60% Design Deliverable

San José-Santa Clara Regional Wastewater Facility

7477/7701 – Headworks Project

Volume 3 of 5

Specifications

(Division 33 through Division 49)

San José-Santa Clara Regional Wastewater Facility

August 2019

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The City of San José, California

San José – Santa Clara Regional Wastewater Facility

SPECIFICATIONS

for the Construction of the

HEADWORKS PROJECT

Project No. CIP 7477/7701

VOLUME 3
DIVISION 33 THROUGH DIVISION 49

August 2019

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San José, California

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CONVEYANCE PIPING—GENERAL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Concrete Institute (ACI): 301, Specifications for Structural Concrete.
   2. American Water Works Association (AWWA):
      a. C110/A21.10, Ductile-Iron and Gray-Iron Fittings.
      b. C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
      c. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 in. Through 144 in. (100 mm Through 3,600 mm).
      d. C210 Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
      e. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
      f. C217, Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines.
      g. C219, Bolted, Sleeve-Type Couplings for Plain-End Pipe.
      h. C221, Fabricated Steel Mechanical Slip-Type Expansion Joints.
      i. C228, Stainless-Steel Pipe Flange Joints for Water Service – Sizes 2 in. through 72 in.
      j. C606, Grooved and Shouldered Joints.
   3. ASTM International (ASTM):
      a. A193/193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
      b. A497/A497M, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
      c. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
      d. C94/C94M, Standard Specification for Ready-Mixed Concrete.
      e. C150/C150M, Standard Specification for Portland Cement.
      f. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   4. NSF International (NSF):
      a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
      b. NSF/ANSI 372, Drinking Water System Components - Lead Content.

1.02 DESIGN REQUIREMENTS

A. Where pipe class or wall thickness is not indicated, design piping system for maximum stress based on the following test pressure and earth loads and earth and traffic loads:
   1. Operating Pressure: 50 psi.
   2. Field Hydrostatic Test Pressure: 75 psi.
   3. Earth Loads: Determined by bury depth.
   4. Soil Density: 135 psi.
   5. Traffic Loads: HS-20.

1.03 SUBMITTALS

A. Action Submittals:
   1. Detailed pipe fabrication drawings showing pipe details, special fittings and bends, dimensions, coatings, and other pertinent information.
   2. Layout drawing showing location of each pipe section and each special length.
   3. Pipe pressure class.
   4. Wall thickness, reinforcing, and strength calculations.
   5. Product Data: Manufacturer's data for couplings, saddles, gaskets, and other pipe accessories. Indicate maximum rated working pressure and test pressure for each item.

B. Informational Submittals: Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.

1.04 DELIVERY, STORAGE, AND HANDLING

A. In accordance with manufacturer's recommendations and as specified in individual Specification(s) following this section.

B. Marking at Plant: Mark each pipe and fitting at plant. Include date of manufacture, manufacturer's identification, specification standard, diameter of pipe dimension ratio, pipe class, pipe number for laying purposes, and other information required for type of pipe.

C. Pipe, specials, and fittings received at Project Site in damaged condition will not be accepted.

D. Gasket Storage: Store rubber gaskets in cool, well ventilated place, and do not expose to direct rays of sun. Do not allow contact with oils, fuels, petroleum, or solvents.

E. Store and support pipe securely to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials.

F. Handling:

1. Pipe shall be handled with proper equipment in a manner to prevent distortion or damage. Use of hooks, chains, wire ropes, or clamps that could damage pipe, damage coating or lining, or kink and bend pipe ends is not permitted.
2. Use heavy canvas, or nylon slings of suitable strength for lifting and supporting materials.
3. Lifting pipe during unloading or lifting into trench shall be done using two slings placed at quarter point of pipe section. Pipe may be lifted using one sling near center of pipe, provided pipe is guided to prevent uncontrolled swinging and no damage will result to pipe or harm to workers. Slings shall bear uniformly against pipe.
4. Pipe and fittings shall not be stored on rocks or gravel, or other hard material that might damage pipe. This includes storage area and along pipe trench.

PART 2 PRODUCTS

2.01 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 PIPE

A. As specified in the individual specification(s) following this section.

2.03 JOINTS

A. As specified in the individual specification(s) following this section.

2.04 COUPLINGS

A. General:

1. Coupling linings for use in potable water systems shall be in conformance with NSF/ANSI 61.
2. Couplings shall be rated for appropriate operating pressure and hydrostatic test pressure.
3. Exposed, bolted, sleeve-type couplings shall be lined and coated with fusion bonded epoxy in accordance with AWWA C213.

4. Buried, bolted, sleeve-type couplings shall be lined and coated with fusion-bonded epoxy in accordance with AWWA C213 and wrapped with petrolatum wax tape in accordance with AWWA C217.

B. Bolting Materials for Couplings: In accordance with the applicable AWWA standard.

2.05 SERVICE SADDLES

A. Double strap design rated for 150 psi minimum working pressure.

2.06 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

A. Modular Mechanical Seal:
   1. Type: Interconnected synthetic rubber links shaped and sized to continuously fill annular space between pipe and wall sleeve opening.
   2. Assemble interconnected rubber links with Type 316 stainless steel bolts, nuts, and pressure plates.
   3. Size modular mechanical seals according to manufacturer's instructions for the size of pipes shown to provide a watertight seal between pipe and wall sleeve opening.
   4. Manufacturers and Products:
      a. Thunderline/LinkSeal, Div. of PSI, Houston, TX; Link Seal.
      b. Calpico, Inc., South San Francisco, California; Sealing Linx.
      c. Advance Products and Systems, Lafayette, Louisiana; Innerlynx.

B. Wall Sleeves:
   1. Diameter, ends, and length shall be as shown on Drawings.
   2. Shall include integral seep ring to minimize seepage between metal sleeve and concrete.

C. Wall Couplings:
   1. Diameter, ends, and length shall be as shown on Drawings.
   2. Wall couplings shall provide flexible mechanical joint.
   3. Body and end rings shall be coated with fusion bonded epoxy.
   4. Body shall include integral seep ring.
   5. Shall comply with AWWA C219.

D. If core drilling is required for penetrations of existing concrete walls or slabs, locations of drilling shall be determined by radiograph to avoid damage to reinforcing steel and conduits.

