to handle all simultaneous loads.
3. Magnetic motor circuit protectors shall be molded-case circuit breakers with instantaneous trip elements. The breakers shall be manually operated with quick-make, quick-break, trip-free toggle mechanism.
4. One thermal overload relay shall be provided in each phase lead. Each starter shall be provided with an external manual reset push button for reset of the thermal overload relays.
5. An external manual breaker operating handle with provisions for up to three padlocks shall be provided on each starter. The access door shall be interlocked with the motor circuit protector so the door cannot be opened while the breaker is closed, except by an interlock override.
6. Control power transformers shall have both primary leads fused, one secondary lead fused, and one secondary lead grounded.
7. Internal panel tubing shall be run in horizontal and vertical planes and shall be rigidly supported to withstand handling and shipped without damage. Compression type bulkhead fitting shall be provided through the panel for all connections.
8. Internal panel wiring shall be neatly bundled and tied and shall be identified with suitable wire markers. Terminal blocks for external connections shall be furnished complete with marking strips, covers, and pressure connectors. A terminal shall be provided for each conductor of external circuits. All wiring shall be grouped or cabled and securely attached to the panel. Clearance for field wiring shall be provided between the terminal strips and base.
9. Each compressor shall be provided with a "Hand-Off-Auto" selector switch or equivalent controls within the solid-state compressor controller. Controls shall be the manufacturer's standard. A separately adjustable pressure switch or transducer shall be furnished for loading and unloading each compressor, and shall be located at each compressor control panel. Pressure shall be sensed on each compressor package.
10. In the "Hand" position, the system shall operate continuously (without shutting off) in the "Load/No load" mode as controlled by pressure switches or transducers.
11. In the "Auto" position, the control system (MCP) shall control capacity and/or load and unload the lead and lag compressor at the specified pressures. Compressors provided with inlet valves as standard equipment shall be capable of automatic capacity control.

E. Air Dryer Control

1. Dryers shall consist of a refrigerant-to-air heat exchanger, separator, hermetically sealed refrigeration unit, and self-regulating hot gas bypass valve. Each dryer shall include an integral pre-cooling/reheat air-to-air heat exchanger. Dryers shall be furnished with manual motor "On-Off" switch, running light, and electric "No-Loss" type condensate drain trap. Each dryer shall be furnished with an evaporator performance gauge and an intake air thermometer.
2. Dry contact outputs from the dryer controls shall be provided for a "Compressed Air Dryer Common Alarm" and for "Compressed Air Dryer in Operation". Contacts shall be rated 5 amperes at 120 VAC.

F. Compressor Control

1. The compressor control system shall automatically start, stop, load, unload, and control capacity to provide constant downstream air pressure within preset limits specified by MSS.
2. Control range shall be recommended by the MSS to provide a minimum 5 min loaded run time for the lead compressor. MSS shall provide sizing calculations for review by Owner's Engineer.
3. Capacity control shall be by cycling. After the compressor has operated for an adjustable time while unloaded, it shall automatically stop. The continuous run timer adjustment range shall be 0 to 60 minutes, with an initial setting of 15 minutes. The capacity control system shall be designed to prevent oil foaming and carry-over with a minimum system cycle time of 10 seconds. Capacity may be controlled either through the compressor's control panel, or separate MCP.
4. The control system shall indicate the following conditions:
 - a. Elapsed time of operation in hours, non-resettable
 - b. Delivered air pressure
 - c. Power on
5. The control system shall stop the compressor, alarm the condition, and indicate the condition on the control panel for each of the following:
 - a. High discharge air temperature, oil temperature or air/oil mixture temperature. Controls shall be provided to indicate any problems in the lubrication or cooling system
 - b. Motor overload
6. A common "Reset" shall be provided so the alarm indicators are displayed until manually reset. Controls shall be designed to allow testing of the alarm indicators without actuating the remote alarm.
7. Dry contact outputs from the compressor controls shall be provided for the following:
 - a. Compressor running

