2. Protect piping and appurtenances by storing off ground.
3. Provide additional protection according to manufacturer instructions.

1.9 AMBIENT CONDITIONS

A. Minimum Conditions: Do not store or handle uninstalled lined pipes or fittings at temperatures below zero degrees F.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

A. Manufacturer and Installer agree to repair or replace components of stainless steel process piping and tubing that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 STAINLESS STEEL PIPE AND FITTINGS

A. General Service Piping:

1. Type:

a) Welded; comply with ASTM A813/A813M.
b) Class: SW; comply with ASTM A814/A814M.

2. Schedule: 40S.
3. Grade: Type 316L.
4. Dimensions: Comply with ASTM A312/A312M.

B. Seamless Stainless Steel Alloy Pipe:

1. Type: Billet-pierce and manufacture seamless (SMLS) stainless steel alloy pipe, 1/4 inch to 48 inch diameter to ASME B36.19 from the following alloys (“L” suffix stands for low alloy, suitable for welding). Furnish SMLS stainless steel pipe in one of the following alloys as designated on Drawings. Specific material designation indicated on Drawings is indicated in parentheses. P-Numbers for base metal classification in ASME BPVC Section IX are also provided below:

a) ASTM A312, Grade TP316L (316L) austenitic stainless steel; ASME P-8.

2. Provide 2D factory finish on SMLS stainless steel pipe, having a wall thickness of 0.010 inch or less.
3. Provide a 2E factory finish on seamless stainless steel pipe, having a wall thickness 0.010 inch to 0.25 inch when delivered to mill.
4. Provide a 1D factory finish on seamless stainless steel pipe, having a wall thickness greater in 0.25.

C. Electric-Resistance-Welded Stainless Steel Alloy Pipe:

1. Type: Install electric-resistance-welded (ERW) stainless steel alloy pipe, 1/4 inch to 48 inch diameter, manufactured to ASME B36.19, where scheduled and indicated on Drawings. ("L" suffix stands for low alloy, suitable for welding). Furnish ERW stainless steel pipe in one of the following alloys as designated on Drawings. specific material designation indicated on Drawings is indicated in parentheses. P-Numbers for base metal classification in ASME BPVC Section IX are also provided below.
2. Provide a 2D factory finish on ERW pipe, having a wall thickness of 0.010 inch or less.
3. Provide a 2E factory finish on ERW pipe, having a wall thickness 0.010 inch to 0.25 inch when delivered to mill.
4. Provide a 1D factory finish on welded pipe, having a wall thickness greater than 0.25 inch or less.
5. Provide cold drawn ERW pipe manufactured from the following alloys (P-Numbers for base metal classification in ASME BPVC Section IX are included in parenthesis):

    a) ASTM A312, Grade TP316L (316L) austenitic stainless steel; ASME P-8.

D. Fittings:

1. Type:

    a) Piping 2 inches and Smaller: Socket welding.
    b) Piping 2-1/2 inches and Larger: Butt welding.

2. Dimensions: Comply with ASTM A312/A312M.
3. Threaded Fittings:

    a) Comply with ASME B16.11 and ASTM A182/A182M.
    b) Grade: Type 316.
    c) Threads: Comply with ASME B1.20.1.

4. Butt-Welding Fittings:

    a) Comply with ASTM A403/A403M.
    b) Grade: Type 316L.
    c) Class: CR; comply with ASME B16.9.

5. Socket-Welding Fittings:

    a) Comply with ASTM A403/A403M.
    b) Grade: Type 316L.
    c) Class: WP-S; comply with ASME B16.11.

6. Flanged Fittings:

   a) Type: Welding neck.
   b) Class: 150.
   c) Comply with ASTM A182/A182M.
   d) Grade: Type 316L.
   e) Facing and Drilling: Comply with ASME B16.5 and matching mating flange.
   f) Backing Flanges:

      1) Material: Stainless steel.
      2) Class: 150.
      3) Comply with ASTM A351/A351M.
      4) Grade: Type 316L.
      5) Type: Van Stone.
      6) Drilling: Comply with ASME B16.5.

7. Low-Pressure Cast Stainless Steel Threaded Fittings:

   a) Provide castings of one of the following alloys for fittings for use with ERW stainless steel pipe, 1/4 inch to 2 1/2 inch:

      1) ASTM A351 Grade CF8M for pipe manufactured from ASTM A312, Grade TP316L austenitic stainless steel.

   b) Provide low-pressure stainless steel threaded fittings meeting requirements of ASME B16.3 for dimensional, material, and pressure Class 150 in accordance with scheduled piping system pressure requirements. Provide bushings and plugs meeting requirements of ASME B16.14. Provide thread form meeting ASME B1.20.1.

8. Wrought Stainless Steel Butt-Welding Fittings:

   a) Provide wrought carbon steel buttwelding fittings, 2 inch to 48 inch diameter for use with ERW and seamless carbon steel pipe where butt-welding fittings are indicated on Contract Drawings and approved Shop Drawings.
   b) Provide butt-welding fittings having a minimum wall thickness corresponding to wall schedule specified for connecting Piping; meeting requirements of ASME B16.9.
   c) Provide wrought stainless steel buttwelding fittings for pipe 1/4 inch to 60 inch diameter conforming to ASME B16.9.
   d) Provide fittings manufactured from the following alloys in accordance with designated ASTM standard:

      1) ASTM A403, Grade WP316L (ASME P-8) for pipes manufactured from ASTM A312 Type 316/316L austenitic stainless steel; and ASTM A778 Type 316L extra-low carbon austenitic stainless steel.

E. Flanged Connections: As required to connect stainless steel piping to fittings and equipment, fittings, and valves as required.

1. Forged Stainless Steel Pipe Flanges:

    a) Provide forged stainless steel flanges for pipe 1/2 inch to 60 inch diameter and larger of raised-face type in weld-neck, slip-on or stub-end configuration, as indicated on Drawings.
    b) Provide forged flange dimensions and tolerances manufactured in accordance with ASME B16.5 and ASME B16.47.
    c) Cut flange gaskets from sheet stock in flat ring configuration in accordance with ASME B16.21, in non-insulating and insulating materials specified below.
    d) Construct forged flanges of the following alloys:

        1) ASTM A182, Grade F316L (ASME P-8) for pipes manufactured from ASTM A312 Type 316L austenitic stainless steel.

F. Unions:

1. Low-Pressure Cast Stainless Steel Threaded Unions:

    a) Manufacture low-pressure stainless steel threaded unions for use with ERW stainless steel pipe, 1/4 inch to 2 1/2 inch diameter, to requirements of MSS SP-114 for heat treating, material thickness, dimensions and marking.
    b) Provide low-pressure threaded unions of castings of one of the following alloys:

        1) ASTM A351 Grade CF8M for pipe manufactured from ASTM A312, Grade TP316L austenitic stainless steel.

    c) Provide low-pressure stainless steel threaded unions meeting requirements of ASME B16.39 for dimensional, material, and pressure Class 150 in accordance with scheduled piping system pressure requirements; thread form meeting ASME B1.20.1.

2.2 STAINLESS STEEL TUBE AND FITTINGS

A. Tube:

1. Type: Seamless or Welded.
2. Comply with ASTM A269/A269M.
3. Grade: Type 316L.

B. Seamless Stainless Steel Alloy Tube:

1. Install seamless stainless steel alloy tube, 1/4-inch to 2 1/2-inch diameter in designated size and wall thickness as scheduled and indicated on Drawings.
2. Provide seamless tube manufactured from the following alloys in accordance with designated ASTM standard:

    a) ASTM A269, Grade S31603, (316L) austenitic stainless steel (ASME P-8), ID and OD: mechanically polished to a No. 2B finish, as a minimum.
    b) Provide seamless annealed stainless steel alloy tube manufactured and/or distributed by:

1) Tioga Pipe Supply Company, Philadelphia, Pennsylvania.
2) Outokumpu Piping Products, Wildwood, Florida.
3) Rath Gibson, Janesville, Wisconsin.
4) Swagelok, Solon, Ohio.
5) Plymouth Tube, Warrenville, Illinois.
6) Bristol Metals (Brismet), Bristol, Tennessee.
7) Alaskan Copper Works, Seattle, Washington.

C. Fittings:

1. Threaded:

a) Comply with ASTM A182 and ASME B16.11.
b) Grade: Type 316.
c) Threads: Comply with ASME B1.20.1.

2. Butt-Welding Fittings:

a) Comply with ASTM A403.
b) Grade: Type 316L.
c) Class: CR.

3. Socket-Welding Fittings:

a) Comply with ASTM A403.
b) Grade: Type 316L.
c) Class: WP-S.

4. Flanged Fittings:

a) Type: Welding neck.
b) Class: 150.
c) Comply with ASTM A182.
d) Grade: Type 316L.
e) Facing and Drilling: Comply with ASME B16.5.
f) Backing Flanges:

1) Material: Stainless steel.
2) Class: 150.
3) Comply with ASTM A351/A351M.
4) Grade: Type 316L.
5) Type: Van Stone.
6) Drilling: Comply with ASME B16.5.

g) Bolting:

1) Bolts: Comply with ASTM A193/A193M, Grade B5; hex head.
2) Nuts: ASTM A194, Grade 316; hex head.

h) Cast-Iron Mating Flange on Valves or Equipment:

1) Bolts: Comply with ASTM A193/A193M, Grade 316; hex head.
2) Washers: Same material as bolts.

5. Crimp Fittings:

a) Material: Cold-drawn stainless steel.
b) Grade: Type 316L.

6. Compression Fittings:

a) Material: Stainless steel.
b) Comply with ASTM A479/A479M.
c) Grade: Type 316.
d) Pressure Rating:150 psig.

7. Welded Stainless Steel Tube Fittings:

a) Only use welded stainless steel tube fittings, 3 inch to 12 inch diameter with ASTM A778 light-wall extra-low-carbon stainless steel pipe; designed and manufactured in accordance with ASTM A774; fitting dimensions in accordance with MSS SP-43.
b) Provide welded stainless steel tube fittings manufactured from the following alloys in accordance with designated ASTM standard:

1) ASTM A774, Grade TP316L (extra low carbon (<0.03 percent) alloy for welded fabrication) for pipes manufactured from ASTM A778 Type 316L extra-low carbon light-wall austenitic stainless steel.

c) Provide low-pressure light-wall fittings for stainless steel pipe manufactured and/or distributed by one of the following:

1) Felker Brothers, Marshfield, Wisconsin.
2) Douglass Brothers, Portland, Maine.
3) Swepco Tube, Clifton, New Jersey.

8. Compression Tube Fittings and Adapters:

a) Use compression fittings and adapters constructed of same material as connecting tube, 1/4-inch to 2 1/2-inch diameter, on stainless steel tube where specified and indicated on drawings.
b) Provide all threaded joints for medium pressure oil hydraulic tube fittings of SAE straight-thread O-ring end-seal type.
c) Provide compression type couplings between tubes, bends and adapters for oil hydraulics.
d) Provide one of the following compression fittings for stainless steel tube:

1) Tube fittings and adapters manufactured by Swagelok, Solon, Ohio.
2) Gyrolok fittings manufactured by Hoke, Spartanburg, South Carolina.

3) Tube fittings manufacture by Tube Fittings Division, Parker Hannifin Corporation, Columbus, Ohio.
4) Tube fittings manufactured by Brennan Industries, Solon, Ohio.

9. Flared 37 Degree Tube Fittings and Adapters:

a) Use flared 37 degree fittings and adapters 1/4-inch to 2-inch diameter on tube fittings where indicated on Drawings. Do not used on oil hydraulic systems. Provide dimensions in accordance with SAE J514 and threads in accordance with ASME B1.20.1.
b) Meet the following material standards:

1) ASTM A182, Grade F316/F316L (ASME P-8) (L – low alloy for welded fabrication) Austenitic for tubes manufactured from ASTM A269, Type 316/316L.

c) Provide flared fittings manufactured by one of the following:

1) Parker Hannifin Corporation, Columbus, Ohio.
2) Brennan Industries, Solon, Ohio.
3) Swagelok, Solon, Ohio.

10. Flared 45 Degree Tube Fittings and Adapters:

a) Use f fittings and adapters 1/4-inch to 2-inch diameter where specified and indicated on Drawings. Provide dimensions in accordance with SAE J513 or SAE J512 with threads in accordance with ASME B1.20.1 and bodies forged to ASTM A182.
b) Meet the following material standards:

1) ASTM A182, Grade F316/F316L (ASME P-8) (L – low alloy for welded fabrication) Austenitic for tubes manufactured from ASTM A269, Type 316/316L.

c) Provide flared 45 degree fittings from one of the following manufacturers:

1) Parker Hannifin Corporation, Columbus, Ohio.
2) Brennan Industries, Solon, Ohio.
3) Mueller Industries, Covington, Tennessee.

2.3 ACCESSORIES

A. Pipe-Thread Tape:

1. Material: PTFE.
2. Comply with ASTM D3308.

B. O-Ring Seals: EPDM.

C. Flange Gaskets:

1. Comply with ASME B16.5.
2. Nonmetallic Gaskets:

a) Material: Chloroprene rubber.
b) Comply with ASME B16.21.

3. Type:

a) Flat-Face Flanges: Full face.