2.07 FLANGES, FLANGE GASKETS, AND BOLTING MATERIALS

A. As specified in individual specifications following this section.

B. Flanges, bolting materials, and flange gaskets for steel flanges shall conform to AWWA C207, Class D.

C. Flanges, bolting materials, and flange gaskets for ductile iron flanges shall conform to AWWA C110 and AWWA C115.

D. Stainless steel bolting material shall conform to ASTM F593, Type 304 stainless steel, Group 1, Condition SH1, 2, 3 or 4.

E. If the flanges are coated, provide two washers for each bolt on each side of the flange to minimize damage to the coating as the nuts are tightened. Provide bolts of the proper length to accommodate the washers.

2.08 CONCRETE FOR THRUST BLOCKS

A. Thrust Block Concrete: As specified in Section 03 30 00, Cast-in-Place Concrete.

B. Reinforcing Steel: ASTM A615/A615M, Grade 60 deformed bars.

C. Welded Wire Fabric: ASTM A497/A497M.

D. Formwork: Plywood earth cuts may be used as approved by Jacobs' Engineer.

E. Mix: ASTM C94/C94M, Option A.
   1. Cement: ASTM C150/C150M, Type II.
   2. Coarse Aggregate Size: 1-1/2 inch(es).
   3. Design for Minimum Compressive Strength at 28 Days: 3,000 psi.

2.09 PIPE LOCATING TAPE

A. As specified in Section 31 23 23.15, Trench Backfill.

2.10 PIPE BEDDING AND PIPE ZONE MATERIAL

A. Granular material or controlled low strength material as specified in Section 31 23 23.15, Trench Backfill.

2.11 TRENCH STABILIZATION MATERIAL

A. As specified in Section 31 23 23.15, Trench Backfill.

PART 3 EXECUTION

3.01 GENERAL

A. Notify Jacobs' Engineer at least 2 weeks prior to field fabrication of pipe or fittings.

B. Furnish feeler gauges of proper size, type, and shape for use during installation for each type of pipe furnished.

C. Distributing Materials: Place materials along trench only as will be used each day, unless otherwise approved by Jacobs' Engineer. Placement of materials shall not be hazardous to traffic or to general public, obstruct access to adjacent property, or obstruct others working in area.

3.02 EXAMINATION

A. Verify size, material, joint types, elevation, and horizontal location of existing pipeline to be connected to new pipeline or new equipment.

B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

C. Damaged Coatings and Linings: Repair using coating and lining materials in accordance with manufacturer's instructions.

3.03 PREPARATION OF TRENCH

A. Prepare trench as specified in Section 31 23 16, Excavation.

B. Unless otherwise permitted by Jacobs' Engineer, maximum length of open trench shall not exceed 50 feet.

3.04 INSTALLATION

A. General:
   1. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.
   2. Install individual pipe lengths in accordance with approved lay diagram. Misplaced pipe shall be removed and replaced.
   3. Inspect pipe and fittings before installation, clean ends thoroughly, remove foreign matter and dirt from inside.
   4. Flanged Joints:
      a. Install perpendicular to pipe centerline.
      b. Bolt Holes: Straddle vertical centerline, aligned with connecting equipment flanges or as shown on Drawings.
      c. Use torque-limiting wrenches to provide uniform bearing and proper bolt tightness.

d. Flange Type: Use flat-faced flange when joining with flat-faced ductile or cast iron flange.

5. Couplings:
   a. Install in accordance with manufacturer's written instructions.
   b. Before coupling, clean pipe holdback area of oil, scale, rust, and dirt.
   c. Do not remove pipe coating. If damaged, repair before joint is made.
   d. Clean gaskets before installation.
   e. If necessary, lubricate with gasket lubricant for installation on pipe ends.
   f. Tighten coupling bolts progressively, drawing up bolts on opposite sides gradually until bolts have uniform tightness.

B. Buried Pressure Pipe:
   1. Concrete Encased or Embedded Pipe: Do not encase joints in concrete, unless specifically shown on Drawings.
   2. Placement:
      a. Keep trench dry until pipe laying and joining is completed.
      b. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.
      c. Measure for grade at pipe invert, not at top of pipe.
      d. Excavate trench bottom and sides of ample dimensions to permit proper joining, welding, visual inspection, and testing of entire joint.
      e. Prevent foreign material from entering pipe during placement.
      f. Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.
      g. In general, lay pipe upgrade with bell ends pointing in direction of laying.
      h. Deflect pipe at joints for pipelines laid on a curve using unsymmetrical closure of spigot into bell. If joint deflection of standard pipe lengths will not accommodate horizontal or vertical curves in alignment, provide:
         1) Shorter pipe lengths.
         2) Special mitered joints.
         3) Standard or special fabricated bends.
      i. Check gasket position with feeler gauge to assure proper seating.
      j. After joint has been made, check pipe alignment and grade.
      k. Place sufficient pipe zone material to secure pipe from movement before next joint is installed.
      l. Prevent uplift and floating of pipe prior to backfilling.
   3. Tolerances:
      a. Deflection From Horizontal Line: Maximum 2 inches.
      b. Deflection From Vertical Line: Maximum 1 inch(es).

c. Joint Deflection: Maximum of 75 percent of manufacturer's recommendation.

d. Horizontal position of pipe centerline on alignment around curves maximum variation of 1 foot from position shown.

4. Cover Over Top of Pipe: Minimum 3 feet, unless otherwise shown.

5. Disposal of Excess Excavated Material: As specified in Section 31 23 16, Excavation.

3.05 THRUST RESTRAINT

A. Location: At pipeline tees, plugs, caps, bends, and locations where unbalanced forces exist.

B. Thrust Blocking:

1. Place only where shown on Drawings.

2. Quantity of Concrete: Sufficient to cover bearing area of pipe and provide required soil bearing area as shown on Drawings.

3. Place blocking so pipe and fitting joints are accessible for repairs.

4. Place concrete in accordance with Section 03 30 00, Cast-in-Place Concrete.

3.06 CORROSION PROTECTION

A. Exposed: As specified in Section 09 90 00, Painting and Coating (as included in Balance of Plant Project).

B. Embedded: Shop coat with epoxy as specified in Section 09 90 00, Painting and Coating (as included in Balance of Plant Project). If in potable water service, use NSF 61 approved epoxy.