- b. Compressor in auto or operating based on remote signal from MCP
 - c. Compressor common alarm, includes alarm conditions specified above and as recommended by the manufacturer, including separate signals for WARNING and FAULT/ALARM wherever applicable
 - d. Capability of dry contact outputs from the compressor controls to be hardwired to the MCP
 - 8. A multi-position selector switch shall be provided to select the starting order of each unit. The selector switch shall be installed in a NEMA 1 enclosure for field mounting on the wall or a pedestal. Mounting will be by the installing contractor under the Hangers and Support section.
 - 9. Each compressor shall be provided with an elapsed time meter mounted on the front of the control panel.
- G. Multiple Unit Controls:
- 1. A solid-state electronic controller or equivalent electromechanical Master Control Panel (MCP) shall be furnished for automatically starting, stopping and adjusting capacity of each compressor to maintain the system pressure required.
 - 2. MCP shall be capable of accepting discrete and analog signals from field instrumentation (e.g. pressure, temperature) provided by the MSS.
 - 3. MCP shall use MSS-supplied field instruments to control blower operation within target operating pressure band of at least 20 psi.
 - 4. MCP shall have output signal capability for:
 - a. Pressure
 - b. Compressor Run Status
 - c. Compressor Fault
 - 5. MCP shall have the ability to control single and multiple-compressor operation independently of any other input from field instrumentation or other source not provided by the MSS.

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 cause for rejection of the equipment. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided. In any case, the unfiltered vibration displacement (peak-to-peak), as measured at any point on the machine, shall not exceed 5 mils.
- B. At any operating speed, the ratio of rotative speed to the critical speed of a unit or its components shall be less than 0.8 or more than 1.3.

2.10 DRIVE UNITS

- A. Each compressor shall be driven by an electric motor directly or through a belt drive or gear reducer as needed by the compressor manufacturer's design. The nominal input power rating of each gear or speed reducer shall be at least equal to the nameplate power rating of the drive motor. Drive units shall be designed for 24-hour continuous service. Gearmotors shall not be used.
- B. Belt Drive
 - 1. Belt drives shall be either V-belt or cogged timing belt. Vbelt and sheave groove dimensional tolerances shall be in accordance with the "Engineering Standards Multiple VBelt Drives" published by the Multiple VBelt Drive and Mechanical Power Transmission Association. Belt drives shall have a service factor of at least 1.6 at maximum speed based on the nameplate power rating of the drive motor. The speed reduction ratio of belt drives shall not exceed 4 to 1. Each belt drive shall include a sliding base or other suitable means of tension adjustment.
- C. Gear Reducers
 - 1. Gear reducers shall be as specified herein, except that permanently sealed, grease lubricated bearings will not be acceptable.
 - 2. Each gear reducer shall be a totally enclosed unit with oil or grease lubricated, rolling element, antifriction bearings throughout.
 - 3. Unless superseded by individual specification requirements each helical, spiral bevel, combination bevel helical, and worm gear reducers shall have a service factor of at least 1.50 based on the nameplate horsepower kilowatts of the drive motor. Cycloidal gear reducers shall have a service factor of at least 2.0 based on the nameplate horsepower kilowatts of the drive motor. Shaft mounted and flange mounted gear reducers shall be rated AGMA Class III. Helical gear reducers shall have a gear strength rating to catalog rating of 1.5. Each gear reducer shall be designed and manufactured in compliance with applicable most current AGMA standards, except the L10 bearing life shall be 200, 000 hours.
 - 4. The thermal horsepower kilowatts rating of each unit shall equal or exceed the nameplate horsepower kilowatts of the drive motor. During continuous operation, the maximum sump oil temperature shall not rise more than 100°F 38°C above the ambient air temperature in the vicinity of the unit and shall not exceed 200°F 93°C.
 - 5. Each grease lubricated bearing shall be installed in a bearing housing designed to facilitate periodic regreasing of the bearing by means of a manually operated grease gun. Each bearing housing shall be designed to evenly distribute new grease, to properly dispose of old grease, and to prevent over greasing of the bearing. The use of permanently sealed grease lubricated bearings will not be acceptable in large sized reducers. In small reducers, similar to basin equipment, permanently sealed grease lubricated bearings rated L10 200,000-hour life may be provided at the manufacturer's option. An internal or external oil pump and appurtenances shall be provided if required to properly lubricate oil lubricated bearings. A dipstick or a sight

glass arranged to permit visual inspection of lubricant level shall be provided on each unit.

6. Gear reducers which require the removal of parts or the periodic disassembly of the unit for cleaning and manual regreasing of bearings will not be acceptable.
7. Certification shall be furnished by the gear reducer manufacturer indicating that the intended application of each unit has been reviewed in detail by the manufacturer and that the unit provided is fully compatible with the conditions of installation and service.

D. Electric Motors

1. The electric motors shall be designed as specified in the Electric Motors.

2.11 ACCESSORIES

- A. At a minimum all accessories shall be installed in the locations indicated on the Drawings. Any additional accessories required by the manufacturer of the MSS for proper operation of the air compressor shall be furnished and installed as recommended.

B. Safety Valves

1. Safety valves in the compressor discharge piping shall be capable of protecting the compressors from damage when operating against a closed discharge valve and shall be suitable for the maximum compressor discharge air temperature.