D. Anti-seize Bolting Lubricants:

1. Install flange bolts using a nickel anti-seize lubricant capable of achieving required bolt torque and sealing stress and permitting future disassembly with minimal manual input.
2. Remove excess anti-seize compound by degreasing solvent prior to finish painting piping.
3. Anti-Seize Compound:

a) Never-Seez Pure Nickel Special Lubricant manufactured by Bostik, Wauwatosa, Wisconsin.
b) Loctite Heavy Duty Anti-Seize Lubricant Manufactured by Henkel Technologies, Rocky Hill, Connecticut.
c) Chesterton 772 Premium Nickel Anti-Seize Compound manufactured by Chesterton Technical Products, Stoneham, Massachusetts.

4. Flange Bolts: Adequately degreased of all corrosion inhibiting slush oil and excess anti-seize lubricant prior to field application of prime and finish coatings.

2.4 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flange mate properly.

3.2 PREPARATION

A. Ream pipe and tube ends and remove burrs.

B. Bevel plain-end pipe.

C. Thoroughly clean pipe and fittings before installation.

3.3 INSTALLATION

A. Comply with ASME B31.3. Install pipe, fittings and specials true to alignment and rigidly supported. Do not exceed deflection at pipe joints recommended by *Supplier*. Support all pipe and appurtenances connected to equipment to prevent any strain on equipment and valves nozzles, and adjoining pipe flanges.

B. Run piping straight along alignment as indicated on Shop Drawings, with minimum number of joints.

C. Fittings:

1. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.
2. Install according to manufacturer instructions.
3. Bolting:

    a) Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight.
    b) Use torque wrench to tighten bolts to manufacturer instructions.

D. Concrete encase pipe under concrete slabs. Wrap stainless steel pipe in protective material, such as petrolatum tape or coat pie as needed, prior to encasement.

E. Provide required upstream and downstream clearances from devices as indicated on Shop Drawings.

F. Install piping with sufficient slopes for venting or drainage of liquids and condensate to low points.

G. Provide expansion joints as specified in Section 400506 “Couplings, Adaptors, and Specials for Process Piping” to compensate for pipe expansion due to temperature differences.

H. Disinfection: Disinfect raw water piping.

I. Dielectric Fittings: Provide between dissimilar metals.

J. Field Cuts: According to pipe manufacturer instructions.

K. Field welding of stainless steel is not permitted.

L. Provide cathodic protection for all buried ferrous piping systems as recommended by the Manufacturer.

M. Joining preparation and finished welds: Under no circumstances may permanent backer-rings or other consumable inserts be used for field or shop welding of steel pipe. Non-consumable refractory inserts are allowed with Engineer’s approval.

N. Assemble joints between straight lengths of carbon steel pipe with full-penetration groove welds. Make full-penetration butt-welded field joints for pipe larger than 8 inch diameter using

line-up clamps. Submit alternative methods to line-up clamps proposed with welding submittals for Engineer's approval.

O. Join socket-welded fittings, used with seamless mill grade stainless steel piping, by fillet welding as indicated on Drawings. Use socket welded fittings only on oil fluid power system piping.

P. Prepare pipe joints by a machining process without damage to pipe exterior. Cut ends smooth and at a right angle to axis of pipe and beveled where required in accordance with approved welding procedure specifications. Deburr pipe and tube as part of preparation of all joint configurations.

Q. Rust spots and corrosion pits on new stainless steel pipe and fittings are not allowed. Verify pipe, tube and fittings are inspected by Engineer and Contractor upon delivery and stored in a location that will prevent entry of contaminants prior to installation.

R. Protect pipe, tube, fittings and valves, and adhere to the following mandatory requirements, and others specified in paragraphs below:

1. Protect stainless steel materials from contact with carbon steel including but not limited to hoisting and rigging equipment, steel tables, storage racks and hand tools.
2. Do not bundle pipe and fittings using ferrous metal banding at factory or Supplier's facility.
3. Do not allow contact between wear surfaces of tools used for carbon steel fabrication and surfaces of stainless steel pipe, tubes and fittings. These tools include abrasive grinding and cutting wheels, wheel cutters and rollers, threading taps and dies, tube bending equipment and all other bearing edge tools.
4. Use manual or powered wire brush tools for surface repair and joint preparation manufactured from stainless steel. Brushes with carbon steel wire cannot be used for fabrication of stainless steel.
5. Shield stainless steel pipe, tube and fittings from all on-site carbon steel pipe and structural steel cutting and blasting operations.
6. Remove all exterior surface scratches; surface contamination by ferrous metal grinding kerf; contamination by paint markers and crayons etc.; and labels after installation.

S. Verify engineer examines exterior surfaces of pipe, tube and fittings at Site for free iron contamination by ferroxyl test or other method. Clean all contaminated surfaces at Site by pickling using a lean spray-applied pickling cleaner suitable for large surfaces system. Follow pickling with passivation of entire treated surface by a neutralizing rinse. Provide one of the following spray-applied pickling solutions:

1. Avesta Classic Cleaner 401®, manufactured by Avesta Finishing Chemicals, Orchard Park, New York.
2. Antox® 75E Pickling Cleaner, manufactured by Chemetall US, New Providence, New Jersey.
3. Kytex® Brightener 123, manufactured/distributed by Harvard Chemical Research, Atlanta, Georgia.

T. Perform field cutting of stainless steel pipe by mechanical wheel cutter or abrasive saw, leaving a smooth cut at right angles to axis of pipe. Use new abrasive cutting wheels for stainless steel pipe and tube designed to prevent iron, sulfur or chlorine contamination to surface under

preparation or repair, and surfaces of adjacent piping. Deburr pipe and tube as part of preparation for all joint configurations. Abrasive cutting wheels acceptable for use on stainless steel pipe and tube as follows:

1. Charger® cutting wheels manufactured by Norton/Saint-Gobain Abrasives, Worcester, Massachusetts.
2. Saitech Z-Tech® cutting wheels manufactured by United Abrasives/SAIT, Windham, Connecticut.
3. Specialist® cutting wheels manufactured by Flexovite, Angola, New York.

U. Perform field grinding of stainless steel pipe and tube, including root pass and enter-pass weld grinding using new grinding wheels. Use grinding wheels designed to prevent iron, sulfur or chlorine contamination to surface under repair or surfaces of adjacent piping. Abrasive grinding wheels acceptable for use on stainless steel pipe and tube as follows:

1. Norzon Plus® grinding wheels manufactured by Norton/Saint-Gobain Abrasives, Worcester, Massachusetts.
2. Saitech Pipeline® grinding wheels manufactured by United Abrasives/SAIT, Windham, Connecticut.
3. Flexon® ZA24S grinding wheels manufactured by Flexovite, Angola, New York.

V. Use wire wheels, to remove defects on pipe surface after installation, constructed of same material as pipe wall or Type 316 stainless steel for super austenitic and duplex stainless steel piping. Verify surface finish on pipe meets specified mill-applied surface finish or better.

W. Installation of Grooved Joint Couplings and Fittings:

1. Assemble steel grooved-joint couplings on piping systems in accordance with latest version of Manual I-100 “Field Installation Handbook” published by Victaulic Company, Easton, Pennsylvania.
2. Install coupling gaskets using Supplier’s standard lubricant compatible with elastomer gaskets. Complete lubrication of gasket exterior, gasket sealing lips, housings, and pipe ends prior to joining to prevent gasket pinching.
3. Tighten coupling nuts evenly by alternating sides until metal-to-metal contact occurs at bolt pads. For angle-bolt-pad couplings, even offsets must be present at bolt pads to obtain pipe-joint rigidity.

X. Bolting Procedure for Flanged Joints:

1. Assemble flanged pipe joints in accordance with gasket Supplier’s instructions and as specified herein. Utilize calibrated bolting equipment capable of applying a measured torque to flange bolts during assembly. Submit bolting patterns, procedures and bolting equipment data to Engineer prior to pipe fitting and bolting.
2. Use hydraulic cassette wrenches for assembly of flanged pipe joints requiring greater than 900 ft-lbs of assembly torque. Document each flanged joint assembly included in Work using “Flange Bolting Worksheet” at end of this Section. Do not use torque multipliers. Engineer reserves right to require documentation of any flange joint requiring less than 900 ft-lbs of bolt torque.
3. Calculate clamping forces and target assembly torque for assembly of all flanged pipe joints included in Work. Verify calculations take into consideration pipe diameter, gasket Supplier’s recommended assembly stress; bolt material tensile and yield stress; gasket

Supplier's recommended bolt stress; pipe service, design and test pressures. Verify calculations are stamped by a professional engineer.

4. Visually inspect and clean flange bolts, stud-bolts, nuts and washers prior to bolting. Lubricate bolts and nuts; if hardened washers are not used, lubricate flange surface around bolt holes. Remove excess lubricant on surfaces to receive protective coatings by cleaning and degreasing solvent prior to applying coating system.
5. Hand-tighten all nuts and bolts, then tighten them to 10 to 20 percent of target torque. Do not exceed 20 percent of target torque, for initial torque. Tightened bolts according to pattern recommended by gasket Supplier. Do not reuse nuts removed during disassembly of existing or newly assembled joints. Dispose of used nuts in presence of Engineer.
6. Perform three rounds of bolt tightening on flanges having 4 to 8 bolts following hand tightening, first to 30 percent; then 60 percent; and finally, 100 percent of target torque calculated by Contractor.
7. Perform four rounds of bolt tightening for flanges having 12 bolts or more, following hand tightening, first to 20 percent; then 40 percent; then 80 percent, and then 100 percent of target torque calculated by Contractor.
8. Measure gap between flanges following application of 100 percent of target at every other bolt to confirm uniformity. Perform a final re-tightening to 100 percent of target torque 24-hours after 100 percent tightening at end of initial bolting sequence. Verify every bolt and stud-bolt has a minimum of three full threads exposed beyond nut following final tightening.
9. Fill out "Flange Bolting Worksheet", located at end of this Section, for all flanged joints on project. Identify joints in accordance with designation included in approved laying schedule. Submit form to Engineer at end of each workday, after 24-hour re-tightening sequence, for filing in project records.

Y. Installation of Stainless Steel Tube:

1. Install tubing using compression fittings and adapters or by welding.

   a) Tubing to be Used with Compression Fittings: Bright annealed and electro-polished as specified above and protected from scratches and deformation during shipping, storage on site and assembly.

2. Minimize use of fittings by tube bending. Perform tube bending using manual or mechanized dies designed for use with annealed stainless steel tube.
3. Cut stainless steel tube to length using cutter-wheel type tube cutters. Debur cut tube ends prior to swaging or welding. For all edge tool components used for installation of stainless steel tube use only new or dedicated for use with stainless steel equipment.

Z. Installation of Compression Tube Fittings:

1. Install compression fittings for annealed stainless steel tubing in accordance with manufacturer's instructions. Remove all markings applied to tube and fittings during assembly by solvent cleaning after installation. General installation requirements below are based upon use of Swagelok tubing and serve as minimum requirement. Adhere to manufacturer's instructions during installation. Do not mix nuts and ferrules from different tube fitting manufacturers.
2. Swage compression fittings 1-inch diameter and smaller manually. Hand-tighten nut, and then turn another 1 and 1/4 turns by a manual wrench to engage ferrule to tube wall. Compression ferrules for fittings larger than 1 inch diameter hydraulically swaged to

tube by a hydraulic swaging tool in accordance with manufacturer's instructions. Apply manufacturer's standard lubricant to body threads and back of ferrule prior to swaging. Verify Engineer inspects fittings after initial assembly for proper pull-up with gap inspection gauges.

3. Install adapter fittings in accordance with requirements below for type of connecting joint, including SAE straight thread O-ring joints, standard tapered threaded joints, SAE hydraulic flanges and welded joints.
4. Do not use thread sealant with SAE straight O-ring threaded joints.
5. Do not use standard tapered threaded joints adapters or liquid thread sealants used for oil operated hydraulic fluid lines. In addition, do not use NPTF Dryseal threads for any adapters for use with any service.
6. Disassemble welded adapters prior to tack welding and re-lubricate prior to hydraulic swaging after welding. Remove all adjacent O-rings and other heat sensitive materials prior to welding and/or protected with heat sinks during welding.
7. Avoid disassembly of compression fittings after initial assembly as much as possible. If a compression joint must be disassembled, mark nut and fitting nut flats to use as a guide for proper pull-up after reassembly.

3.4 TOLERANCES

A. Piping Laying Tolerance: 5/8 inch.

3.5 FIELD QUALITY CONTROL

A. After installation, clean completed lines with Oakite deoxidizer or similar deoxidizer as recommended by manufacturer to remove all foreign matter, construction stains or shop markings. Rinse cleaned lines with steam or hot water. Verify all cleaning chemicals are NSF 60 approved.

B. Inspection:

1. Inspect for damage to piping or tubing that may be detrimental as determined by Engineer.
2. Repair damaged piping, or provide new, undamaged pipe.
3. After installation, inspect for required supports and anchoring, interferences, and damage to pipe, tube, or fittings.

C. Pressure Testing:

1. Test Pressure: Not less than 200 psig or 50 psi in excess of maximum static pressure, whichever is greater.
2. Conduct hydrostatic test for minimum two hours.
3. Filling:

a) Fill section to be tested with water slowly and expel air from piping at high points.
b) Install corporation cocks at high points.
c) Close air vents and corporation cocks after air is expelled.
d) Raise pressure to specified test pressure.