C. Notify Jacobs' Engineer at least 3 days prior to start of surface preparation, coating application, and corrosion protection work.

3.07 PLACEMENT OF PIPE LOCATING TAPE

A. Place pipe locating tape in accordance with Section 31 23 23.15, Trench Backfill.

3.08 PIPE BEDDING AND ZONE MATERIAL

A. Place pipe bedding and pipe zone material in accordance with Section 31 23 23.15, Trench Backfill.

3.09 FIELD QUALITY CONTROL

A. Pressure Leakage Testing: As specified in the individual specification(s) following this section.

3.10 CLEANING

A. Following assembly and testing, and prior to final acceptance, flush pipelines with water at 2.5 fps minimum flushing velocity until foreign matter is removed. Dispose of water and flushed foreign matter.

B. If impractical to flush large diameter pipe at 2.5 fps, clean pipe in-place from inside by brushing and sweeping, then flush or blow line at lower velocity.

C. Remove accumulated debris through blowoffs 2 inches and larger or by removing spools and valves from piping.

END OF SECTION

SECTION 33 05 01.01
WELDED STEEL PIPE AND FITTINGS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide lined and coated welded steel pipe, special, and fittings as specified herein, complete, in accordance with the Contract Documents.

1.02 RELATED SECTIONS

A. Related sections include the following:
   1. Division 01, General Requirements.
   2. Section 05 05 23, Welding.
   3. Section 09 90 00, Painting and Coating.
   4. Section 09 97 13.02, Pipeline Joint Coating.
   5. Section 31 23 16, Excavation.
   6. Section 31 23 19.01, Dewatering.
   7. Section 31 23 23.15, Trench Backfill.

1.03 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.47, Large Diameter Steel Flanges, NPS 26 though NPS 60.
      b. B16.5, Pipe Flanges and Flanged Fittings, NPS 1/2 through NPS 24.
      c. B16.9, Factory-Made Wrought Buttwelding Fittings.
      d. B36.10M, Welded and Seamless Wrought Steel Pipe.
      e. BPVC SEC V, Nondestructive Examination.
      f. BPVC SEC VIII, Div. 1, Rules for Construction of Pressure Vessels.
      g. BPVC SEC IX, Welding and Brazing Qualifications.
   2. American Society for Nondestructive Testing Inc. (ASNT): SNT-TC-1A, Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing.
   3. American Water Works Association (AWWA):
      a. C200, Steel Water Pipe - 6 In. (150 mm) and Larger.
      b. C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. (100 mm) and Larger - Shop Applied.
      c. C206, Field Welding of Steel Water Pipe.
      d. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm.
      e. C208, Dimensions for Fabricated Steel Water Pipe Fittings.

f. C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
g. C210, Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
h. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
i. C215, Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines.
j. C216, Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
k. C217, Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines.
l. C218, Coating the Exterior of Aboveground Steel Water Pipelines and Fittings.
m. C219, Bolted, Sleeve-Type Couplings for Plain-End Pipe.
n. C221, Fabricated Steel Mechanical Slip-Type Expansion Joints.
o. C222, Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings.
p. C602, Cement-Mortar Lining of Water Pipelines in Place - 4 In. (100 mm) and Larger.
q. C604, Installation of Steel Water Pipe – 4 In. (100 mm) and Larger.
r. M11, Steel Pipe - A Guide for Design and Installation.

4. American Welding Society (AWS):
   a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
   b. A3.0M/A3.0, Standard Welding Terms and Definitions Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying.
   c. D1.1/D1.1M, Structural Welding Code - Steel.
   d. QC 1, Standard for AWS Certification of Welding Inspectors.
5. ASTM International (ASTM):
   a. A20/A20M, Standard Specification for General Requirements for Steel Plates for Pressure Vessels.
   b. A36/A36M-08 Standard Specification for Carbon Structural Steel.
   c. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   d. A106/A106M, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
   e. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

f. A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
g. A435/A435M, Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates.
h. A516/A516M, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service.
i. A770/A770M, Standard Specification for Through-Thickness Tension Testing of Steel Plates for Special Applications.
j. A1018/A1018M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
k. D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
l. E23, Standard Test Methods for Notched Bar Impact Testing of Metallic Materials.
m. E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
n. E1255, Standard Practice for Radioscopy.

6. International Organization for Standardization (ISO).
7. Lloyd's Registry.
8. NSF International (NSF): NSF/ANSI 372, Drinking Water System Components - Lead Content.
9. Steel Pipe Fabricators Association (SFPA).

1.04 DEFINITIONS

A. Fittings and Specials: Including, but not limited to fittings, closure pieces, bends, elbows, reducers, tees, wyes, bifurcations, crosses, outlets, manifolds, nozzles, wall sleeves, bulkheads, vent pipes, and other piping and appurtenances fabricated from steel plate, sheet, or coils as required to provide the Work, complete. Also includes piping above ground or inside structures.

B. Main Pipe Supplier: Manufacturer of the pipeline and as further defined in this section.

C. Acronyms:
1. CJP: Complete Joint Penetration.
2. CWI: Certified Welding Inspector.
3. LHA: Lining holdback area.
4. LT: Leak Testing.
5. MPS: Main pipe supplier.
6. MT: Magnetic Particle Testing.
7. NDE: Nondestructive Examination.
8. NDT: Nondestructive Testing.

9. PJP: Partial Joint Penetration.
10. PQR: Procedure Qualification Record.
11. PT: Liquid Penetrant Testing.
12. RT: Radiographic Testing.
13. UT: Ultrasonic Testing.
14. VT: Visual Testing.
15. WPQ: Welder/Welding Operator Performance Qualification.
16. WPS: Welding Procedure Specification.

1.05 DESIGN REQUIREMENTS

A. Fittings:
   1. Design reinforcement, unless otherwise shown.
   2. Design in accordance with AWWA Manual M11, AWWA C200, AWWA C208 and this Specification.
   3. Submit design calculations to Jacobs' Engineer for review prior to manufacture of steel pipe fabricated specials.
   4. For the purposes of design calculations, the following are defined:
      a. Maximum Operating Pressure (psi): 50 psi.
      b. Test Pressure (psi): 75 psi.
      c. Vacuum Pressure: Minus 7.23 psi.
   5. Design elbows for working and test pressures using allowable stresses of 50 percent yield strength and 62.5 percent of yield strength, respectively.
   6. Design outlet reinforcing for working pressure using an allowable stress of 50 percent of yield strength.
   7. Design nozzles, dished heads, and test heads for test pressure in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
   8. Design based on native soil E' value of 875 psi.