C. Pressure Gauges

1. Each pressure gauge shall have a stainless-steel rotary geared movement. Each gauge shall be accurate to within 2 percent of full scale. Gauges shall have a range equal to approximately twice the normal operating pressure at the point of installation. The units of measurement shall be indicated on the dial face. Pressure readout shall be available in "psi" or "psig."
2. Panel-mounted gauges shall have a 1/4 inch, minimum, NPT connection. All other gauges shall have a 1/2 inch, minimum, NPT connection. Each gauge shall be provided with a shutoff valve.

D. Differential Pressure Gauges

1. Differential pressure gauges shall be furnished for monitoring the pressure differential across each inlet filter. The gauge shall be permanently mounted and shall be furnished with a mounting bracket, tubing and all required fittings. Unless otherwise indicated, the installation hardware shall be Type 316 stainless steel. Tubing shall be 1/2 inch SS tubing, unless otherwise indicated, properly supported and braced for a permanent installation. The differential shall read the pressure in the suction pipe and the atmospheric pressure outside the building.

E. Pressure Switches and Indicators

1. Each pressure switch shall have spdt contacts rated 10 amperes at 120 volts ac and shall be complete with shutoff valve. Pressure switches mounted inside the control panel shall have NEMA Type 1 housings.
2. Panel-mounted switches shall have a 1/4 inch, minimum, NPT connection. All other switches shall have a 1/2 inch, minimum, NPT connection.
3. Pressure indicators shall be in conformance with the Instrumentation Products section. Analog signal output shall be hardwired, 4-20mA. Materials of construction shall be compatible with full operating temperature and pressure range of the application while maintaining accuracy requirements.

F. Thermometers

1. Thermometers shall be of the direct reading, bimetallic type. Thermometers shall be accurate to within one percent of full scale. Thermometers shall be furnished complete with a uniformly graduated dial indicator, temperature sensor, and thermowell. Thermometer ranges shall be such that the normal operating reading will be near the midpoint of the range. The units of measurement shall be indicated on the dial face.

G. Temperature Switches and Indicators

1. Temperature switches shall be remote bulb type with spdt contacts rated 10 amperes at 120 volts ac. Temperature switches shall have NEMA Type 1 housings, stainless steel thermowell assemblies, and armored capillaries. Capillary tubing shall be sufficient length for mounting the switch inside the control panel. Spare length of capillary tubing shall be neatly coiled and tied.
2. The diameter of air piping shall be increased at the thermowell location, so that the area between the well and pipe is not smaller than the cross-sectional area of the original piping. The entire sensitive portion of the temperature sensor shall be installed within the airflow stream.
3. Temperature indicators shall be in conformance with the Instrumentation Products section. Analog signal output shall be hardwired, 4-20mA. Materials of construction shall be compatible with full operating temperature and pressure range of the application while maintaining accuracy requirements.

H. Each compressor shall be provided with an elapsed time meter mounted on the front of the control panel.

I. Flexible Connections

1. Braided stainless steel flexible connections shall be furnished and installed on the compressor discharge piping connection to limit the transmission of vibration to the connecting piping.

2.12 SHOP TEST

- A. Prior to shipment each compressor unit shall be operated to check alignment; faulty equipment and controls; proper wiring; leaks in piping, seals, or wells; and proper operation of the safety and operating controls. Compressor pressure controls shall be adjusted to the specified pressures. Defective equipment and controls disclosed by such tests shall be replaced and the package placed in satisfactory operating condition before shipping. A statement from the package supplier certifying that the specified shop test has been performed shall be submitted to Engineer prior to shipment.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Each compressed air package shall be installed in accordance Special Provisions section.
- B. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. Anchor bolts shall be set in accordance with the manufacturer's recommendations and setting plans.

3.02 FIELD QUALITY CONTROL

- A. Installation Check
 - 1. An installation check by an authorized representative of the manufacturer is not required.
- B. Installation Supervision
 - 1. Installation supervision by the manufacturer is not required.

3.03 TRAINING

- A. The manufacturer's representative shall provide training of Owner's personnel as described in the Demonstration and Training specification. All costs for training services shall be included in the Contract Price.