4. Observe joints, fittings, and valves under test.
5. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.
6. Leakage:

    a) Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate.
    b) Maintain pressure within plus or minus 5 psi of test pressure.
    c) Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.
    d) Compute maximum allowable leakage by following formula:
    e) L = SD x sqrt(P)/C:

        1) L = testing allowance, in gallons per hour.
        2) S = length of pipe tested, in feet.
        3) D = nominal diameter of pipe, in inches.
        4) P = average test pressure during hydrostatic test, in psig.
        5) C = 148,000.

    f) When pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.
    g) If test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.
    h) Correct visible leaks regardless of quantity of leakage.

D. Replace pipe or fittings with mortar cracks wider than 1/16 inch.

3.6 ADJUSTING

A. Adjust hardware and moving parts to function smoothly, and lubricate as recommended by manufacturer.

3.7 PROTECTION

A. Remove and replace piping or tubing that are wet, moisture damaged, or mold damaged.

3.8 CLEANING

A. Keep pipe interior clean as installation progresses.

B. After installation, clean pipe interior of soil, grit, and other debris.

END OF SECTION 400523

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SECTION 400551 - COMMON REQUIREMENTS FOR PROCESS VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Common requirements for valves.
2. Common requirements for valve actuators.

B. Related Requirements:

1. Section 400507 “Hangers and Supports for Process Piping” for product and execution requirements for valve supports specified by this Section.
2. Section 400557 “Actuators for Process Valves and Gates.”
3. Section 400561 “Gate Valves.”
4. Section 400564 “Butterfly Valves.”

1.3 ACTION SUBMITTALS

A. Valve Schedule:

1. Submit valve schedule populated with all Division 40 process valves specified for this project. Include all information shown on the Sample Valve Schedule included in this project.
2. Approval of valve schedule submittal to precede all individual valve submittals. All subsequent individual valve submittals to include the approved valve tag number or group on the submittal cover sheet.

B. Valve Tags:

1. Materials, dimensions and thickness of tags, materials and gauge of cable and splicing hardware.
2. Color palate for Owner selection.
3. Full scale drawing of sample with lettering dimensions and scribe depth.
4. Valve tag lettering provided with Valve Schedule above.

C. Shop Drawings: Valve and actuator model number and size, valve parts list, materials of each part including material standard designation (ASTM or other), position indicators, limit switches, actuator mounting.

D. Provide certified hydrostatic test data, per manufacturer's standard procedure or MSS-SP-61 for all valves.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Instructions: Submit installation and operation instructions for each component including valve, actuator, gearbox, and any included instrumentation.

B. Source Quality-Control Submittals: Indicate results of integrators facility tests and manufacturers factory tests and inspections.

C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

D. Manufacturer Certification of Installation: Certify that equipment has been installed according to manufacturer instructions.

E. Qualifications Statement:

1. Submit qualifications for manufacturer and licensed professional.

1.5 QUALITY ASSURANCE

A. Maintain clearances as indicated on Drawings and Shop Drawings.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Mate valves to actuators at manufacturer’s or integrator’s facility. Fully test assembled product and certify ready for installation prior to shipment to the job site.

1. Only in special cases for extremely large assemblies where installation requires disassembly, may actuators be mounted to valves in the field.

D. Materials in Contact with Potable or Raw Water: Certified to NSF 61 and NSF 372.

E. Furnish affidavit of compliance with testing and manufacturing standards referred in this specification and the individual valve specifications.

F.

F. Obtain Manufacturer’s Certification of Proper Installation for Specified valves and valve assemblies.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing valves and actuators with minimum ten years' documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Deliver factory mated power actuated valves on rigid wooden skids, fully braced and strapped to prevent damage to valve, actuator or coupling system.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
3. Provide additional protection according to manufacturer instructions.

1.8 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to materials ordering or any fabrication.
2. Indicate field measurements on Shop Drawings.

1.9 WARRANTY

A. Furnish one-year manufacturer's warranty from time of substantial completion for valves and actuators.

PART 2 - PRODUCTS

2.1 VALVES

A. Description: Valves, operator, actuator, handwheel, chainwheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and other accessories as required.

B. Provide all valves of the same type by same manufacturer.

C. Valve Ends: Compatible with adjacent piping system and as indicated on valve schedule.

D. Operation:

1. Close by turning clockwise. Coordinate with Owner prior to shipment.
2. Cast directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.

E. Valve Marking and Labeling:

1. Marking: Comply with MSS SP-25.
2. Labeling (valve tags):

a. Fiberglass reinforced plastic, ASTM D709, 70 mil thick, 2 1/2-inch diameter or 2 1/2-inch by 1 1/4-inch.
b. Lettering 1/16-inch thick of silk screening or other permanent embedment of subsurface printed graphics, permanently sealed.
c. Colors of lettering and backing as selected by Owner.
d. Two, 1/4-inch clear opening Type 316 stainless steel grommets at each end, center of hole 3/8-inch from tag edge.
e. 3/32-inch Type 316 SS cable and splice hardware.

F. Valve Construction: As Specified in Valve Sections.

G. Do not use Van Stone flanges with pinch valves, industrial butterfly valves; elastomer bellows style expansion joints or other piping system components having an elastomer liner (rubber seat) that is used as a gasket.

2.2 VALVE ACTUATORS

A. Provide mechanical position indicators for power actuated and gearbox actuated valves.

B. Gear and Power actuators as specified in Section 400557 “Actuators for Process Valves and Gates”.

2.3 FINISHES

A. Valve Coating: Comply with AWWA C550.

B. Factory finishes are included in individual valve sections.

C. Exposed Valves: As specified.

D. Stainless Body Valves: Do not coat.

E. Do not coat flange faces of valves unless otherwise specified.

2.4 SOURCE QUALITY CONTROL

A. Testing: Test valves according to manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that piping system is ready for valve installation.

B. Fully examine valves for debris, damage and interior finish blemishes prior to installation. Do not install valves with soiled interior or any visible damage to seats, discs or interior finish.

C. Identify any piping, plant or equipment clearance issues prior to installation, bring to Engineer's attention via job meetings, submittal process or request for information process.

3.2 INSTALLATION

A. Install valves, actuators, extensions, valve boxes, and accessories according to manufacturer instructions.

B. Inspect valve interiors before line closure for the presence of debris. At the option of the Engineer, internal inspection of valve and appurtenances may be required any time that the likelihood of debris is a possibility. Clean connecting pipes prior to installation, testing, disinfection and final acceptance.

C. Disinfect valves installed in potable water lines with approved pipeline disinfection process.

D. Rigidly support valves to avoid stresses on piping.

E. Coat studs, bolts and nuts with anti-seizing lubricant.

F. Dielectric Fittings: Provide between dissimilar metals.

G. Clean field welds of slag and splatter to provide a smooth surface.

H. Mate, adjust and fully test gearboxes, electric, hydraulic and pneumatic actuators to valves at manufacturer's or integrator's facility.

1. Only in special cases for extremely large assemblies where installation requires disassembly may actuators be mounted to the valves in the field. These circumstances require preinstallation meetings.

I. Do not install stems vertically downward.

J. Unless otherwise indicated on Drawings:

1. Install Gate, Globe, Ball valves with stem vertical in the 12 o'clock position.
2. Install Plug valves with stem horizontal and plug opening to the top of the body unless position will not allow proper actuator access, in which case stem may be vertical in the 12 o'clock position.
3. Install Butterfly valves 12 inch and smaller with stem horizontal or vertical in the 12 o'clock position.

4. Install Butterfly valves 14 inch and larger with the stem horizontal unless position will not allow proper actuator access, in which case stem may be vertical in the 12 o'clock position.
5. Install Control valves in horizontal pipelines with top works vertically upward.

K. Install all brackets, extension rods, guides, the various types of operators and appurtenances as indicated. Before properly setting these items, check all drawings and figures which have a direct bearing on their location.

L. Inspect all materials for defects in construction and materials. Clean debris and foreign material out of openings, etc. Verify valve flange covers remain in place until connected piping is in place. Verify operability of all operating mechanisms for proper functioning. Check all nuts and bolts for tightness. Repaired or replace valves and other equipment which do not operate easily or are otherwise defective.

M. Where installation is covered by a referenced standard, install and certify in accordance with that standard, except as herein modified. Also note additional requirements in other parts of this Section.

N. Unless otherwise noted, provide joints for valves and appurtenances utilizing the same procedures as specified under the applicable type connecting pipe joint. Install valves and other items as recommended by the manufacturer. Verify manufacturers' torqueing requirements for all valves.

O. Coordinate direction of flow through offset type and shaped butterfly valve discs with the mated actuator torque capacity.

P. Rotate valve operators and indicators to display toward normal operation locations. Consult with Engineer prior to installing valves with handwheels to confirm final position of handwheel.

Q. Vertically center floor boxes, valve boxes, extension stems, and low floor stands over the operating nut, with couplings as required.

1. Adjust elevation of the box top to conform to the elevation of the finished floor surface or grade at completion of the Contract.
2. Support boxes and stem guides during concrete placement to maintain vertical alignment.

R. Install brass male adapters on each side of valves in copper-piped system and solder adapters to pipe.

S. Install 1-inch gate valves with cap for drains at main shutoff valves, low points of piping, bases of vertical risers, and equipment.

T. Install valves with clearance for installation of insulation and to allow access.

U. Provide access where valves and fittings are not accessible.

V. Pipe Hangers and Supports: As specified in Section 400507 "Hangers and Supports for Process Piping".

W. Comply with Division 40 - Process Interconnections for piping materials applying to various system types.

3.3 FIELD QUALITY CONTROL

A. Valve Field Testing:

1. Test for proper alignment.
2. If specified by valve Section, field test equipment to demonstrate operation without undue noise, vibration, or overheating.
3. Functional Test:

    a. Prior to system startup, inspect valves and actuators for proper alignment, quiet operation, proper connection and satisfactory performance.
    b. After installation, open and close all manual valves in the presence of the Engineer to show the valve operates smoothly from full open to full close and without leakage.
    c. Operate pressure control and pressure relief valves in the presence of Engineer to show they perform their specified function at some time prior to placing the piping system in operation and as agreed during construction coordination meetings.

4. Field test pipelines in which the valves and appurtenances are to be installed. During these tests, adjust, remove or replace defective valve or appurtenance, or otherwise make acceptable to Engineer. Test regulating valves, strainers, or other appurtenances to demonstrate conformance with the specified operational capabilities. Correct deficiencies, replace device or otherwise made acceptable to Engineer.

END OF SECTION 400551

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SECTION 400553 - IDENTIFICATION FOR PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.

B. Related Requirements:

1. Section 400551 “Common Requirements for Process Valves” for basic materials and methods for valves.

1.3 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's catalog literature for each specified product.

B. Shop Drawings:

1. Indicate list of wording, symbols, letter size, spacing of labels, and color-coding for mechanical identification and valve chart and schedule.
2. Indicate valve tag number, location, function, and valve manufacturer's name and model number.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

B. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Tools: Furnish special crimpers and other devices required for Owner to reinstall tags.

1.7 QUALITY ASSURANCE

A. Piping Color Scheme and Lettering Size: Comply with ASME A13.1.

B. Perform Work according to Collier County standards and preferences.

C. Comply with recommended water treatment plant color coding from the latest version of Ten State Standards unless otherwise requested by Owner.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Craftmark Pipe Markers.
2. Kolbi Pipe Marker Co.
3. Pipemarker.com (Brimar Industries, Inc.)
4. Seton Identification Products.

B. Description: Laminated three-layer plastic with engraved black letters on light, contrasting background color.

2.2 TAGS

A. Plastic Tags:

1. Manufacturers:

a. Brady ID.
b. Craftmark Pipe Markers.
c. Kolbi Pipe Marker Co.
d. Marking Services, Inc.
e. R&R Identification Co.
f. Seton Identification Products.

2. Description:

a. Laminated three-layer plastic with engraved black letters on light, contrasting background color.
b. Minimum Tag Size and Configuration: 2 inches; square.
c. Provide with brass hooks suitable for attaching the tag to the valve operator.
d. Stamp or etch tags with the valve number and information on the valve schedule coded in a system provided by the Owner.

B. Metal Tags:

1. Manufacturers:

a. Brady ID.
b. Craftmark Pipe Markers.
c. Kolbi Pipe Marker Co.
d. Marking Services, Inc.
e. Pipemarker.com (Brimar Industries, Inc.).
f. R&R Identification Co.
g. Seton Identification Products.

2. Description:

a. Brass, Aluminum, or Stainless steel construction; stamped letters.
b. Minimum Tag Size and Configuration: 2 inches; diameter or square with finished edges.
c. Provide with brass hooks suitable for attaching the tag to the valve operator.
d. Stamp or etch tags with the valve number and information on the valve schedule coded in a system provided by the Owner.

C. Information Tags:

1. Manufacturers:

a. Brady ID.
b. Seton Identification Products.

2. Description:

a. Clear plastic with printed text CAUTION.
b. Minimum Tag Size: 3-1/4 by 5-5/8 inches.
c. Furnish grommet and self-locking nylon ties.

3. Tag Chart: Typewritten, letter-size list of applied tags and location, plastic laminated.

2.3 STENCILS

A. Manufacturers:

1. Kolbi Pipe Marker Co.
2. Marking Services, Inc.
3. Pipemarker.com (Brimar Industries, Inc.)
4. R&R Identification Co.
5. Seton Identification Products.