B. Pipe Layout:
   1. Design complete pipeline layout, in accordance with AWWA M11:
      a. General:
         1) Horizontal and Vertical Alignment: See Contract Drawings.
         2) Base stationing and elevation convention as shown on Drawings.
         3) Maximum Laying Lengths:
            a) Not limited, unless specifically shown on Drawings.
            b) Select lengths to accommodate installation operation.
      b. Include, as minimum:
         1) Specific number, location, and direction of each pipe, joint, and fitting. Number each pipe in installation sequence.

2) Station and centerline elevation at changes in grade or horizontal alignment.
3) Station and centerline elevation to which bell end of each pipe will be laid.
4) Elements of curves and bends, both in horizontal and vertical alignment.
5) Location of mitered pipe sections, beveled ends and/or pulled joints for alignment conformance, butt straps, and deep bell lap joints for temperature stress control.
6) Location of closures, cutoff sections for length adjustment, temporary access manways, vents, and weld lead outlets for construction convenience.
   a) Provide for adjustment in pipe laying headings and to conform to indicated stationing.
   b) Changes in location or number will require Jacobs' Engineer approval.

C. Welding Procedure Specification (WPS):
1. Qualified by testing in accordance with ASME BPVC SEC IX for shop welds and AWS D1.1/D1.1M for field welds.
2. PQRs conducted on unassigned base metals, which are base metals not listed in ASME BOVC SEC IX, Table QW-422. Base metal (most coil products are unlisted base metals) to be production welded as required in the referenced welding Code and to be traceable to heat lots.
3. Written WPS required for welds, both shop and field.
4. Notch-tough welding procedures that require heat input control is required for welding of pipe and/or crotch plates with thickness equal to 7/16-inch or greater:
   a. AWS D1.1/D1.1.M prequalified welding procedures are not allowed.
   b. Qualify in accordance with ASME BPVC SEC IX, WPS used to shop fabricate pipe and include Supplementary Essential Variables.
   c. Qualify WPS used to install pipe in the field for heat input control in accordance with AWS D1.1/D1.1M.
   d. PQRs:
      1) Qualified for notch tough welding with consideration for thickness of steel, test temperature, and Charpy V-notch CVN values.
      2) Refer to AWS D1.1/D1.1M, Table 4.6 for PQR Supplementary Essential Variable Changes and Section 4, Part D Requirements for CVN Testing, Option A (three specimens).
      3) CVN Test Temperature and Acceptance: The same as pipe base metal specified herein.

D. Stulling (Strutting): Design for pipe, specials, and fittings such that over-deflection and damage is avoided during handling, storage, and installation, including backfill and compaction.

1.06 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
    a. Submit shop drawings of steel pipe, specials, and fittings in accordance with the requirements in Section 01 33 00, Submittal Procedures, and the following supplemental requirements as applicable. Prepare and submit submittals for steel pipe and steel pipe specials by a single pipe supplier. MPS is responsible for preparation of the material.
    b. Show pipe layout as described in Article Design Requirements, Paragraph Pipe Layout.
2. Material list and steel reinforcement schedules for materials specified.
3. Fabrication Information:
    a. Pipe and fitting details for temporary and permanent facilities indicating:
        1) Cylinder thickness.
        2) The position, type, size, and area of reinforcement.
        3) Manufacturing tolerances.
        4) Maximum angular deflection limitations of field joints.
        5) Closure sections and cutoffs for field length adjustment.
        6) Bulkheads, including details for removal of test bulkheads and repair of lining.
        7) Weld lead outlets and plugs.
        8) Stulling size, spacing, and layout.
        9) Other pertinent information required for the manufacture and installation of the product.
    b. Welded joint details including:
        1) Butt joints.
        2) Miter-cut ends for alignment conformance.
        3) Lap joints.
        4) Special thermal control joints required for control of temperature stresses.
        5) Butt strap joints.
4. Welding Data (Shop and Field Welding):
    a. Show on a weld map, location, type, size, and extent of welds with reference called out for WPS and NDE numbers in tail of welding symbol.
    b. Distinguish between shop and field welds.
    c. Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal. Provide complete joint welding details showing bevels, groove angles, and root openings for welds.
    d. Welding and NDE symbols in accordance with AWS A2.4.

e. Welding terms and definitions in accordance with AWS A3.0M/A3.0.
f. Submit welding data at the same time as Shop Drawings.

5. Product data for the following:
   a. Welded Steel Pipe and Fittings:
      1) Material data.
      2) Mill certifications, chemical, and physical test reports showing data consistent with specified requirements for each heat of steel proposed for use with pipe, fitting, and special.
   b. Coatings and Linings:
      1) Technical data sheets itemizing chemical composition, technical and performance information that indicates compliance with this Specification.
      2) Color chart, if applicable.
      3) Manufacturer's name, product number or name, and thickness.
   c. Flanged Joints:
      1) For Each Flanged Connection: Reference standard, dimensional data, bolt hole number, pattern and diameter, bolt diameter and length, face condition (raised or flat).
      2) Gaskets and Bolting: Technical data sheets itemizing chemical composition, technical and performance information that indicates compliance with this Specification.
6. Coordinated flange submittal showing the type of flange at each flange connection.
7. Pipe handling equipment and methods for loading and unloading pipe.
8. Stulling Plan: Size, number, location of stulls to be placed in pipe. For pipe that is 30-inch diameter or greater, maximum stull spacing is 15 feet.

B. Informational Submittals:
1. Certificates: Manufacturer's Certificate of Compliance that products furnished meet requirements of this Specification and in accordance with Section 01 43 33, Manufacturers' Field Services.
2. MPS's written Quality Assurance/Control (QA/QC) Plan.
3. Statements of Qualification:
   a. Pipe manufacturer.
   b. Fittings and specials fabricator.
   c. Welder Performance Qualifications and Welder Logs:
      1) Welder Performance Qaulifications (WPQ) test records conducted by MPS and field welding Subcontractor.
      2) Current Welder Logs that include:
         a) Name of welder.
         b) Welding procedures/positions for which welder is qualified to weld.