Schedule 1: Mixing System for Centrate Basin

Location	Electrical Building
Service Location	BNR Basin No 1 BNR Basin No 2
Compressors	
Tag Numbers	2401-BNR-COMP 2402-BNR-COMP
Minimum Number of Compressors	Two (2) ⁸
Operation	Lead/LagG
Compressor Rated Discharge Pressure.	As required by Mssc
Maximum Motor Rating.	75 hp
Drive Motor Speed.	As required by MSS ⁰
Compressor Cooling.	Air cooled
Oil Mist Eliminators	
Minimum Number of Oil Mist Eliminators	Two (2)
Design Minimum Air Inlet Temperature	As required by MSS
Design Air Inlet Pressure	As required by MSS
ir Receiver	
Tag Numbers	2403-BNR-REC 2404-BNR-REC
Minimum Number of Receivers	Two (2)
Minimum Design Pressure	25 psi greater than lead compressor stop pressure
Minimum Nominal Volume	As required by MSSA
Pressure Switch Low-Pressure Setting	As required by MSS
Notes:	
A. Total receiver volume shall allow for a minimum of 5 minutes of loaded run time for the duty/lead air compressor at maximum capacity and minimum system demand or 2 gallons per nozzle, whichever is larger. B. MSS is responsible for selecting the number of compressors and their capacity based on maximum total required system air demand plus. One additional compressor shall be provided. All compressors supplied and installed for this system shall be identical. C. Discharge pressure needs to account for all system losses, including piping, fittings, valves, filters, dryers, and all accessories in the system. To account for system losses in the piping provided by the contractor two psi shall be added to system losses. In addition the losses noted the compressors selected shall be capable of at least 25 psi more than the max compressor pressure requirement for the mixing system, i.e., the lead compressor shutoff pressure, for the purpose of keeping the motor from operating into its service factor at the rated operating point. The rated operating point and corresponding brake horsepower shall be submitted to the Engineer for review and acceptance. D. Motor shall be sized for rated pressure and flow required by MSS and motor shall not operate into service factor at these conditions. E. Standard cubic feet per minute, scfm, is defined as air at 14.7 psia, 68° F and 36 percent relative humidity. F. The motor nameplate rating shall be not less than the combined total of the maximum power required at the compressor input shaft and the belt or gear losses. G. The lead compressor shall provide the total system air requirements and the lag unit normally serving as standby.	

END OF SECTION

SECTION 11727

LIQUID CHEMICAL FEED SYSTEMS

PART 1 GENERAL

1.01 SCOPE

- A. This section covers liquid chemical feed equipment and accessories. Principal items to be furnished and installed shall include the following:
 - 1. Aluminum Sulfate Feed System
 - a. One Quick Connect Adapter
 - b. One Calibration Column
 - c. Two Metering Pumps (One installed, one shelf spare)
 - d. One Control Panel
 - e. One Pump Table
 - f. One Tote Containment Pallet
 - g. One Diffuser
- B. The following items of work and equipment are covered under other sections:
 - 1. Piping and valves between items of equipment.
 - 2. Water supply and electric power supply to the equipment.
 - 3. Drain and vent piping.
 - 4. Bulk chemical storage tank.

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 CHEMICAL FEED SYSTEM INTEGRATOR

A. General

1. The chemical feed systems shall be designed, coordinated, and supplied by a competent Chemical Feed System Integrator.
2. The Chemical Feed System Integrator shall be regularly engaged in the business of designing and assembling liquid chemical feed systems for water treatment or wastewater treatment plant projects.
3. The Chemical Feed System Integrator shall be responsible for ensuring that a complete functioning system is supplied for each Chemical Feed System.
4. The Chemical Feed System Integrator shall be responsible for coordinating all equipment, piping, and valves, and appurtenances for each Chemical Feed System.

B. Chemical Feed System Integrator Qualifications

1. The Chemical Feed System Integrator shall meet all of the following requirements and within 30 days after the Notice of Award, the Contractor shall submit proof of the following qualifications for the intended Chemical Feed System Integrator:
 - a. The Chemical Feed System Integrator has successfully provided similar work for at least 5 years.
 - b. The names of at least three references who are users of similar systems designed, assembled, and furnished by the Chemical Feed System Integrator.
 - c. The Chemical Feed System Integrator has the required financial capability.
 - d. The names of manufacturers whose products will be supplied.
 - e. The Chemical Feed System Integrator maintains a qualified technical staff and design office.
 - f. The Chemical Feed System Integrator has the physical plant and fabricating personnel to complete the work specified.
 - g. The Chemical Feed System Integrator has and will maintain competent service personnel to service the equipment furnished.

1.04 GENERAL

- A. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by the Engineer.