B. Description:

1. Quality: Clean-cut symbols.
2. Letters:

OUTSIDE DIAMETER OF PIPE	SIZE OF LETTERS
3/4-inch to 1-1/4-inches	1/2-inch
1-1/2-inches to 2-inches	3/4-inch
2-1/2-inches to 6-inches	1-1/2-inches
8-inches to 10-inches	2-1/2-inches
Over 10-inches	3-inches

C. Stencil Paint:

1. Description: Semigloss enamel.
2. As specified.

2.4 PIPE MARKERS

A. Plastic Pipe Markers:

1. Manufacturers:

a. Brady ID.
b. Craftmark Pipe Markers.
c. Marking Services, Inc.
d. R&R Identification Co.
e. Seton Identification Products.

2. Description:

a. Factory-fabricated, flexible, and semi-rigid plastic.
b. Preformed to fit around pipe or pipe covering.
c. Larger sizes may be of maximum sheet size, with spring fastener.
d. Letter sizes per Paragraph 2.3B.
e. Color shall be white or black depending on background color.

B. Plastic Tape Pipe Markers:

1. Manufacturers:

a. Brady ID.
b. Craftmark Pipe Markers.
c. Kolbi Pipe Marker Co.
d. Marking Services, Inc.
e. Pipemarker.com (Brimar Industries, Inc.)
f. Seton Identification Products.

2. Description:

a. Flexible, 3.5 mil vinyl film tape with pressure-sensitive adhesive backing and printed markings.
b. Letter sizes per Paragraph 2.3B.
c. Color shall be white or black depending on background color.

C. Plastic Underground Pipe Markers:

1. Manufacturers:

a. Kolbi Pipe Marker Co.
b. Marking Services, Inc.
c. Pipemarker.com (Brimar Industries, Inc.)

d. Rhino Marking and Protection System.
e. Seton Identification Products.

2. Description:

a. Brightly colored, continuously printed plastic ribbon tape.
b. Minimum Size: 6 inches wide by 4 mils thick.
c. Manufactured for direct burial service.
d. Letter sizes per Paragraph 2.3B.

2.5 CEILING TACKS

A. Manufacturers:

1. Marking Services, Inc.
2. R&R Identification Co.
3. Seton Identification Products.

B. Description:

1. Material: Steel.
2. Head:

a. Color-coded.
b. Diameter: 3/4 inch.

2.6 LABELS

A. Manufacturers:

1. Brady ID.
2. Seton Identification Products.

B. Description:

1. Material: Aluminum.
2. Minimum Size: 1.9 by 0.75 inches.
3. Adhesive backed, with printed identification.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:

1. Manufacturers:

a. Brady ID.
b. Master Lock Company, LLC.

2. Description:

a. Material: Anodized aluminum.
b. Furnish hasp with erasable label surface.
c. Minimum Size: 7-1/4 by 3 inches.

B. Valve Lockout Devices:

1. Manufacturers:

a. Brady ID.
b. Master Lock Company, LLC.

2. Description:

a. Material: Nylon or Steel.
b. Furnish device to restrict access to valve operator and to accept lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Stencil Painting: Prepare surfaces as specified.

3.2 INSTALLATION

A. According to manufacturer instructions.

B. Apply stencil painting as specified.

C. Install identifying devices after completion of coverings and painting.

D. Install plastic nameplates with corrosion-resistant mechanical fasteners or adhesive.

E. Labels:

1. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.
2. For unfinished covering, apply paint primer before applying labels.
3. Titles:

a. Locate maximum of 26 feet apart.
b. Locate directly adjacent to pipeline breaches on each side wall.
c. Locate adjacent to each side of the valve regulator, flow meter, strainer, cleanout and all pieces of equipment.
d. Identify the contents by complete name at least once in each room or space and thereafter may be labeled by generally recognized abbreviations.

F. Tags:

1. Identify valves in main and branch piping with tags.
2. Install tags using corrosion-resistant chain.
3. Number tags as indicated on drawings. Submit in writing to Engineer for any valves that does not have a tag indicated on Drawings.

G. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

H. Piping:

1. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape pipe markers, or stenciled painting.
2. Use tags on piping 3/4-inch diameter and smaller.
3. Identify service, flow direction, and pressure.
4. Install in clear view and align with axis of piping.
5. Locate identification not to exceed 20 feet on straight runs, including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

I. Ceiling Tacks:

1. Provide ceiling tacks to locate valves above T-bar-type panel ceilings.
2. Locate in corner of ceiling panel closest to equipment.

END OF SECTION 400553

SECTION 400557 - ACTUATORS FOR PROCESS VALVES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: Following types of actuators for linear, multi-turn, and quarter turn valves and gates:

1. Manual actuators.

B. Related Requirements:

1. Section 400507 “Hangers and Supports for Process Piping” for hangers, anchors, sleeves, and sealing of piping to adjacent structures.
2. Section 400551 “Common Requirements for Process Valves” for common product requirements for valves for placement by this Section.
3. Section 400561 “Gate Valves”
4. Section 400564 “Butterfly Valves”

1.3 DEFINITION

A. Where the term “valve” alone is used in this Section, it applies to both valves and gates as the corresponding text context dictates.

1.4 COORDINATION

A. Section 400551 “Common Requirements for Process Valves” for valve schedule requirements.

B. Coordinate Work of this Section with installation of valves, gates, and accessories.

1.5 ACTION SUBMITTALS

A. Product Data: Manufacturer information for actuator with model number and size indicated.

B. Shop Drawings:

1. Parts list, materials, sizes, position indicators, limit switches, control system, actuator mounting, wiring diagrams, and control system schematics with external interfaces on assembly drawings.
2. Actuator Shop Drawings with respective valve submittal.

C. Manufacturer's Certificate: Products meet or exceed specified requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturer Instructions: Special procedures and placement requirements.

B. Source Quality-Control Submittals: Results of factory tests and inspections and provide required certifications.

C. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.

D. Qualifications Statements:

1. Qualifications for manufacturer and installer.
2. Manufacturer's approval of installer.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Documentation of actual locations and types of actuators.

1.8 QUALITY ASSURANCE

A. Minimum NEMA Enclosure Classification:

1. Non-submergence Installations: NEMA 4X.
2. Submergence Installations: NEMA 6P/IP68.

B. Single Source Requirements:

1. Furnish electric motor actuators in the scope of the project by the same manufacturer. Coordinate this requirement with actuated valves and gates included in scope of vender furnished equipment.
2. Furnish actuators, floor stands, stem guides, stems, extensions, and accessories for slide gate assemblies by slide gate manufacturer.

C. Mate actuators to equipment at equipment manufacturers or integrators facility.

1. Test assembled product. Certify ready for installation prior to shipment to job site.
2. For extremely large assemblies requiring disassembly for installation, the actuator may be disassembled for shipment and remounted in the field.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
3. Provide additional protection according to manufacturer’s instructions.

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

A. Manufacturer’s Special Warranty: Submit standard written warranty against manufacturing defects for manual and electric-motor actuators.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide clockwise closed actuation unless otherwise noted on valve and gate schedule.

B. Supply chain actuators for manual valves located 7 feet or higher above finished floor.

2.2 ACCESSORIES

A. Floor Stands:

1. Materials:

a. Stand: Stainless steel.
b. Stem Bushing: Sintered bronze.
c. Position Indicator: Bronze.

2. Height to input shaft or handwheel: 36 inches.
3. Base Mounting Requirements:

a. Concrete Floor Mounting: Type 316 stainless steel anchor bolts.
b. Face of Basin or Offset Mounting: Heavily reinforced, adjustable wall bracket with required anchor hardware using Type 316 stainless steel.

4. Actuator Mounting Requirements:

a. Manual Actuator: Cast iron handwheel on top of floor stand with dual ball type thrust bearings, grease fitting on bearing bowl, hardened machined alloy bronze lift nut (for rising stem). Where manual effort is greater than 40 lb rim pull with 2 foot diameter wheel, provide geared actuator with a handwheel or crank.

1) Handwheel casting to include the word “OPEN” and an arrow indicating the direction of operation.

b. Gearbox or Direct Powered Actuator: Through bolt holes matched to actuator or gearbox bolting pattern.

5. Non-rising stem position indicator: Mechanical indicator connected to and driven by stem extension and cast position marks on floor stand with the word “OPEN” cast at the top of the travel, and a field mounted aluminum “CLOSED” tag supplied with drive rivets, installed based on number of valve turns.
6. Rising Stem Position Indicator: Permanent markings on transparent stem covers.

B. Stem Covers: Fracture-resistant clear polycarbonate stem covers for rising stems. Closed top with adhesive type position indicator markings.

C. Extension Stems and Stem Guides:

1. Extension stems and couplings to actuate recessed, buried, below slab valves and gates via operating nut or floor stand mounted actuator.
2. Stem Extensions and Stem Couplings: Alloy steel, hardware of Type 316 stainless steel unless specified otherwise in the respective slide gate specification.
3. Stem and Stem Couplings: Rated for five times the maximum input torque capacity of the actuator.
4. Adjustable, Cast Iron Wall Bracket Type Stem Guides: Include two-piece bronze bushing.
5. Spacing: 10 feet spacing or at spacing calculated by manufacturer to prevent buckling with a safety factor of 2 based on design thrust, shaft material and shaft size.

D. Torque Tubes:

1. Supply where shown on Drawings or Valve and Gate Schedule.
2. Supported by/mated to valve bonnet/yoke.
3. Sized by supplier for the required actuator torque.
4. Drilled specifically for valve and actuator bolt pattern.
5. Internal extension keyed or shaped specifically to mate to valve shaft and fabricated of Type 316 stainless steel.
6. Internal extension designed for axial adjustment for mating purposes.

2.3 MANUAL ACTUATORS

A. Operating Nuts:

1. 2 inch cast iron AWWA design.

    a. Painted Carbon Steel Tee Handle Operator: 2-inch AWWA nut socket end extension length for nut actuated valves where nuts are recessed in valve boxes.
    b. Tee Extension Length: Determine based on nut height as shown on Drawings with handle height approximately 3 feet above operating surface.

2. Operating Nuts Recessed on Concrete: Cast iron floor box with cover and tee handle operator with 2 inch AWWA nut socket end.
3. Nut Operated Non-Rising Stem Buried Valves: Cast iron bonnet skirts, extension pipes valve box and cover. Stem extensions with AWWA nut end to elevation shown on the Drawings or scheduled.
4. Two tee handles for every ten buried or encased non-rising stem application with 2 inch AWWA operating nut.

B. Gear-Assisted Manual Valve Actuators:

1. Provide:

    a. For manually actuated valves and gates larger than 8 inch nominal diameter and for ball and plug valves 6 inch and larger.
    b. With power actuators where torque requirements dictate.

2. Comply with AWWA C504.
3. Handwheel Diameter: 8 inches.
4. Maximum Handwheel Pull: 40 lbs. maximum.
5. Housings: Cast or ductile iron.
6. Worm or helical gear type.
7. Gears: Hardened steel, machine cut and mated.
8. Bearings: Permanently lubricated bronze.
9. Input and Output Shafts: Sealed with greased, waterproof machine shaft seals.
10. Filled with waterproof grease and designed for submerged service where scheduled.
11. Handwheel: Removable.

    a. Diameter: 8 inch up to 12 inch valve size.
    b. Diameter: 12 inch diameter up to 16 inch valve size.

c. Diameter: 18 inch diameter for larger than 16 inch valve size.
d. Maximum Diameter: 24 inch diameter.

12. Include mechanical top mounted valve position indication, opening direction, and adjustable stops.

2.4 SOURCE QUALITY CONTROL

A. Factory Testing:

1. Shop inspect and test completed assemblies.
2. Factory performance test each actuator and supply individual test certificates. Submit test certificates prior to shipment of valve actuators.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field dimensions are as indicated on Shop Drawings.

3.2 INSTALLATION

A. Install products plumb, square, and true according to manufacturer's published installation instructions.

B. Securely mount actuators using brackets or hardware specifically designed for attachment to valves/gates.

3.3 FIELD QUALITY CONTROL

A. After installation, inspect for proper supports and interferences according to manufacturer's requirements and Section 400551 "Common Requirements for Process Valves".

END OF SECTION 400557

SECTION 400561 - GATE VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Solid wedge, resilient-seated gate valves.
2. General duty gate valves smaller than 3 inches.

B. Related Requirements:

1. Section 400551 “Common Requirements for Process Valves” for basic materials and methods related to valves commonly used for process systems.
2. Section 400557 “Actuators for Process Valves and Gates”.

1.3 DEFINITIONS

A. Outside screw and yoke (os&y) valve: A valve in which the operating screw is driven by a threaded nut that is built into the handle.

1.4 SUBMITTALS

A. As specified in Section 400551 “Common Requirements for Process Valves” for submittal requirements for compliance with this section.

1.5 QUALITY ASSURANCE

A. Test valves in accordance with AWWA C500, C509, C515.

B. Provide Installation Inspection and Operator Training per Section 400551.

C. Provide testing and inspection certificates.

PART 2 - PRODUCTS

2.1 SOLID WEDGE, RESILIENT-SEATED GATE VALVES – For gate valves 4” and larger.

A. Manufacturers:

1. M&H Valve; J&S Valve.
2. American R/D Valve.
3. Stockham Valve, Walworth.

B. Description:

1. Raw water service.
2. As specified in Section 400551 “Common Requirements for Process Valves”.
3. Comply with AWWA C509.
4. Minimum Working Pressure: 150 psig at 104 degrees F.
5. Maximum Process Fluid Temperature: 80 degrees F.
6. End Connections: Mechanical joint.
7. Gear Actuators for Manual Valves: Comply with AWWA C509.
8. Body: No recesses in valve body.