3) Assigned certification stamp number.
4) Certification date.
5) Current certification status.
6) Reviewer.

d. MPS Certified Welding Inspector (CWI) for shop welding.
e. Jacobs and Subcontractor's CWI for field welding.
f. NDT Personnel Certifications.

4. Procedures:
   a. Shop and Field Welding Information: At a minimum include complete welding code paper trail with linkage to Shop Drawings.
   b. Written WPS, WPQ, and PQR:
      1) Provide complete joint dimensions and details showing bevels, groove angles, root face, and root openings for welds.
      2) Provide notch-tough welding procedures for steel thicknesses equal to or greater than 7/16-inch. For shop welding, address supplementary essential variables in addition to essential variables as indicated in ASME Section IX, QW-251.2. For field welding, heat-input, include control PQR essential variables as indicated in AWS D1.1/D1.1M, Table 4.6. For shop and field welding, provide heat-input table on WPSs for welder guidance.
      3) Document in PQRs for notch-tough welding heat-input control by monitoring volts, amps, and travel speed or time-rate of change of weld metal volume as calculated by measuring change in electrode length over a period of time. Conduct Charpy V-notch tests on weld metal and heat affected zone. Orient test coupons transverse to final direction of rolling. Full size Charpy specimen test acceptance shall be same as base metal specified herein.
      4) Written NDT procedures.
   c. Written description of proposed sequencing of events or special techniques such as:
      1) Controlling pipe wall temperature stress during installation.
      2) Minimizing distortion of steel.
      3) Monitoring pipeline temperatures during installation.
      4) Field coating and lining application and repair.
   d. Written weld repair procedures for the Work.
   e. Field coating application and repair.
   f. Field lining application and repair.
5. Reports:
   a. Source Quality Control Test Reports:
      1) Hydrostatic testing.
      2) Nondestructive weld testing.

3) Steel impact testing using Charpy V-notch method.
4) Letter certifying pipe furnished meets requirements of this Specification.

b. Final Inspection Reports.

c. Field Quality Control Test Reports:

1) Weld tests, including re-examination of repaired welds, on each weld joint for the following tests, as applicable:
a) VT.
b) RT.
c) UT.
d) MT.
e) PT.

2) Coating and lining site visit letter by qualified technical representative certifying Subcontractor is meeting the requirements of the Contract.

3) Applicator's quality control records, including environmental conditions, dry film thickness, and adhesion tests.

6. Field Testing Plan:

a. Submit at least 15 days prior to testing and include following information at a minimum:

1) Testing dates.
2) Piping system and sections to be tested.
3) Joint testing.

7. Design Calculations:

1) Prepared by a licensed professional engineer in the State of California for fittings and specials, including opening reinforcement details of collars, nozzles, wrappers, crotch plates; and harnessed joint assemblies.
2) Submit design calculations before or at the same time as Shop Drawings.

8. Temperature Strees Control Plan:

a. Not required for weld after backfill.

b. For Weld Before Backfill:

1) Submit at least 45 days prior to installing pipe and include at least the following information:
a) Step by step installation procedures and sequencing to demonstrate compliance with temperature control requirements, including:
(1) Pipe installation.
(2) Joint welding of standard joints and temperature control joints.
(3) Pipe bedding and backfill.
b) Methods to ensure compliance with procedures by installation personnel.
c) Equipment to be used to monitor pipe wall temperature.

d) Time of day, climatic, or seasonal installation limits to be used to achieve compliance with temperature control requirements.

1.07 QUALITY ASSURANCE

A. Qualifications:

1. Pipe Manufacturer:
   a. Experienced in fabricating pipe of similar diameters, lengths, and wall thickness required for the Work.
   b. Steel Pipe Fabricators Association (SPFA), Lloyd's Registry Certification, or ISO 9001:2000 Certification.
   c. Demonstrate current production capability for volume of work required for Project.
   d. Experience includes successful fabrication to AWWA C200 standards of similar diameters and wall thickness, within past 5-year period.
   e. Experience applicable to the fabrication plant facilities and personnel completing the Work, not company or corporation that currently owns fabrication facility or employs personnel.
2. Fittings and Specials Fabricator:
   a. Experienced in fabricating fittings and specials of similar diameters and wall thickness required for the Work.
   b. Steel Pipe Fabricators Association (SPFA), Lloyd's Registry Certification, or ISO 9001:2000 Certification.
   c. Demonstrate current production capability for volume of work required for this Project.
   d. Experience includes successful fabrication to AWWA C200 and AWWA C208 standards of at least 100 fittings of 30-inch or larger pipe, with wall thickness 0.1875-inches or greater, within past 5-year period.
   e. Experience includes successful fabrication of at least five crotch plate fittings requiring post weld heat treatment within past 5-year period.
   f. Experience applicable to fabrication shop facilities and personnel, not company or corporation that currently owns fabrication facility or employs personnel.
3. Welders and Welding Operators:
   a. Shop Welders: In accordance with ASME BPVC SEC IX.
   b. Field Welders: In accordance with AWS D1.1/D1.1M.
4. MPS Certified Welding Inspector (CWI) for Shop Welding and Jacobs CWI for Field Welding.

5. NDT Quality Control Personnel:
    a. In accordance with requirements of ASNT SNT-TC-1A, NDT Level II.
    b. At least one NDT person must have 5 years' minimum professional experience related to NDT inspection similar to the Work. Other NDT Level II personnel may work under the supervision of 5 year NDT, provided they have 1 year of related professional experience after receiving NDT qualification.

B. Field Welder Qualifications:
    1. Field Welding Procedures, Welders, and Welding Operators: Qualified in accordance with AWS D1.1/D1.1M.
    2. Welder performance qualifications must have breen conducted by or on behalf of the Contractor (welder certifications conducted by Others will not be accepted).