- B. Each item shall be furnished and installed complete with all mechanical and electrical equipment required for proper operation, all components indicated on the drawings or specified, and all additional materials or construction required by the design of the system.
- C. Coordination
 - 1. The Chemical Feed System Integrator shall verify that each system component is compatible and consistent with all other components of the system, that all pipe materials and sizes are appropriate, and that all devices necessary for a properly functioning system have been provided and installed.
 - 2. Devices and appurtenances necessary for a properly functioning system shall be constructed of materials consistent with the piping materials unless otherwise indicated.
 - 3. The Chemical Feed System Integrator shall assume responsibility for ensuring that Minimum Suction Head and NPSH available is adequate for the supplied pumps.
 - 4. Similar components of different chemical feed systems shall be from the same manufacturer to facilitate maintenance and stocking of repair parts. Whenever possible, identical units shall be furnished.
 - 5. Review of drawings submitted prior to the final determination and coordination of related equipment to be provided will not relieve the Contractor from responsibility for supplying systems in full compliance with the specific requirements of the related equipment.
- D. General Equipment Stipulations
 - 1. The General Equipment Stipulations shall apply to all equipment furnished under this section. Piping on skids shall be constructed consistent with the piping and valve specifications.
- E. Governing Standards
 - 1. All electrical equipment shall conform to applicable standards of the National Electrical Manufacturers Association and the National Electrical Code.
- F. Power Supply
 - 1. Unless otherwise specified, the power supply will be 120 volts, 60 Hz, single phase. Where control voltage lower than the power supply voltage is required, a suitable control power transformer shall be furnished. Both power and control equipment shall be insulated for not less than 600 volts even though operating voltages may be lower.
 - 2. Metal Thicknesses
 - 3. Metal thicknesses and gauges specified herein are the minimum required. Gauges refer to US Standard gauge.

G. Nameplates

1. A nameplate shall be provided and mounted on or adjacent to each piece of chemical feed equipment to identify its function and identifying tag number corresponding to those indicated on the drawings.
2. Nameplates shall be approximately 1 by 3 inches, made from black on white phenolic material.
3. Letters shall be engraved to the white interior and shall be at least 3/16-inch high.

H. Spare Parts

1. A list of recommended spare parts with pricing shall be furnished during the submittal phase.

1.05 SUBMITTALS

A. General

1. Submittals for chemical feed systems shall have the following organization and information as a minimum.

B. Submittal Organization

1. The submittal shall be split up into different sections with a separate section for each chemical feed system. Each system section shall be supplied with the following information.
 - a. Chemical Feed System Integrator Name, Contact Name, Phone Number, Address, and Email Address.
 - b. Chemical Feed System Integrator Contact Name Qualifications and Experience.
 - c. Bill of Materials.
 - d. System piping and instrumentation diagram (P&ID) with legend.
 - e. Equipment and piping layout starting from bulk storage tank pump suction nozzle to discharge of anti-siphon loop.
 - f. Metering pump selections.
 - g. Metering pump appurtenances including calibration column.
 - h. Control panel layout and wiring diagram.
 - i. Metering pump table drawings and selection
 - j. Diffuser selection.
 - k. Control narrative.
 - l. Spare parts.

C. Drawings and Data

1. Complete fabrication, assembly, installation and equipment and piping layout drawings, piping and instrumentation diagrams, and wiring 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 Section.

D. Calibration Graphs

1. The Chemical Feed System Integrator shall prepare a calibration graph from field tests for each chemical feed pump. Each graph shall include a curve of pump speed versus gallons per hour at 10, 25, 50, 75 and 100 percent speed. Each graph shall be furnished on hard paper and sealed in clear plastic.

E. Control Narrative

1. A narrative description of the proposed metering pump controls, including all control modes, manual and automatic operations, electrical interlocks, alarms, and interfaces to the Plant Control System shall be submitted.

F. Operation and Maintenance Data and Manuals

1. Operation and maintenance manuals shall be supplied and shall be submitted in accordance with the Submittals section. Equipment designations used shall correspond to those indicated on the drawings.
2. Operation and maintenance manuals shall include the following:
 - a. Equipment function, normal operating characteristics, and limiting conditions.
 - b. Assembly, installation, alignment, adjustment, and checking instructions.
 - c. Operating instructions for startup, routine and normal operation, regulation and control, shutdown, and emergency conditions.
 - d. Lubrication and maintenance instructions.
 - e. Guide to troubleshooting.
 - f. Parts lists and predicted life of parts subject to wear.
 - g. Outline, crosssection, and assembly drawings; engineering data; and wiring diagrams.
 - h. Test data and performance curves, where applicable.
 - i. A listing of all filter locations, type, size, and quantity associated with each piece of equipment.
3. 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 CHEMICAL FEED SYSTEM INTEGRATOR

- A. The chemical feed system shall be coordinated and supplied by a qualified Chemical Feed System Integrator who is regularly engaged in the business of designing and assembling liquid chemical feed systems for water treatment or wastewater treatment plant projects.