C. Operation:

1. As specified in Section 400551 “Common Requirements for Process Valves”.
2. Stem: Nonrising.
3. 2 inch AWWA nut.
4. Furnish gear operators for valves 8 inches and larger, and chainwheel operators for valves mounted over 7 feet above operating floor.

D. Materials:

1. Wedge: Resilient ASTM A126, cast iron, fully encapsulated with molded rubber.
2. Body and Disc: ASTM A126, cast iron or ASTM A536, ductile iron.
3. Stem, Stem Nuts, Glands, and Bushings: Type 316 stainless steel.
4. Connecting Hardware: Type 316 stainless steel.

E. Finishes:

1. As specified in Section 400551 “Common Requirements for Process Valves”.
2. Body, Internal and External, Including Bonnet: AWWA C550, Epoxy, 4-mil minimum thickness.
3. Gate: ASTM D2000 EPDM encapsulated, ASTM D429 Method B Bonded and vulcanized.

2.2 GENERAL-DUTY GATE VALVES - SMALLER THAN 3 INCHES

A. Manufacturers:

1. Mueller Co; J&S Valve.
2. M&H/Clow Valve.

3. American Flow Control.
4. American R/D Valve.
5. Crane; a Crane Co. brand.
6. NIBCO INC.

B. 2 Inches and Smaller:

1. Wastewater service.
2. Comply with MSS SP-80, Class 150.
3. Maximum Process Fluid Temperature: 80 degrees F.
4. Body and Trim: Bronze, ASTM B62.
5. Gates: Bronze or Type 304 stainless steel.
6. Bonnet: Threaded or Union.
7. Operation: Lockshield stem.
8. Inside screw with backseating stem.
9. Wedge Disc:

    a. Type: Solid or Split.
    b. Bronze, ASTM B62.

10. End Connections: threaded.

C. 2-1/2 Inches to 3 Inches:

1. Wastewater service.
2. Comply with MSS SP-70, Class 125.
3. Maximum Fluid Temperature: 80 degrees F.
4. Stem: Nonrising.
5. Body: bronze.
6. Gates: Bronze or Type 304 stainless steel.
7. Trim: Bronze, ASTM B62.
8. Bonnet: Bolted.
9. Handwheel, OS&Y.
10. Wedge Disc: Solid, with bronze seat rings.
11. End Connections:

    a. Type: Flanged.
    b. Comply with ASME B16.5.

D. Finishes:

1. As specified in Section 400551 “Common Requirements for Process Valves”.
2. Interior ferrous surfaces: AWWA C550, Epoxy, 4-mil minimum thickness.

2.3 SOURCE QUALITY CONTROL

A. As specified in Section 400551 “Common Requirements for Process Valves”.

B. Testing: Test gate valves according to AWWA C509.

C. UL and FM approved.

PART 3 - EXECUTION

3.1 INSTALLATION

A. According to AWWA C509.

END OF SECTION 400561

SECTION 400564 - BUTTERFLY VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Double offset high performance butterfly valves.

B. Related Requirements:

1. Section 400551 “Common Requirements for Process Valves” for basic materials and methods related to valves commonly used for process systems.
2. Section 400557 “Actuators for Process Valves and Gates”.

C. Van Stone flanges shall not be used with pinch valves, industrial butterfly valves; elastomer bellows style expansion joints or other piping system components having an elastomer liner (rubber seat) that is used as a gasket.

1.3 SUBMITTALS

A. As specified in Section 400551 “Common Requirements for Process Valves” for submittal requirements for compliance with this Section.

1.4 QUALITY ASSURANCE

A. Test valves in accordance with AWWA C504, API 598, MSS SP61 as applicable for types listed herein.

B. Provide Installation Inspection and Operator Training per Section 400551 “Common Requirements for Process Valves”.

C. Provide testing and inspection certificates.

PART 2 - PRODUCTS

2.1 HIGH PERFORMANCE BUTTERFLY VALVES- Tag Type BFV

A. Manufacturers:

1. Cameron WKM DynaCentric.
2. Powell 1572/3072.
3. Jamesbury Model 815L.
4. Crane Flowseal Soft Seat.
5. Tyco K-Lok 360/362 and 370/372.

B. Description:

1. Comply with MSS SP 25, 44, 55, 61, 67, 68, API 609, ANSI B16.5, 16.34, 16.47, ISO 5211.
2. Minimum Working Pressure:

    a. Fluid Service (Tag Type BFV) 150 psig.

3. Maximum Process Fluid Temperature:

    a. Fluid service (Tag Type BFV) 104 degrees F.

4. Body Style: Lugged.
5. Disc: eccentric, single or double offset design.
6. Shaft: single or two-piece design, taper pinned. Capable for mechanical separation from disc without damage to shaft or disc.
7. Bearings: Self-lubricating.
8. Shaft Seals/Packing:

    a. Multiple square rings.
    b. Multiple V-rings.
    c. Mechanically retained.
    d. Blow out proof retainer.

9. Seats:

    a. Mechanically retained.
    b. Energized.
    c. Located in body.
    d. Resilient and replaceable. Field replaceable.

C. Actuator:

1. Handwheel.
2. Gear Actuators for Manual Valves: Comply with AWWA C504.

D. Materials:

1. Body: ASTM A182 Type F316 SS (saline service).
2. Stem: Nitronic 50 (saline service).
3. Disc: Alloy 20 or Alloy 2205 case hardened (saline service).
4. Taper pins: Nitronic 50 (saline service).
5. Seat elastomer: Reinforced PTFE with silicone rubber energizer (saline service).
6. Seat retainer: Titanium (saline service).
7. Shaft Bearings: glass-backed PTFE (saline service).
8. Thrust Bearings: Alloy 20 (saline service).
9. Shaft Seals: Teflon Chevron packing (saline service).
10. Seal Retaining rings and thrust washers: Inconel (saline service).

E. Finishes:

1. As specified in Section 400551 “Common Requirements for Process Valves”.
2. Manufacturers standard fusion bonded epoxy.
3. Manufacturers polyester powder coat.
4. No coatings for stainless steel body valves.

F. NSF 61 compliant for raw water service valves.

2.2 SOURCE QUALITY CONTROL

A. Testing: Test butterfly valves according to AWWA C504.

B. Submit affidavit of compliance stating that the valves have been manufactured and tested in accordance with AWWA C504 and specifically list all exceptions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. As specified in Section 400551 “Common Requirements for Process Valves” for submittal requirements for compliance with this Section.

3.2 INSTALLATION

A. As specified in Section 400551 “Common Requirements for Process Valves”.

B. According to Manufacturer’s Instructions.

C. Van Stone flanges shall not be used with industrial butterfly valves, or other piping system components having an elastomer liner that is used as a gasket.

END OF SECTION 400564

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SECTION 400565.35 – GLOBE BODY SILENT CHECK VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: Globe body silent check valves, 2.5 through 42 inches in size.

B. Related Requirements:

1. Section 400551 “Common Requirements for Process Valves” for basic materials and methods related to valves commonly used for process systems.

1.3 ACTION SUBMITTALS

A. Product Data: Submit catalog information, indicating materials of construction and compliance with indicated standards.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Source Quality-Control Submittals: Indicate results of factory tests and provide required certifications.

B. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

C. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record the actual locations of piping, valves and other appurtenances, connections, and centerline elevations.

1.6 QUALITY ASSURANCE

A. Comply with AWWA C518.

B. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.

C. Provide Installation Inspection and Operator Training Per Section 400551 “Common Work Requirements for Process Valves.”

D. Provide testing and inspection certificates.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum five years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Protect valves and appurtenances by storing off ground.
3. Cover flange faces with 3/4-inch plywood blinds.
4. Provide additional protection according to manufacturer’s instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

A. Furnish two-year manufacturer's warranty for globe body silent check valves.

PART 2 - PRODUCTS

2.1 GLOBE BODY SILENT CHECK VALVES – Tag Type CV

A. Manufacturers:

1. Bermad, Model 80N.
2. Substitutions: Not permitted.

B. Description:

1. Clean Water Service:

a. Type: Globe body, double guided, spring-loaded, poppet check valves.
b. Style: Flanged.
c. Body: Type 316 stainless steel.
d. Cover: Type 316 stainless steel.
e. Disk: Concave Type CF8M stainless steel.
f. Seats: Buna-N or EPDM.
g. Disc Pin: Type 316 stainless steel.
h. Spring: Type 316 stainless steel.

C. Working Pressure Rating:

1. Valves 2.5 through 12 Inches: 150 psig at 150 degrees F.

D. Finishes: As specified in Section 400551 “Common Requirements for Process Valves.”

2.2 SOURCE QUALITY CONTROL

A. Testing:

1. Hydrostatically test check valves at twice rated pressure according to AWWA C518.
2. Permitted Leakage at Indicated Working Pressure: None.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Inspect existing flanges for nonstandard bolt-hole configurations or design and verify that new valve and flange mate properly.

3.2 PREPARATION

A. Thoroughly clean valves before installation.

B. Surface Preparation:

1. Solvent clean surfaces that are not shop primed.
2. Clean surfaces to remove loose rust, mill scale, and other foreign substances by commercial sand blasting; SSPC SP 6.

3.3 INSTALLATION

A. According to AWWA C518 and manufacturer instructions.

B. Dielectric Fittings: Provide between dissimilar metals.

3.4 FIELD QUALITY CONTROL

A. Section 400551 “Common Requirements for Process Valves.”

B. Inspection:

1. Inspect for damage to valve lining or coating and for other defects that may be detrimental as determined by Engineer.
2. Repair damaged valve or provide new, undamaged valve.
3. After installation, inspect for proper supports and interferences.

C. Pressure test valves with piping.

3.5 CLEANING

A. Keep valve interior clean as installation progresses.

END OF SECTION 400565.35

SECTION 400578.19 - COMBINATION AIR VALVES FOR WATER SERVICE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: Combination air valves for water treatment facilities.

B. Related Requirements:

1. Section 400507 “Hangers and Supports for Process Piping” for anchors and supports.
2. Section 400551 “Common Requirements for Process Valves” for typical product and installation requirements for valves specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: Submit manufacturer catalog information.

B. Shop Drawings: Indicate materials, dimensions, weights, and end connections in assembly drawings.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Instructions: Submit special procedures and setting dimensions.

B. Source Quality-Control Submittals: Indicate results of factory tests and inspections and provide required certifications.

C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

D. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.

E. Qualifications Statements:

1. Submit qualifications for manufacturer and installer.
2. Submit manufacturer's approval of installer.
3. American Iron and Steel (AIS): Submit certification indicating compliance with AIS requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of combination air valves.

1.6 QUALITY ASSURANCE

A. Materials in Contact with Raw Water: Conforms to NSF 61 and NSF 372.

B. Manufacturer Quality Management System: Certified to ISO 9001.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
3. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

A. Furnish two-year manufacturer's warranty for combination air valves.

PART 2 - PRODUCTS

2.1 COMBINATION AIR VALVES FOR WATER SERVICE – Tag Type CAV

A. Manufacturers:

1. 2-inch Combination Air Valve Upstream of Check Valve: ARI Model D-040PT02.
2. 2-inch Combination Air Valve with non-slam Downstream of Check Valve: ARI Model D-060CHFNST02.

B. Description:

1. Type:

a. Fully automatic, float operated.
b. Body: Single.

2. Comply with AWWA C512.
3. Size: As indicated on Drawings.
4. Suitable for potable or raw water service.
5. Minimum Pressure Rating: 150 psig.
6. Maximum Operating Temperature: Water to 104 degrees F.
7. Combination air valves shall perform the functions of an air/vacuum valve (exhaust large quantities of air on start-up, admits air on shut-down) and air release valves (release air continuously during operation) to maintain system efficiency and prevent pipeline surges.

C. Materials:

1. Body and Cover: Reinforced nylon or Type 316 stainless steel.
2. Float: Type 316 Stainless steel.
3. Seats: Stainless steel.
4. Seals: Buna-N/Nitrile.
5. Trim: Stainless steel.
6. Hardware: Stainless steel.

D. End Connections:

1. Size 4 Inches and smaller: Threaded, NPT.
2. Size Larger than 4 Inches: Flanged, ASME B16.5.

E. Accessories:

1. Backwash accessories, including inlet shutoff valve, blowoff valve, rubber supply hose, and quick-disconnect couplings.
2. Throttling device on outlet for combination air valves downstream of the check valves. Throttled to 5-percent open.

2.2 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Inspect existing flanges for non-standard bolt hole configurations or design and verify that new pipe and flanges mate properly.

3.2 PREPARATION

A. Thoroughly clean end connections before installation.

B. Close pipe and equipment openings with caps or plugs during installation.

C. Surface Preparation: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

A. According to manufacturer instructions.

B. Provide access for operation, removal, and maintenance, and to avoid discharge to occupied areas or other equipment.

C. Vent the valve properly and pipe outlet to nearest drain or as directed by Engineer.

3.4 FIELD QUALITY CONTROL

A. Inspect for interferences and proper supports.

B. Testing:

1. As specified in Section 400551 “Common Requirements for Process Valves”.
2. Demonstrate operation without undue noise or vibration.

C. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.
3. Repair damaged coatings with material equal to original coating.

D. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.5 CLEANING

A. Keep interior of air release valves clean as installation progresses.

3.6 DEMONSTRATION

A. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 400578.19

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SECTION 406100 - PROCESS CONTROL AND ENTERPRISE MANAGEMENT SYSTEMS GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes procurement of the services of a Process Control System Supplier (PCSS) to provide all materials, equipment, labor, and services required to achieve a fully integrated and operational system as specified herein, in “Related Requirements” under this Article, and in related drawings, except for those services and materials specifically noted.

B. Under this Contract, PCSS will also serve as Applications Engineer System Supplier (AESS).

1. The Owner shall be providing configuration and development of HMI screens for this project.

C. Include auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with existing equipment or equipment provided by others under other Sections of these specifications, whether indicated on Drawings or not.

D. Equipment and installations shall satisfy applicable Federal, State, and local codes. Refer to Electrical Drawings for area classifications for Class and Division ratings.

E. Use the equipment, instrument, and loop numbering scheme indicated on the Drawings and in the specifications in the development of the submittals. Do not deviate from or modify the numbering scheme.

F. Related Requirements:

1. Section 406866 “Configuration of Controller Software.”
2. Section 407000 “Instrumentation for Process Systems.”
3. Section 4071XX “Sections for flow measurement.”
4. Section 4073XX “Sections for pressure, strain, and force measurement.”

G. The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

1.3 DEFINITIONS

A. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve fully integrated and operational control system.

B. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

C. Maintenance of Plant Operations (MOPO): A construction plan which prevents or limits process disruptions during construction.

D. Leadership in Energy and Environmental Design (LEED): A green building certification indicating that a building was designed and constructed to be environmentally responsible and use resources efficiently.

E. Section 4062XX “Sections for Computer System Hardware”: The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

1.4 PREINSTALLATION MEETINGS

A. Conduct a project kickoff coordination meeting within two weeks after submitting the Project Plan. The purpose of the meeting is to discuss the PCSS's Project Plan, to summarize the PCSS's understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate hardware and software related issues; and request any additional information required from the Owner. The meeting will last up to 4 hours.

B. Conduct a submittal review coordination meeting after the Hardware, Panel Drawing, and Loop Drawing Submittal package has been reviewed by the Engineer and returned to the PCSS. The purpose of this meeting is to review comments made on the submittal package; to refine scheduled deadline dates; coordinate equipment installation activities; and provide a forum for any further required coordination between the PCSS and AESS. The meeting will last up to 4 hours.

C. Attendance at MOPO workshop.

D. Bi-Weekly on-site or conference call coordination meetings with Engineer, Contractor, Vendors, and AESS as required prior to any field start-up or activity testing begins.

E. Schedule mandatory coordination meetings. Hold meetings at Owner's designated location and include attendance by Owner, Engineer, Contractor, PCSS's Project Engineer, and AESS Project Engineer, if applicable. Other Division 40 specifications may require additional meetings. Prepare and distribute an agenda for this meeting a minimum of one week before the scheduled meeting date. Schedule meeting for a minimum of one week before requested meeting date.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, mountings, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of control equipment, control panels, and instrumentation as specified herein.
4. Include diagrams for power, signal, and control wiring.

C. Qualifications Submittal:

1. For non-listed PCSS', submit, within 30 calendar days after Notice to Proceed, detailed information on staff and organization to indicate compliance with the Quality Assurance requirements of this Section. Qualifications submittal is required to be submitted and approved before any further submittals will be accepted. Failure to meet the minimum requirements is grounds for rejection as a PCSS. Qualifications Submittal to contain the following:

    a. Copies of ISA CCST Level 1 certificates for all field technicians or resumes demonstrating field experience.
    b. Notarized statement from the firm's financial institution demonstrating ability for the firm to meet the obligations necessary for the performance of the work.
    c. Copy of UL-508 certificate for panel fabrication facilities.
    d. Project references for water or wastewater projects as defined in the "Quality Assurance" paragraphs.
    e. Documentation to demonstrate the ability to complete this project including resumes of key staff, financial capacities, details on engineering, design, fabrication, and field service capacity, and location of staff responsible for responding to the site within four hours to resolve startup issues.

D. Project Plan, Deviation List, and Schedule Submittal:

1. Submit, within 45 calendar days after Notice to Proceed, a Project plan. Submit for approval the Project Plan before further submittals are accepted. The Project Plan to contain the following:

    a. Overview of the proposed control system describing the understanding of the project work, a preliminary system architecture drawing, interfaces to other systems, schedule, startup, and coordination. Include a general discussion of startup, replacement of existing equipment with new, switchover (Maintaining

Plant Operations during system transition), approach to testing and training, and other tasks as required by these specifications.

b. Preliminary list of PLC hardware, including version numbers, solely to determine compliance with the requirements of the Contract Documents prior to beginning development of system programming. The review and approval of software and hardware systems as part of this Project Plan stage does not relieve the PCSS of meeting all the functional and performance requirements of the system as specified herein. Substitution of manufacturer or model of these systems after the submittal is approved is not allowed without Engineer's approval.

c. Project personnel and organization including the PCSS project manager, project engineer, and lead project technicians. Include resumes of each of these individuals and specify in writing their commitment to this project. These do not need to be submitted again if already submitted in the Qualification submittal.

d. Sample formats of the shop drawings to be submitted and in conformance with the requirements of the Specifications. At a minimum include samples of panel fabrication drawings, control system architecture and I/O wiring diagrams.

2. Define Exceptions to Specifications or Drawings in a Deviation List consisting of a paragraph-by-paragraph review of the Specifications indicating acceptance or any proposed deviations, the reason for exception, the exact nature of the exception and the proposed substitution so that an evaluation may be made by Engineer. Specifically, state if no exceptions are taken to Specifications or Drawings. If there is no statement by PCSS, then it is acknowledged that no exceptions are taken.

3. PCSS must coordinate their work with General Contractor's overall schedule. PCSS schedule incorporates all PCSS milestones including but not limited to the following:

   a. Schedule for all subsequent project submittals. Include the time required for Contractor's submittal preparation, Engineer's review time, and a minimum of two complete review cycles.
   b. Proposed dates for all project coordination meetings.
   c. Hardware purchasing, fabrication, and assembly (following approval of related submittals).
   d. Software purchasing and configuration (following approval of related submittals).
   e. Shipment of instrument and control system equipment.
   f. Installation of instrument and control system equipment.
   g. Testing: Schedule for all testing.
   h. Schedule for system cutover, startup, and/or going on-line for each major system. At a minimum include the schedule for each process controller and HMI server/workstation provided under this Contract.
   i. Schedule for all training including submittal and approval of O&M manuals, factory training, and site training.
   j. Listing of all major graphics and PLC programs intended to be created or modified for this project. Indicate if graphic or program is new or existing.

4. Component and Wiring Identification and Tagging Plan:

   a. Components provided by PCSS require a tag, label, or nameplate. Review specifications and provide a table indicating the tagging and labeling scheme used by the PCSS:

1) Instruments.
2) Network Rack Components.
3) Panel Hardware.

b. Provide detailed information so Engineer can review the following characteristics for each type of tag, label, or nameplate for the different types of components provided above:

1) Size or range of size of the tag, label, or nameplate.
2) Font style.
3) Material.
4) Color(s).

E. Input/Output (I/O) List Submittal:

1. Submit, within 60 days after Notice to Proceed, a complete system Input/Output (I/O) address list for equipment connected to the control system under this Contract.
2. Base I/O list on P&ID's, Drawings, the design I/O list (if included), and requirements in Specifications. Submit the I/O list in both a Microsoft Excel readable electronic file format and an 8-1/2 inch by 11-inch hard copy.
3. Reflect all active and spare I/O points on the I/O list. Add points to accommodate spare I/O's as required in the specifications.
4. Arrange the I/O list so that each control panel has a dedicated worksheet, which includes the following information:

a. TAG NUMBER(S): As indicated on Drawings, the identifier assigned to a device that performs a function in the control system. As part of this information, break out the tag loop number to allow for sorting by loop.
b. DESCRIPTION: A description of the function of the device (text that includes signal source, control function, etc.) Include the text "Spare Points" for all I/O module points that are not connected to equipment.
c. PHYSICAL LOCATION: Control Panel designation of where the I/O point is wired to.
d. PHYSICAL POINT ADDRESS: Rack, Slot, and Point (or Channel) assignment for each I/O point.
e. I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, PI - Pulse Input, or PO - Pulse Output.
f. RANGE/STATE: The range in engineering units corresponding to an analog 4-20 mA signal, or, the state at which the value of the discrete points is "1."
g. ENGINEERING UNITS: The engineering units associated with the Analog I/O.
h. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.
i. P&ID - P&ID or Drawing where the I/O point appears on. Mark as "NA" (Not Applicable) if the I/O point is derived from a specification requirement and is not on the P&IDs.
j. LOGICAL POINT ADDRESS: I/O address of each point.
k. EXISTING or NEW I/O POINT: Indicate if point is existing (E) or new (N).
l. CONDITION OF EXISTING SIGNAL: Condition of existing I/O signals to be noted as functional (F) if working properly or if not functioning (NF) with issue described.

5. Sort the I/O list in order by:

    a. Physical location.
    b. I/O Type.
    c. Loop Number.
    d. Device Tag.

6. Once I/O list is approved, PLC I/O addresses are not to be modified without approval by Engineer.
7. For I/O layout requirements, refer to Section 406343 “Programmable Logic Controllers.”

F. Field Instruments Submittal:

1. Refer to the Instruments section for submittal requirements.

G. Control System Architecture, Computer Equipment Rack, Hardware and Software Packages Submittal:

1. For each hardware and software packages component specified in the sections above, submit a cover page that lists date, specification number, product name, manufacturer, model number, location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001 (updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
2. Complete system architecture drawing(s) showing in schematic form the interconnections between major hardware components including, control panels, computers, networking equipment, control panels with PLC systems and I/O modules, local operator interfaces, process equipment vendor panels with PLCs, and networked peripherals such as power monitors, security cameras, etc. PCSS is required to provide unique network architecture drawings for the following networks:

    a. SCADA.
    b. Instrumentation.
    c. Electrical.

3. Develop the system architecture drawings in accordance with the following information and guidelines:

    a. Show power connections to each piece of equipment or grouping of equipment with voltage and power sources noted such as 120VAC UPS battery, 24VDC battery, or 120VAC from LP (lighting panel). Indicate specific UPS number or circuit number whenever possible.
    b. All communication cable types should be uniquely identified with a specific linetype and cable characteristics clearly indicated in a key or legend located on drawing(s). For example, 50/125-micron multimode mode fiber, or CAT6 Ethernet copper cabling. Any multiconductor communication cables will be clearly labeled above each individual communication with a note added to drawing that states if no quantity exists above a linetype, there is only one communication cable between devices. If a multi-conductor cable has multiple colors, legend to clearly indicate which colors are used for which networks (i.e., a multi-pair fiber optic cable used for dedicated networks such as SCADA, Electrical, Security, HVAC, etc.)

c. Communication cables shall be assigned a unique cable identification label and shown in either a table or above the communication line.
d. Identify network protocols for each communication path or for system indicated in a key or legend as appropriate. Examples are Allen-Bradley EtherNet/IP, Modbus TCP/IP, or DNP3.
e. Indicate which port or connection number the communication cable is terminating at any device that has multiple ports or connection points. For multiple devices, this could be shown once in a key or legend and noted on architecture as appropriate.
f. For each PLC control panel or network communication enclosure provided by PCSS, the architecture drawing clearly references other drawings provided by the PCSS for detailed panel wiring diagrams with a note near that PLC panel or communication enclosure indicating referenced drawing numbers. A placeholder is acceptable at the time of submission if these drawings are to be submitted at a later date.
g. Use symbology and/or icons whenever possible to represent a device and differentiate between devices that are different form factors (i.e. tower computer vs. desktop computer vs. rack mounted). Vendor CAD libraries are preferred for symbols.
h. Develop a diagram that will allow a qualified technician to interconnect all equipment without having to refer to additional manuals or literature.
i. Use a minimum sheet size of 11 inch x 17 inch and use of more than one sheet is acceptable with a logical breakout between sheets (i.e., head end on one sheet and plant control system on another). Clearly identify line continuations between drawings.

H. Panel Layout Drawings and Wiring Diagrams Submittal:

1. Panel Layout Drawings: Submit Drawings for all panels specified. Draw to scale panel assembly and elevation drawings and detail all equipment in or on the panel. Use 11 inch x 17 inch sheet size for panel drawings and include the following:

a. Clearly indicate a legend sheet with all symbols used on drawings and with voltage, color, and size of each wire.
b. Interior and exterior panel elevation drawings to scale.
c. Nameplate schedule.
d. Conduit access locations.
e. Panel construction details.
f. Cabinet assembly and layout drawings to scale. Include a bill of material on the assembly drawing with each panel component clearly defined. Cross-reference the bill of material to the assembly drawing so that a non-technical person can readily identify all components of the assembly by manufacturer and model number.
g. Fabrication and painting specifications including color (or color samples).
h. Construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.
i. For every outdoor control panel, heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and environmental conditions. Include on calculations the recommended type of equipment required for both heating and cooling.

j. Submit evidence that all control panels are constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application accomplished at the fabrication location or by field inspection by UL inspectors. Costs associated with obtaining the UL seal and any inspections are be borne by Contractor.