C. CWI for Field and Shop Welding:
    1. Owner may provide their own welding inspectors for verification inspection. See AWS D1.1/D1.1M, Section 6.1.2.2.
    2. Jacobs and MPS CWI:
        a. In accordance with AWS QC 1, with knowledge of welding code for the Work.
        b. CWI must have 5 years' minimum professional experience related to welding inspection similar to the Work. Other CWIs may work under the supervision of 5-year CWI, provided they have 1 year of related professional experience after receiving CWI qualification.
        c. Provide welding inspection at suitable intervals before, during, and after welding in accordance with the requirements of AWS D1.1/D1.1M, Sections 6.1.3, 6.1.4, and 6.6.1. The presence of the Owner's testing agency and/or welding inspectors does not relieve the Contractor from these code required quality control duties for welding inspection.
        d. Responsibilities:
            1) Verify conformance to use of specified materials and their proper storage.
            2) Monitor conformance to approved WPS.
            3) Monitor conformance to approved NDT procedure specifications.
            4) Monitor conformance of WPQ.
            5) Provide 100 percent VT before, during, and after field welding.
            6) Coordinate NDT work and review test results.
            7) Maintain records and prepare report confirming results of inspection and testing.

D. Prefabrication Meeting:
   1. Hold prior to fabrication of pipe and fittings between representatives of Owner, Jacobs, Subcontractor, and MPS to review following:
      a. Project scope.
      b. Submittal requirements.
      c. Testing.
      d. Inspection responsibilities.
      e. Shop welding requirements.
      f. Field welding requirements.
      g. Shop and field coating and lining requirements.
      h. Production and delivery schedule.
      i. Other issues pertinent to the Work.

E. Inspection of Coating and Lining Application: Inspection requirements for pipeline coatings in accordance with the applicable pipeline coating system specification section.

F. Retain services of a qualified technical representative to:
   1. Test coating and lining system in shop and field in accordance with applicable pipeline coating system specification as selected.
   2. Visit the MPS facility and Site at the beginning of the application process to verify proper workmanship associated with coating and lining application and as may be required to resolve shop or field problems.
   3. Provide certification letter that lining and coating meet specifications and include results of specified tests.

G. Onsite Observation of MPS Field Service Representative:
   1. Make available an experienced MPS staff member to be onsite when requested by Jacobs Engineering and/or Subcontractor.
   2. MPS Field Services: Minimum of 15 person-days.
   3. Subcontractor to provide notification for MPS field services a minimum of 48-hour prior to field services.
   4. The MPS staff member's duties include, but not limited to the following:
      a. Provide field services in accordance with Section 01 43 33, Manufacturers' Field Services.
      b. Inspect pipe upon delivery to site.
      c. Observe pipe handling, moving, storage, and hoisting operations.
      d. Report any concerns to Jacobs' Engineer's onsite observer.
      e. Answer questions and provide assistance to the Owner or Jacobs' Engineer and the Subcontractor.
      f. Inspection and certification of field mortar lining repair and dielectric coating repair of pipe, fittings, or specials when requested.
      g. MPS's written Quality Assurance/Control (QA/QC) Plan.

H. MPS QA/QC Plan Minimum Requirements:

1. Ensure the achievement of adequate quality throughout applicable areas of the Contract.
2. Describe the program and include procedures, work instructions and records.
3. Describe methods relating to areas which require special testing and procedures as noted in the Specifications.
4. Identification and Control of Items and Materials: Procedures to ensure that items or materials that have been accepted at the manufacturing site are properly used and installed. Provide for proper identification and storage, and prevent the use of incorrect or defective materials.
5. Inspection and Tests:
    a. Written procedures and description of defining a program for control of inspections performed.
    b. Perform and document inspections and tests by qualified individuals. At a minimum, "qualified" means having performed similar QA/QC functions on similar type projects. Maintain records of personnel experience, training and qualifications and make available for review by Jacobs' Engineer upon request.
    c. Maintain adequate records of such inspections and tests. Submit inspection and test results.
    d. Include in Procedures:
        1) Specific instructions defining procedures for observing work in process and comparing this work with the Contract requirements (organized by specification section).
        2) Specific instructions for noting deficiencies and steps to be taken to have the deficiency corrected, repaired, or replaced.
        3) Specific instructions for recording observations and requirements for demonstrating through the reports that the Work observed was in compliance or a deficiency was noted and action to be taken.
        4) Procedures to preclude the covering of deficient or rejected Work.
        5) Procedures for halting or rejecting Work.
        6) Procedures for resolution of differences between the QA/QC representative(s) and the production representative(s).
    e. Identify contractual hold/inspection points, as well as any MPS imposed hold/inspections points.
    f. Include procedures to provide verification and control of testing including:
        1) Verifying and noting on Daily Report required testing was performed and documenting results if available. (Include a sample of the MPS's Daily Report.)
        2) Provide location maps for tests performed or location of Work covered by the tests.

3) Maintaining copies of test results.
4) Submitting tests.
5) Ensuring Jacobs' Engineer receives independent copy of tests.
6) Ensuring testing lab(s) are functioning independently and in accordance with the Specifications.
7) Ensuring re-tests are properly taken and documented.

6. Control of Measuring and Test Equipment: Include procedures to adequately maintain, calibrate and adjust measuring and/or testing instruments to maintain accuracy within prescribed limits. Include procedures to perform calibration at specified periods against valid standards traceable to nationally recognized standards and documented.
7. Supplier Quality Assurance: Include procedures to ensure that procured products and services conform to the requirements of the Specifications. Apply requirements of these procedures, as appropriate, to lower-tier suppliers and/or Subcontractors.
8. Nonconformances and Corrective Action: Include procedures for handling of nonconformances. Nonconformances are defined as documentation, drawings, material, equipment or Work not conforming to the specified requirements or procedures. Include procedures for prevention of the use of nonconformances by identification, documentation, evaluation, separation, disposition and corrective action to prevent recurrence. Promptly identify conditions having adverse effects on quality and report to the senior level management. Document and measure cause of conditions adverse to quality. Implement measures to prevent recurrence.
9. Special Processes and Personnel Qualifications:
    a. Include detailed procedures for the performance and control of special process (e.g., welding, soldering, heat treating, cleaning, plating, nondestructive examination, etc.).
    b. Provide personnel performing special process tasks that have the experience, training and certifications commensurate with the scope, complexity, or nature of the activity.
10. Audits: Provide for documented audits to verify that QA/QC procedures are being fully implemented by the MPS as well as its subtiers. Make audit records available to Jacobs' Engineer upon request.
11. Documented Control/Quality Records:
    a. Establish methods for control of Contract Documents which describe how Drawings and Specifications are received and distributed to ensure the correct issue of the document being used.
    b. Maintain evidence of activities affecting quality, including operating logs, records of inspections and tests, audit reports, material analyses, personnel qualification and certification records, procedures, and document review records.
    c. Maintain quality records in a manner that provides for timely retrieval, and traceability. Protect quality records from deterioration, damage, and destruction.