2.02 GENERAL CONSTRUCTION

- A. Chemical feed equipment shall be of substantial construction with all parts designed for long life under working conditions including corrosive atmospheres and intermittent or continuous operation.
- B. All wearing parts and items requiring adjustment shall be readily accessible.
- C. Each unit shall be completely enclosed and dust tight when in operation.
- D. All parts which are exposed to corrosive conditions shall be made from corrosion-resistant materials or covered with suitable protective coatings.

2.03 ALUMINUM SULFATE FEED SYSTEM

- A. One assembly of feeding equipment shall be furnished and installed to dispense aluminum sulfate to the following feed points:
 - 1. Wet Weather Diversion Structure
- B. Chemical Solution Properties
 - 1. 48.5% aluminum sulfate solution with a specific gravity of 1.335.
- C. Quick Connect Adapters
 - 1. Quick Connect Adapter Requirements:
 - a. Location: Truck unloading station
 - b. Quantity: 1
 - c. Materials: Polypropylene
- D. Calibration Columns
 - 1. Calibration Column Requirements:
 - 2.
 - a. Associated Pump Tag Number(s): 1610-MP-ALS1
 - b. Quantity: 1
 - c. Diameter, inch: 4"
 - d. Flow Fitting Size, inch: 1"
 - e. Capacity, gallons: 0.65
 - f. Graduation Increments, gallons: 0.05
- E. Metering Pumps
 - 1. Metering Pump Requirements:
 - a. Feed Point(s): Wet Weather Diversion Structure
 - b. Pump Quantity: Two (One installed, one shelf spare)
 - c. Pump Type: Hose-type Peristaltic
 - d. Tag Number(s): 1610-MP-ALS1

- e. Capacity Control Range, Percent: 0 to 100
- f. Metering Range, gph: 2.80-38.00
- g. Minimum Drive Motor, voltage: 120
- h. Accuracy, percent of scale over metering range: 2%
- i. Minimum Suction Head Required, psia: 9.5
- j. Nominal Discharge Pressure, psi: 25

F. Diffusers

1. Diffuser Requirements:

- a. Feed Point: Wet Weather Diversion Structure
- b. Diffuser Quantity: One
- c. Diffuser Type: Channel
- d. Drawing Reference: MA-15, MZ-9

2.04 QUICK CONNECT ADAPTER

- A. Quick connect adapter shall be provided as shown on the drawings and as specified in the individual chemical system paragraphs of this section.
- B. The material of construction shall be compatible with the chemical and approved by the Engineer. The quick connect shall be the standard cam and groove type manufactured to specification A-A-59326D stainless steel.
- C. The quick connect fitting shall be the adapter type (grooved fitting) with a locking dust cap.
- D. The adapter shall be constructed of material suitable for the chemical service with female NPT threads for connecting to the fill piping.
- E. The adapter shall be the same size as the associated fill line as indicated on the drawings.
- F. The quick connect adapters shall be as manufactured by OPW Engineered Systems, PT Coupling Company, Inc, or equal.

2.05 CALIBRATION COLUMNS

- A. Unless otherwise shown on the drawings, one transparent plastic calibrating column shall be furnished and installed on the pump suction piping, of each chemical feed metering pump, as indicated on the drawings.
- B. The column shall be a clear PVC or other chemically resistant, rigid, transparent plastic tubing having a vented top cap and screwed flow fitting as indicated in the individual chemical system paragraphs of this section.
- C. Capacities and graduation units for each calibration column shall be as covered in the individual chemical system paragraphs of this section.
- D. The bottom of the calibration column shall be located at or below the bottom of elevation of the storage metering pump suction nozzle.

- E. The columns shall be Valcom, Inc., "Model 85000", or equal, and shall be mounted on steel legs.

2.06 METERING PUMPS - PERISTALTIC HOSE TYPE

A. Performance

- 1. Specific pump quantities and performance requirements are covered in the individual chemical system paragraphs of this section.