2. Wiring Diagrams Submittal:

a. PCSS to provide complete wiring diagrams showing all wiring connections in the I/O system where direct hardwired interfaces exist between the PCSS control panels and vendor provided control panels furnished under other Divisions. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. Include drawings in Final O&M submittal. Leaving this information blank on Final Documentation drawings is not acceptable.

b. ISA Loop Wiring Diagrams: Not required.

I. Controller Program Submittal:

1. Refer to Section 406866 “Configuration of Controller Software” for specific submittal requirements.

J. Testing Plan Submittals:

1. Refer to Section 406121.20 “Process Control System Testing” for specific testing submittal requirements.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For all PCSS supplied hardware to include in operation and maintenance manuals.

1. Include the following information on the operations and maintenance manuals:

a. Table of Contents:

1) Provide Table of Contents for the entire manual with the specific contents of each volume clearly listed. Include the complete Table of Contents in each volume.

b. Instrument and Equipment Lists:

1) Develop the following lists in Microsoft Excel format:

a) An instrument list or spreadsheet for all instruments supplied including tag number, description, specification section and paragraph number, manufacturer, model number, calibrated range, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.

b) An equipment list or spreadsheet for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.

c. Equipment Operations and Maintenance Information:

1) Provide ISA-TR20.00.01-2001(updated in 2004-2006) data sheets for all field instruments. For non-field instrumentation devices, provide a cover page for each device, piece of equipment, and OEM software that lists date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001(updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
2) Provide either new documentation written specifically for this project or modified standard vendor documentation to the vendor O&M documentation for each device, piece of equipment, or OEM software. Indicate with arrows or circles all portions that apply to all standard vendor documentation furnished. Neatly line out or cross out all portions that do not apply. Remove groups of pages or sections that do not apply to the specific model supplied.
3) Provide the record documentation of the system audit and completed test forms with sign-offs as specified in Section 406121.20 “Process Control System Testing.”
4) Include instrument/equipment calibration and configuration forms.

d. As-Built Drawings:

1) Complete as-built drawings, including all drawings and diagrams specified in this section under the "Submittals" section. Include on the drawings all termination points on all equipment the system is connected to, including terminal points of equipment not supplied by the PCSS. Provide electronic files for all drawings produced. Provide drawings in AutoCAD ".dwg" format and in Adobe Acrobat format. Provide drawings using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
2) Include on as-built documentation information from submittals, as described in this Specification, updated to reflect the as-built system. Incorporate errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests.

B. Operations and Maintenance Data - Software Maintenance Manual:

1. Include these manuals as part of "Final System Documentation."
2. Software Listings and Databases: Submit hard copies of the same information required in the "Controller Program Submittal" except include files updated to reflect the as-built system. Include PDF versions of these files on the DVDs specified below.
3. PID Loop Tuning Parameters: Submit annotated chart recorder traces or computer system trend screen printouts showing tuned control loop response to plus and minus 40 percent of full span step changes of loop setpoint for each individual loop. For cascade loops,

submit charts showing response of the secondary loop with secondary setpoint on manual and also response of the entire cascade control loop in automatic mode. Include a description of tuning methodology used.

4. Supply hardcopies of configuration information for the HMI systems, reporting systems, Historian Systems, and any other programs developed under this Contract.
5. Machine Readable Documentation: Provide two sets of as-built software documentation on DVDs or USB thumb drives in original electronic format for all PLC, HMI systems, reporting systems, Historian Systems, and any other programs developed under this Contract. Incorporate all changes made during or after testing, start-up, and commissioning.
6. Include final version of the system standards and conventions manual reflecting as-programmed conditions.
7. System Configuration Section:

    a. Include printout (or screen capture) of all configuration screens for every device requiring PCSS configuration. This includes, but is not limited to, PLC processors, EtherNet/IP and any other communication modules.

C. Operations and Maintenance Data - Operators' Manual:

1. Provide Operator's Manuals prior to final acceptance of the system.
2. Separately bind and include in the manual all information necessary for the operator to monitor and control the plant from the control system. Write the manuals in non-technical terms and organize for quick access to each detailed description of the operator's procedure. Include the following information:

    a. A comprehensive table of contents of the manual.
    b. A simple overview of the entire system indicating the function and purpose of major control system components described by area or building.
    c. A detailed description of the operation of the HMI and OIT including all appropriate displays. Including a screenshot of each HMI and OIT display screen and annotating each function in text is an acceptable format for presenting this information.
    d. Step-by-step procedures for starting up or shutting down critical component of the control system such as server or a control panel.
    e. Login / logout procedures for the operator interface system(s).
    f. Complete, step-by-step procedures for printing reports and entering manual data.
    g. Complete, step-by-step procedures for performing system or selected file backup and restoration including archiving historical data. Include recommended archiving schedule for historical data and/or frequency system performs an automatic back-up with a listing of all applications that are backed up or need to be backed up.
    h. Operational description for operating HMI computer equipment and peripherals including printers, CD-ROMs, removable bulk storage devices, UPS, etc. Include in the description procedures for typical maintenance and troubleshooting tasks.
    i. A complete glossary of terms and definition of acronyms.
    j. List of personnel to be contacted for warranty and emergency services, including name, address, telephone number, pager or cell phone number, fax number, and email address.

3. Electronic O&M Information:

1) In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals and data sheets, along with any software back-up of configuration files, on DVD or USB thumb drive. Supply electronic documents in Adobe Acrobat format.
2) Provide electronic files for all custom-developed manuals including training manuals. Supply text in Microsoft Office and Adobe Acrobat formats.
3) Provide electronic files for all drawings produced. Supply drawings in AutoCAD ".dwg" and in Adobe Acrobat formats. Provide drawings using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
4) Back up each computer system hardware device onto DVD or USB thumb drive after Substantial Completion and turn over to the Owner.
5) If specified in the training section, provide digital copies of all training videos. Format videos so they are readable by standard DVD players and by standard PC DVD drives, a minimum of 800 by 600 pixels, and include sound.

1.7 MAINTENANCE MATERIAL SUBMITTAL

A. Furnish extra materials from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Refer to individual specification sections in Division 40 for spare equipment requirements and provide one comprehensive spare parts submittal for project.

B. Pack all spare parts in individual cartons and label with indelible markings clearly indicating components inside. Supply with the required spare parts complete ordering information paperwork including manufacturer's contact information (address and phone number), part name, part number, equipment name and tag number(s) for which the part is to be used (if applicable). Deliver and store the spare parts in a location directed by the Owner or Engineer.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: PCSS to hold a valid UL-508 certification for their panel fabrication facility.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

C. Responsible for the technical supervision of the installation by providing on-site supervision to the installers of the various components.

D. Process Control System Supplier (PCSS) shall be a “systems integrator” regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a “systems integrator” means an organization that complies with all of the following criteria:

1. Employs personnel on this project who have successfully completed ISA or manufacturer's training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel to hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience. Key personnel includes, as a minimum, the lead field technician.
2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion is defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references for projects where the PCSS's contract was of similar size to this project.
3. Has been actively engaged in the type of work specified in this Section for a minimum of five years.

E. Maintain a permanent, fully staffed and equipped service facility with full-time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. Respond to on-site problems within 12 hours of notice. Provide an on-site response within four hours of notification starting at two months before scheduled startup to two months after startup completion.

F. Listed suppliers will not be required to submit a qualifications proposal (see "Informational Submittals"). Contractors interested in listing an equal to the above listed suppliers to submit PCSS' qualifications for review and approval as specified herein.

G. Select a PCSS from one of the following:

1. Carollo, Contact: Joe Hanlon, Phone: 727-460-2550.
2. McKim & Creed, Contact: Robert Garland, Phone: 941-379-3404.
3. Tetra Tech, Contact: Danny Nelson, Phone: 239-438-2108.
4. Revere Control Systems, Contact: Ben Matthews, Phone: 863- 337-3001.
5. Jacobs, Contact: Bill Gramer, Phone: 239-860-4922.

H. Select a fiber optic cable provider/installer from one of the following:

1. Aztek Communication Technologies, Phone: 239-659-0017.
2. IT Solutions, Inc. Phone: 239-354-7755.

I. Being listed in this specification does not relieve any potential PCSS from meeting the qualifications specified in this Section.

1.9 FIELD CONDITIONS

A. Environmental Requirements: Refer to Electrical Drawings for specific environmental and hazardous area classifications.

B. Elevation: Design equipment to operate at the project ground elevation.

C. Temperature:

1. Outdoor area equipment to operate between -4 to 122 degrees F ambient.
2. Equipment in indoor locations operate between 50 to 95 degrees F degrees ambient minimum.
3. Storage temperatures range from 32 to 122 degrees F degrees ambient minimum.
4. Furnish additional cooling or heating if required by the equipment specified herein.
5. Relative Humidity. Air-conditioned area equipment operate between 20 to 95 percent relative, non-condensing humidity. All other equipment operates between 5 to 100 percent relative, condensing humidity.

D. Do not ship control system equipment located in the control room until the control room areas comply with specified ambient temperature and humidity and free of dust and debris.

1.10 WARRANTY

A. Warranty Period: One year from Date of Final Completion unless noted otherwise in individual specification Sections.

PART 2 - PRODUCTS

2.1 GENERAL

A. Electrical Requirements for Control System:

1. Operate equipment on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above to be provided between power supply and interconnected instrument loop. Supply constant voltage transformers where equipment requires voltage regulation.
2. With the exception for field device network connected devices, all electronic instrumentation utilize linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless specified otherwise. However, signals between instruments within the same panel or cabinet may be 1 - 5 VDC (volts direct current).
3. Outputs of equipment that are not of the standard signals as outlined, have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero-based signals will be allowed.
4. All switches have double-pole, double-throw (DPDT) contacts rated at a minimum of 600 VA, unless noted otherwise.
5. Switches and/or signals indicating an alarm, failure or upset condition wired in a fail-safe manner. A fail-safe condition is when an open circuit generates an alarm state (i.e. contact opens).
6. Materials and equipment UL approved whenever such approved equipment and materials are available.
7. All equipment furnished designed and constructed so that in the event of power interruption, the systems specified all go through an orderly shutdown with no loss of

memory and resume normal operation without manual resetting when power is restored, unless otherwise noted.

8. Surge protection requirements for control system power, signal, and communication lines are specified in Section 407856 “Isolators, Intrinsically Safe Barriers, and Surge Suppressors.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where control panels and instrumentation will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION

A. The shield on each process instrumentation cable to be continuous from source to destination and be grounded at only one ground point for each shield.

B. Provide sunshades for equipment mounted outdoors in direct sunlight. Include sunshades standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North to minimize the impact of glare and ultraviolet exposure on digital readouts.

3.3 IDENTIFICATION

A. Provide identification system for all PCSS provided hardware, instrumentation, and communication cabling. Provide details as specified in “Project Plan”.

3.4 FIELD QUALITY CONTROL

A. Refer to individual hardware and instrument specification Sections.

3.5 STARTUP SERVICE

A. Refer to Section 406121.20 “Process Control System Testing.”

B. Refer to Section 406126 “Process Control System Training.”

C. Engage factory-authorized service representative to perform startup service as specified in individual hardware and instrument specification sections.

D. Weekly on-site coordination meetings with Engineer, Contractor, Vendors, and AESS as required during active construction period.

3.6 PCSS MAINTENANCE SERVICE

A. Provide written proposal for a maintenance contract executed by the PCSS to the Owner for on-site preventive maintenance services related to the Instrumentation and Control system. Do not include the cost of this maintenance contract in the Contract Price.

B. Visits to the sites to correct deficiencies under warranty are not included in this preventive maintenance service contract.

END OF SECTION 406100

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SECTION 406121.20 - PROCESS CONTROL SYSTEM TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes process control system testing, where the Applications Engineering services are performed by Contractor.

1. Furnish labor, materials, equipment, and incidentals required to complete testing of provided devices and systems.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.3 DEFINITIONS

A. Process Control System Supplier (PCSS): Entity responsible for providing materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

B. Applications Engineering System Supplier (AESS): Entity who provides programming, configuration, and related services for the control system equipment provided by the PCSS.

C. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.

D. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.

E. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

F. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

G. Uninterruptible Power Supply (UPS): A device capable of providing emergency battery power when the main power source fails.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Refer to Section 4061000 “Process Control and Enterprise Management Systems General Provisions.”

1.5 ACTION SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Testing Submittals - Submit, in one submittal, the following testing related documents:

1. Status Signoff Forms:

a. Develop and submit project specific I/O Status and Automatic Control Strategy signoff forms to be used during factory and field testing to organize and track each loop's inspection, adjustment, calibration, configuration, and testing status and sign off. Include sign-off forms for each testing phase showing all loops.

1) Example forms are shown in Appendices.
2) Separate forms for factory and field testing can be used, or they can be combined, at discretion of the PCSS.
3) Submit testing forms prior to start of testing.

1. Testing Procedures:

a. Submit detailed procedures proposed to be followed for each of the tests specified herein. Test procedures serve as the basis for execution of the required tests to demonstrate that the system meets and functions as specified. At a minimum, provide the following test procedures:

1) Network and Communications Testing.
2) I/O Testing.
3) UPS.
4) Control panel power, indictors, and hardwired logic tests.

b. Structure documents in an orderly and easy to follow manner to facilitate an efficient and comprehensive test.
c. Indicate in test procedures all pre-testing setup requirements, all required test equipment, and simulation techniques to be used.
d. Structure test procedures in a cause-and-effect manner where the inputs are indicated, and the outputs are recorded.
e. Include in test procedures the demonstration and validation under normal operating conditions and under various failure scenarios as specified in Contract Documents.
f. Do not start testing until all Testing Submittals have been approved.