d. Provide a list with specific records as specified in the Contract Documents for submittal at the completion of activities.

e. Provide a CD or DVD with electronic file(s) in PDF format of the Final Inspection Report for each pipe segment, fitting, and special. Final Inspection Report will include detailed record of the source material, fabrication, observations, welding, destructive and nondestructive tests, coating, and lining for each pipe segment, fitting, and special.

12. Acceptance of QA/QC Plan:

a. Jacobs' review and acceptance of the MPS's QA/QC Plan does not relieve the MPS from any of its obligations for the performance of the Work. The MPS's QA/QC staffing is subject to Jacobs' review and continued acceptance. Owner or Jacobs, at its sole option, without cause, may direct the MPS to remove and replace the QA/QC representative. Do not start Work covered by the QA/QC Plan until Jacobs' Engineer's acceptance of MPS's QA/QC plan has been obtained.

b. Jacobs' or Owner's testing agency may perform independent quality assurance audits to verify that actions specified in MPS's QA/QC Plan have been implemented. Audit findings or reports by Jacobs' or Owner's testing agency do not relieve MPS from any requirements of this Contract.

1.08 DELIVERY, HANDLING, AND STORAGE

A. Pipe Marking:

1. Legibly mark installation sequence number on pipe and fittings in accordance with piping layout.
2. Mark special pipe sections and fittings at each end with notation "TOP FIELD CENTERLINE".
3. Paint or mark the word "TOP" on outside top spigot of each fitting.
4. Mark "TOP MATCH POINT" for compound bends per AWWA C208 so end rotations can be easily oriented in field.
5. Percisely paint 3/4-inch insertion band circumferentially around spigot end of each pipe to indicate location of maximum insertion into the bell.

B. Delivery:

1. Securely bulkhead or otherwise seal ends of pipe and fittings prior to loading at manufacturing site.
2. Keep pipe ends sealed until installation.
3. Unload pipe using equipment and methods as approved by MPS and in accordance with MPS pipe handling submittal.
4. Inspect each pipe and fittings for damage. Remove or smooth out any burrs, gouges, weld splatter or other small defects prior to laying the pipe.
5. Repair damage to pipe and fittings, including linings and coatings, found upon delivery to Site or remove from Site and replace.

C. Storage:

1. Support pipe securely to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials.
2. Support on sand or earth berms free of rock exceeding 3 inches in diameter.
3. Carefully handle and protect pipe, fittings, and specials against damage to lining and coating/interior and exterior surfaces, impact shocks, and free fall. Submit pipe handling equipment for acceptance by Jacobs' Engineer. Do not place pipe directly on rough ground but support at the 1/3 and 2/3 points along the length of the pipe section in a manner which will protect the pipe against injury whenever stored at the trench site or elsewhere.
4. Repair damage to pipe, fittings, or specials, including linings and coatings, found in stored pipe in accordance with manufacturer's instructions or remove from site and replace.
5. Gasket Storage: Store rubber gaskets in cool, well ventilated place, and do not expose to direct rays of sun. Do not allow contact with oils, fuels, petroleum, or solvents.
6. Pipe and Specials Protection: Protect with suitable bulkheads the openings of pipe and specials where the pipe and specials have been cement-mortar lined in the shop to maintain a moist atmosphere and to prevent unauthorized access by persons, animals, water or any undesirable substance. Maintain bulkheads, fix tears or replace bulkheads damaged. Introduce water into the pipe to keep the mortar moist where moisture has been lost due to damaged bulkheads.

1.09 SEQUENCING AND SCHEDULING

A. Notify Subcontractor in writing of the following:

1. Pipe Manufacturing: Not less than 14 days prior to starting.
2. Not less than 5 days prior to start of each of the following:
   a. Welding.
   b. Welding of fittings and specials.
   c. Coating application.
   d. Lining application.
   e. Shop hydrostatic testing.

PART 2 PRODUCTS

2.01 GENERAL

A. Pipe Manufacturer:

1. Manufacture of pipe and fabricated specials shall be under the direction and management of one steel pipe supplier only. This does not prevent a separate supplier from manufacturing specials or fittings; however, MPS will direct the Work.

2. Responsibility of MPS includes, at minimum:
    a. Ensure pipe, fittings, and specials are being maufactured in full acccordance with Drawings and Specifications.
    b. Manage the design and fabrication of the pipe and specials.
    c. Prepare and submit submittal information and shop drawings.
    d. Make corrections that may be required to the submittal information and shop drawings.
    e. Certify that the pipe and specials have been manufactured in accordance with the Specifications and Drawings.

B. Pipe Size:
    1. Pipes larger than 24 Inches in Diameter: Unless shown otherwise, the finished inside diameter after lining is the diameter shown in these Contract Documents.
    2. Pipes 24 Inches in Diameter and Less: Diameter shown per ASME B36.10M.

C. Manufacture, test, and inspect steel pipe, fittings, and specials to comply with AWWA C200, C208, and additional requirements of these Contract Documents. Provide the pipe diameter and wall thickness as indicated in these Contract Documents.

D. In lieu of collar reinforcement, pipe, fittings, or specials with outlets may be fabricated in their entirety of steel plate having thickness equal to sum of pipe wall plus required reinforcement.