B. Pump Requirements

- 1. The pump shall be of the positive displacement hose-type peristaltic pump, utilizing a flexible hose and shoe. Each pump shall consist of an epoxy- coated cast iron or cast aluminum housing, pump hose, rotor assembly, connectors, motor, and motor controller. The process fluid shall only contact the inside of the pump hose.
- 2. The pumps shall be either closed-coupled or "SPX-Direct Coupled" by the Manufacturer.
- 3. The pump hose shall be a suitably reinforced hose and constructed of materials resistant to the solution as acceptable to the Engineer. The hose insert shall be constructed of stainless steel. The hose shall have a static burst pressure of at least 220 psi. The hose shall be in contact with the inside diameter of the track through an angle of 180 degrees and shall be held in place on the suction and discharge by the manufacturer's standard connectors. The hose shall be replaceable without removing the pump or opening the pump head door. Inlet/outlet connectors shall be constructed of stainless steel. Inlet/outlet connectors shall be located by and secured to the pump housing by permanent stainless-steel nuts, washers, and bolts.
- 4. The rotor assembly shall be equipped with two sliding shoes. Shoes shall be located 180 degrees apart for complete occlusion of the hose against the track twice per rotor revolution. Each rotor assembly shall be keyed to the output shaft of the gear reducer/gearmotor and be axially secured to the shaft by a heavy-duty washer and socket head cap screw.
- 5. The pump shall be completely self-priming with a suction lift capability of up to 20 feet. The pump shall be capable of running dry without damaging effects to the pump or hose. The pump shall be valve-less and without diaphragms and not utilize any dynamic seals in contact with the pumped liquid.
- 6. The pump housing shall contain a threaded drain plug and vent port. The drain shall be located at the lowest point in the housing and shall allow complete removal of all liquid from within the housing.
- 7. Each pump shall be supplied with a spare hose. Spare hose material, thickness, and diameter shall match the hose provided for service.

8. Each pump shall be equipped with an inverter duty motor and an electric speed adjustment to operate from an AFD controller with tachometer or encoder-based closed loop speed control. The pump shall be capable of operating continuously over the entire range indicated above. The signal input shall be 4-20 mA dc and shall be ungrounded differential type with an input resistance of not more than 250 ohms. The controller shall accept either the remote signal or a manual rate control signal at the controller, and vary the ac voltage to the motor, with feedback as required to attain the desired rate. Each controller shall operate from a 480-volt, three phase, 60 Hz power supply, and shall be mounted in a metering pump control panel as described in the Metering Pump Control Panel paragraph.
9. Motor horsepower for each pump shall be based on the individual chemical system performance requirements and on the discharge back pressure required by the pump furnished. Motor shall not be less than the indicated horsepower. Power to the motor shall be provided by an AFD controlled rate controller as specified herein.
10. Each pump shall be furnished with the following accessories. All metering pump suction and discharge appurtenances described below and branch piping to these appurtenances shall be the same sizes as the suction and discharge piping indicated on the P&ID.
 - a. The pump shall be provided with the manufacturer's standard leak detection. The switch shall be rated for 120 volts ac and shall close upon a leak and shall be connected in the 120-volt control circuit for the pump motor and shall shut down the pump on a leak condition.
 - b. One properly sized diaphragm type pulsation dampener in each pump loop fabricated of materials resistant to the pumped solution and shall include an air charging valve and air gauge. The pulsation dampener shall be sized to limit pressure surges to between 5 and 10 percent of mean pressure.
 - c. One transparent PVC bodied Y-pattern strainer with 12-mesh screen and O-ring seals.
 - d. One pressure gauge and high-pressure switch with isolating diaphragm installed in the discharge piping. The pressure gauge shall be indicating dial type with adjustable pointer and acrylic plastic or shatterproof glass window. The dial shall be 4 1/2 inches in diameter, with white background and black markings. Pointer travel shall be approximately 270 degrees. The unit of measurement shall be pounds per square inch and shall be indicated on the dial face. The gauge shall be selected so that gauge readings will be mid-scale under normal operating conditions. The isolating diaphragm shall protect the pressure gauge from the chemical solution.
11. The high-pressure switch shall be of the diaphragm type, shall have a weatherproof housing, shall have a trip point reliability better than 1 percent of actual pressure, and shall at minimum be SPOT rated at 10 amp at 120 VAC.
 - a. One external relief valve sized to pass the maximum displacement of the pump.

- b. One properly sized diaphragm type pulsation dampener in each pump discharge piping arrangement. Each pulsation dampener shall be fabricated of materials resistant to the pumped solution and shall include an air charging valve and air gauge. The pulsation dampener shall be sized to limit pressure surges to between 5 and 10 percent of mean pressure.

12. Metering pump shall be Watson-Marlow/Bredel APEX Series, Verder Dura Series, or Flowrox LPP-D Series without exception.

C. Metering Pump Table

1. Metering pump table shall be provided as recommended by pump manufacturer. Dimensions shall accommodate the selected metering pump model.
2. Materials of construction shall be compatible with the chemical service and approved by the Engineer.
3. Metering pump table shall be provided with a lip to contain incidental spills and a 2-inch drain located at the bottom.
4. Metering pump table shall be bolted to a concrete pad as indicated on the drawings.