C. Test Documentation:

1. Upon completion of each required test, document the test by submitting a copy of the signed off Testing Status forms. Testing is not to be considered complete until the signed-

off forms have been submitted and approved. Submittals of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

1.6 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For Test Documentation of system:

1. Upon completion of each required test, document the test by submitting a copy of the signed-off Testing Status forms. Testing is not considered complete until the signed-off forms are submitted and approved. Submittal of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

1.7 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.8 COST OF TRAVEL

A. Scheduled tests will only be attended once by Engineer /Owner. If test is not successful, all subsequent tests will be performed at Contractor's expense. Reimburse Owner for all costs, including labor and expenses, invoiced by Engineer and incurred by Owner for subsequent retests.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TESTING - GENERAL

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Track results of all testing on a project specific status sign-off form or similar document. The PCSS is responsible for maintaining the sheet. Appendix of this Section has an example template for this sheet.

C. Tests the PCSS is required to perform are as follows:

1. Factory Testing:

a. Unwitnessed Factory Test (UFT).
b. Witnessed Factory Test (WFT).

2. Field Testing:

    a. Operational Readiness Test (ORT).
    b. Functional Demonstration Test (FDT).
    c. Site Acceptance Test (SAT).

D. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide all special testing materials and equipment required for a suitable means of simulation.

E. PCSS to coordinate all required testing with Contractor, affected subcontractors, Engineer, and Owner.

F. Do not ship equipment to jobsite until Engineer or Owner has received all Factory Testing results and approved the system as ready for shipment.

G. Engineer reserves the right to test or re-test any functions.

H. Correction of Deficiencies:

1. Correct deficiencies in workmanship and/or items not meeting specified testing requirements to meet specification requirements at no additional cost to Owner.
2. Repeat testing, as specified herein, after correction of deficiencies is made until specified requirements are met.

3.2 FACTORY TESTING - UNWITNESSED FACTORY TEST (UFT)

A. Purpose of UFT is for PCSS to check system prior to Engineer and/or Owner attending factory testing. This type of testing is part of any quality firm's internal QA/QC procedures.

B. Temporary network connections are required to confirm the network configuration. Temporary wiring of primary elements, final control elements, and field-mounted transmitters is not required.

C. Hardware to be tested includes all control system devices shown on System Architecture drawings and provided by PCSS.

D. Perform these tests, but not be limited to the following. Address each of these tests in the Test Procedure submittal.

1. All panels and enclosures provided to undergo a thorough inspection to verify integrity of cabinet enclosures, frame structures, paint work and finish, etc. Review panel drawings to ensure they accurately reflect panel layout and wiring.
2. Perform a system audit to verify all components have been staged for test and have been documented properly with correct model numbers, serial numbers, etc. Prove documentation of audit at factory test and submit as part of O&M Manual Documentation:

    a. For each workstation and server, list of all software installed (including the operating system), with software revision number, software improvement modules

or patches installed, license number and owner registration information, warranty period, vendor and local distributor names and contacts.

b. For each microprocessor-based component connected to control communication backbone in system (PLCs, managed switches, protocol converters, communication cards on final field devices, radios, etc.), list firmware revision, vendor and local distributor information, and system, warranty information, configuration parameters (e.g., communication settings, fail position settings, etc.)

3. Perform panel wire pull tests to ensure all wiring has been connected with appropriate torque to prevent wires from coming loose.
4. Test UPS to verify UPS switch power correctly while keeping all UPS powered loads online. Perform testing of UPS to determine if they have been sized correctly to maintain specified run time during field testing.
5. Perform 100 percent I/O point checkout to verify proper operation of input/output points from panel terminations to HMI and OIT nodes. At a minimum, I/O checkout consists of four steps.

    a. Jumper discrete input signals at field terminal blocks in control panels to verify proper status in HMI and OIT nodes.
    b. Connect analog input signals to a signal generator at field terminal blocks in control panels to verify proper status in HMI and OIT nodes and verify signals are at zero percent, 50 percent, and 100 percent of full scale.
    c. Test discrete output signals by switching equipment to manual control at HMI and OIT nodes and turning the output on or other means to turn the output on. Then verify the output is on by connecting a digital multimeter to measure continuity at terminations, thus verifying command from PLC has properly executed contact closure.
    d. Test analog output signals by switching the equipment to manual control at HMI and OIT nodes and turning output on or other means to turn the output on. Then verify output by utilizing a digital multimeter to measure current or voltage generated at termination points.

6. Verify all control strategies using simulation or other means to verify logic performs as expected. Verify faults and logical failure conditions for control strategies such instrument failures, equipment failures, loss of communication between HMI Server and PLC, loss of peer-to-peer communication, out of range testing (over and under scale) for analog inputs, and all other strategies specified in control strategy document.
7. For each hardware enclosure, include with inspection, but not be limited to, cabinet enclosures, frame structure, paint work and finish, dimensions, and hardware operability (i.e., fans, door hinges, keylocks, etc.).
8. For each subpanel, include with inspection, but not be limited to, I/O subsystem physical layout, power supply sizing and mounting, cable routing, wire runs across hinges properly installed, fans and blowers unobstructed and mounted to maximize air flow, power conditioning correctly installed, and overall layout and installation of components meets manufacturer's recommendations and standard industry accepted practices.
9. All other control panel circuitry.
10. Perform the following systems tests:

    a. Demonstrate ability to share data between operator workstations and servers.
    b. Demonstrate ability of each workstation to print reports on all designated report printers.

c. Demonstrate ability for each workstation to read and write designated files from servers and other workstations on the network.
d. Demonstrate operability of all back-up and mass storage equipment.
e. Demonstrate communication failure and recovering self-healing ring testing.
f. Demonstrate total power failure and recovery. Remove the UPS for this test.
g. Demonstrate capabilities of the historical server.
h. Demonstrate failover capabilities of the redundant HMI servers.
i. Demonstrate failover capabilities of the redundant PLCs.

E. Upon successful completion of UFT, PCSS to submit a record copy of test results as specified in PART 1. As part of this test results submittal, notify Engineer and Owner in writing that system is ready for WFT. No other notice of Factory test will be accepted. Engineer and/or Owner to schedule a test date within 30 days of receipt of this submittal.

3.3 FACTORY TESTING - WITNESSED FACTORY TEST (WFT)

A. Purpose of WFT is to allow Engineer or Owner representatives to witness functionality, performance, and stability of entire hardware and software system as a complete integrated system. WFT to be run by PCSS and conducted at PCSS's facility.

B. Required Documents for Test:

1. Clean set of approved panel drawings and wiring diagrams.
2. Set of Contract Documents: Drawings and Specifications.
3. All design-change related documentation.
4. Master copy of the PCSS developed factory testing signoff forms.
5. Testing procedures.

C. Operate the system continuously throughout WFT without failure, except where initiated per established test procedures. Unanticipated failures may, at Owner or Engineer's option, result in overall WFT being deemed unsuccessful. Correct and re-test all deficiencies identified during these tests prior to completing WFT or shipment of panels to jobsite as determined by Owner/Engineer.

D. Perform these tests during the WFT, but not be limited to, the following:

1. A repeat of all tests specified in the UFT.

E. Daily schedule during these tests to be as follows:

1. Morning meeting to review the day's test schedule.
2. Scheduled tests and sign-offs.
3. End of day meeting to review day's test results and to review or revise next day's test schedule.
4. Unstructured testing period by witnesses.

F. Upon successful completion of WFT, PCSS to submit a record copy of test results as specified in PART 1.

3.4 FIELD TESTING - OPERATIONAL READINESS TEST (ORT)

A. Purpose of ORT is to check that process equipment, instrument installation, instrument calibration, instrument configuration, field wiring, control panels, and all other related system components are ready to monitor and control the processes. This test determines if equipment is ready for operation.

B. This test to take place prior to FDT and startup. Prior to starting this test, install relevant process equipment and mechanically test instruments installed, control panels installed, and field wiring complete.

C. Required Documents for Test:

1. Master copy of the PCSS developed field testing sign-off forms.
2. Testing procedures.
3. Calibration forms.

D. These inspections, calibrations, and tests do not require witnessing. However, Engineer may review and spot-check testing process periodically. All deficiencies found to be corrected by PCSS prior to commencement of Functional Demonstration Test.

E. PCSS to maintain Sign-off forms and Calibration forms at job site and make them available to Engineer/Owner at any time.

F. Perform the following tests as part of ORT:

1. Instrument calibration, configuration, and set-up.
2. Input/Output (I/O) Testing to HMI and OITs.
3. Testing of control strategies.

G. Instrument calibration, configuration, and set-up:

1. Calibrate, configure, and set-up all components and instruments to perform specified functions.
2. Calibration form:

    a. For any component or instrument requiring dip switch settings, calibration, or custom configuration, maintain a calibration form in field documenting this information. These forms provide a summary of the actual settings used in the field to allow an Instrument technician to replace the device entirely and configure it to function as it did before.
    b. Add this information to Instrument data sheet and to a copy of manufacturer's standard "Configuration Sheet" or create a separate form.

        1) If a separate form, list Project Name, Loop Number, ISA Tag Number, I/O Module Address, Manufacturer, Model Number/Serial Number, Output Range and Calibrated Value.

c. Some examples of required information are:

1) For Discrete Devices: Actual trip points and reset points.
2) For Instruments: Any configuration or calibration settings entered into instrument.
3) For Controllers: Mode settings (PID).
4) For I/O Modules: Dip switch settings, module configuration (if not documented in native programming documentation).

d. Maintain copy of these forms in field during testing and make them available for inspection at any time.
e. For any device that allows a software back-up of configuration files to a laptop, make configuration files available to Engineer/Owner for inspection. Submit as part of Final System Documentation as specified in Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

H. I/O Testing:

1. Purpose of I/O testing is to check that process equipment, instrument installation, calibration, configuration, field wiring, and control panels are set-up correctly to monitor and control the processes. This test is commonly referred to as a "loop test" or an I/O checkout.
2. PCSS in conjunction with Contractor to test signals under process conditions. Preferred test method will always be to execute test wherever possible to end elements. For example, preferred test will prove valve open/close limit switches by operating valve, not by installing a jumper on limit switch contacts. However, if equipment or process is not available to test a signal over its entire calibrated range, PCSS may test using a simulation method and make a note on sign-off form.
3. Perform the following I/O tests:

a. Discrete Input: At device or instrument, change signal condition from inactive to active state. Observe results on all indicators within loop such as HMI screens, OIT screens, pilot lights, horns, beacons, etc.
b. Analog Input: Test analog signal over entire engineering range at various intervals including 0, 50 percent, and 100 percent as well as on increasing and decreasing range. Observe results on all indicators within loop such as HMI screens, OIT screens, recorders, digital indicators, etc.
c. Test discrete output signals by switching equipment to manual control at the HMI and OIT nodes and turning output on or using other means to turn output on. Then verify equipment responds accordingly.
d. Test analog output signals by switching equipment to manual control at HMI and OIT nodes and turning output on or other means to turn output on. Then verify equipment responds accordingly.

I. Testing of Automatic Control Strategies:

1. Verify all automatic control strategies using actual process equipment and instruments, or other means, to verify logic performs as expected. Verify faults and logical failure scenarios for control strategies such as instrument failures, equipment failures, loss of communication between HMI Server and PLC, loss of peer-to-peer communication, out

of range testing for analog inputs, loss of power, and all other strategies specified in control strategy document.

J. Repeat all systems tests specified under factory testing.

K. Test UPS to verify UPS switch power correctly while keeping all UPS powered loads online. Also, test sizing of UPS by switching off-line power to UPS and verify if they maintain specified run time.

L. For all panels with enclosures modified by this Contract, test internal control panel temperature under full running conditions to ensure proper cooling/ventilation is being provided.

M. Upon successful completion of ORT, PCSS to submit a record copy of test results as specified in PART 1 and request scheduling of FDT.

3.5 FIELD TESTING - FUNCTIONAL DEMONSTRATION TEST (FDT)

A. After facility is started-up and running treatment process in automatic control to extent possible, perform a Functional Demonstration Test. Purpose of FDT is to allow Engineer or Owner representatives to witness actual functionality, performance, and stability of system while connected to process equipment.

B. Required Documents for Test:

1. Set of panel drawings and wiring diagrams from ORT with corrections noted.
2. Set of Contract Documents: Drawings and Specifications.
3. All design-change related documentation.
4. Signed-off master copy of the PCSS developed field testing signoff forms.
5. Testing procedures.
6. Copy of completed calibration forms.
7. One copy of all O & M Manuals for PCSS supplied equipment.

C. Perform a witnessed FDT on each process area. To extent possible, repeat testing performed during ORT.

D. Follow specified daily schedule during factory tests and FDT.

E. After coordinating with Operations, perform a "Black Start" of the plant to confirm plant operation recovers as specified in Contract Documents. Black start means shutting off power to the plant and turning it back on. Perform separate tests by recovering the plant while on generator (if a generator is specified) and while on utility power.

F. Document punch list items and resolutions noted during test on Punch list/Resolution form. In event of rejection of any part or function test procedure, PCSS to perform repairs, replacement, and/or retest within 10 days.

G. Upon successful completion of the FDT, PCSS to submit a record copy of test results as specified in PART 1.