D. Peristaltic Hose Metering Pump Controls

1. For variable speed hose metering pumps, the pump supplier shall provide a local control panel for each pump. The control panel shall house the AFD drive and control components required for operation of the metering pump as specified herein.
2. The control panel shall be a fiberglass or 316 SS NEMA Type 4X enclosure and suitable for wall mounting in the location indicated on the drawings.
3. All wiring terminals shall be furnished complete and ready for connection to the external power supply, the remote pump controls, and the pump and pump mounted devices. Each control panel shall be provided with an engraved nameplate indicating the controlled unit, and nameplates for all major components contained on the panel face and within the control panel.
4. Control panels for variable speed pumps shall have an "On-Off-Remote" switch and local speed adjustment on the panel front. When "On" is selected, the pump shall run and speed shall be adjusted using the local controls. When "Remote" is selected, start/stop control shall be by a normally open contact input to the panel, and speed control shall be by a 4-20 mA input. Indicating lights shall be provided on the panel front for "Running", "Stopped", and "Drive Failure". These indicating lights shall be red, green, and amber respectively. Where a high discharge pressure switch is indicated on the drawings or specified to be provided for the pump, the pump shall shut down on high discharge pressure, and an amber "High Discharge Pressure" indicating light on the panel front shall illuminate. Where leak detection system is indicated on the drawings or specified to be provided for the pump, the pump shall shut down on leakage and an amber "Hose Failure" indicating light on the panel front shall illuminate. LCD or similar type display functions are acceptable alternatives to indicating lights.

5. Outputs shall be provided from panels for variable speed hose metering pumps as follows:
 - a. In Remote (NO dry contact)
 - b. Running (NO dry contact)
 - c. Fail (NO dry contact)
 - d. Speed (4-20 mA)
6. The signal controlling the Fail contact shall be generated by the AFD drive. Where high discharge pressure and/or hose leakage is monitored, the Fail contact shall include these conditions. Manual reset of the failure condition shall be required at the control panel.

2.07 CHEMICAL TOTE AND DRUM CONTAINMENT

- A. Unless otherwise indicated on the Drawings or in the individual chemical system paragraphs in this section, each chemical tote or drum shall be provided with a chemically-resistant containment pallet to support the tote or drum.
- B. The containment pallet shall have a total weight capacity appropriate for the installed installation and as specified in in the individual chemical system paragraphs of this section.
- C. Tote Containment
 - a. Each containment pallet shall have a capacity as specified in in the individual chemical system paragraphs of this section.
 - b. Each containment pallet shall include a platform that can support totes measuring 38 to 50 inches in width.
 - c. The maximum load capacity shall be 10,000 pounds and the pallet shall be constructed of polyethylene.
 - d. Provisions shall be included to drain the pallet of rainwater.
 - e. Pallets shall be Interstate Products, Inc. "IBC Spill Unit Model H-4435" or equal.

2.08 DIFFUSERS

- A. Chemical diffusers shall be provided for injection of chemical at the feed points, as indicated on the drawings.

2.09 SAFETY EQUIPMENT

- A. One chemical handling safety equipment kits shall be provided. Each kit shall include, but shall not be limited to, chemical splash goggles, rubber gloves, and rubber apron, all packed in a suitable carrying case.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Equipment and materials furnished under this section shall be installed in proper operating condition in full conformity with Drawings, specifications, and recommendations of the equipment manufacturer, unless exceptions are noted by the Engineer. All items necessary for a complete operating system shall be installed.
- B. Equipment Bases
 - 1. Unless otherwise specified or indicated on the Drawings, each item of chemical feed equipment shall be mounted on a concrete base approximately six inches above the floor. If feeders or other components must be supported at higher elevations above the floor, suitable supplementary bases shall be provided.
- C. Installation Check
 - 1. An experienced, competent, and authorized representative of the Chemical Feed System Integrator shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when equipment is placed in operation in accordance with the Special Provisions 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 Chemical Feed System Integrator's representative shall furnish a written report certifying that the equipment has been properly installed; that gas piping has been properly cleaned; is in accurate alignment; is free from undue stress imposed by connecting piping or anchor bolts; and has been operated at full load conditions and that it operated satisfactorily.
 - 3. All costs for these services shall be included in the contract price for the number of days and round trips to the site as required.

3.02 STARTUP AND TESTING

- A. Chemicals required for startup and testing will be provided by the Owner. Contractor shall give the Owner 45 days' notice before chemicals are required except as otherwise specified herein.

3.03 CLEANING

- A. At the completion of installation and 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 at no additional cost to Owner.

END OF SECTION