2.02 PIPE BARREL

A. Steel:
    1. Provide steel coils for spiral welded steel pipe or steel plate for straight seam welded steel pipe per AWWA C200 and as follows:
        a. ASTM 1018 SS Grade 36, Type 1.
        b. Specified Minimum Yield Strength: 36,000 psi.
        c. Specified Minimum Tensile Strength: 53,000 psi.
        d. Minimum Elongation in 2-Inch Gauge Length: 25 percent.
            1) If measured elongation is less than 25 percent, then conduct four additional sets of production weld bend tests per heat of steel used for pipe fabrication
        e. Weld-Ability: Maximum carbon equivalent of 0.45, as measured using AWS D1.1/D1.1M, Annex XI, Guideline on Alternative Methods for Determining Preheat formula: CE=C+(Mn+Si)/6+(Cr+Mo+V)/5+(Ni+Cu)/15.

f. Pressure Vessel Quality as follows:
   1) Coils: Continuous cast process, fully-killed, fine grained practice conforming to physical, manufacturing and testing requirements of ASTM A1018/A1018M, Structural (SS) Grade 36, Type 2 (modified).
   2) Plate:
      a) Fully-killed, conforming to ASTM A20/A20M, fine grained practice conforming to physical, manufacturing and testing requirements of ASTM A516/A516M, Grade 65 or Grade 70.
      b) Steel Chemistry: Conform to ASTM A516/A516M, Grade 65 or Grade 70. Normalize steel plates that are 3/4-inch thick or greater.
   3) Toughness:
      a) Charpy V-notch Acceptance Criteria (Steel Mill): Wall thickness equal to or greater than 7/16 inches. Transverse specimen orientation, full size specimens,25 foot-pounds energy at test temperature of 30 degrees F.
      b) Frequency: See Paragraph Steel Toughness Testing for Thickness Equal to or Greater than 7/16 inches.

g. Wall Thickness:
   1) Base metal thickness supplied is to meet or exceed the minimum wall thickness as shown on Drawings. No variation or under-tolerance less than the specified minimum wall thickness will be allowed or accepted.
   2) When not shown on Drawings, use standard weight in accordance with ASME B36.10M.

2.03 FITTINGS AND SPECIALS

A. Fabrication:
   1. Shop fabricate. No field fabrication will be allowed, unless approved by Jacobs' Engineer.
   2. Fabricate from materials or straight pipe in full conformance with requirements of these Contract Documents and dimensions of AWWA C208, unless otherwise indicated.

B. Wall Thickness:
   1. General:
      a. Refer to ASME B36.10M for definitions of wall thickness for standard weight pipe and nominal pipe size (NPS).
      b. Reinforce to withstand either internal pressures, both circumferential and longitudinal, or external loading conditions, whichever is greater.
      c. Minimum handling thickness shall be the steel cylinder outside diameter divided by 160.

d. Minimum Thickness: The greater of adjacent mainline pipe, thickness shown on Drawings, thickness calculated as hereinafter specified, or minimum thickness required for handling

C. Elbows, Unless Otherwise Indicated:
1. Minimum Radius: 2.5 times pipe diameter unless specifically indicated on Drawings.
2. Minimum Wall Thickness: Greater of Table 1 above, wall thickness of adjoining pipe, or, if radius shown on Drawings is less than 2.5 times pipe diameter, as calculated using equations 7-3 or 7-4 in Chapter 7 of AWWA M11, Fifth Edition.
3. Maximum Miter Angle: 11-1/4 degrees on each section resulting in a maximum deflection angle of 22.5 degrees per miter weld as recommended in AWWA C208.
4. Bevels: Vary bevels on miters to provide a constant weld groove angle. For 11-1/4-degree miter, (22.5-degree miter weld) bevels must vary from 18.75 degrees on OD of bend to 41.25 degrees on ID of bend to provide a constant 60-degree groove angle for CJP welding.
5. Complete joint penetration (CJP) welds required for all miter welds.

D. Steel Butt-Weld Fittings:
1. 24 Inches and Smaller: In accordance with ASME B16.9 conforming to ASTM A234/A234M.
2. Standard weight.
3. Taper pipe wall at welds at 4:1 for connection to pipe of different wall thickness.
4. Coordinate difference in diameter convention between specials and AWWA C200 and AWWA C208 pipe and fittings to provide complete piping system as shown.

2.04 WELDED JOINTS

A. Shop Welded:
1. Fabricate in accordance with AWWA C200 as modified herein.
2. Use complete joint penetration (CJP) butt joints for longitudinal, girth, and spiral welds, unless otherwise indicated.
3. Do not shop-join lengths of pipe using lap joints.

B. Preparation of Joints for Field Welding:
1. Butt Joints:
a. Plain ends beveled as required by AWWA C200 and Contractor's field WPS.
1) Tolerances on CJP butt joint beveled ends are to permit field assembly of pipe ends within workmanship assembly tolerances per AWS D1.1/D1.1M.

2) Provide protection for factory beveled pipe ends so that ends are not damaged during transport.

b. Taper pipe wall at welds at 4:1 for connection to pipe of different wall thickness.

2. Lap Joints:

a. Single fillet lap joint is the standard, unless otherwise shown on Drawings.

b. For pipe 30 inches in diameter and larger, precisely paint a circumferential 3/4-inch insertion band (leading edge of band indicating minim insertion; tailing edge of band indicating maximum insertion; pulled joints to occur within band around entire circumference) around the outside of spigot end to indicate location at which spigot end has reached required penetration into bell.

c. MPS to tap and drill double fillet lap and butt-strap welded lap joints for testing from the outside in accordance with AWWA C206 and Drawings.

d. Preparation for field welding: In accordance with Drawings and AWWA C200.

C. Miter-End Cuts:

1. As shown on Drawings.

2. Welded Lap Joints:

a. Moderate deflections and long radius curves may be made using miter-end cuts.

b. Use only with lap welded joints, unless specifically approved in writing by Jacobs' Engineer.

c. Maximum Total Allowable Angle: 3 degrees per pipe joint.

d. Mitering allowed on bell end only; mitering of spigot ends will not be permitted.

e. Cold expand miter cut square with face of miter-cut on bell ends.

3. Welded Butt Joints:

a. Maximum Total Allowable Angle: 2.5 degrees per pipe joint.

b. Minimum Pipe Wall Thickness: 3/8-inch.

c. Welding: CJP required.

2.05 FLANGES

A. In accordance with AWWA C207 Class D unless otherwise indicated on Drawings.

B. Flange gaskets shall conform to AWWA C207 and flange pressure rating.

C. Field coating for access manways, flanges, blind flanges, and couplings to be in accordance with Section 09 90 00, Painting and Coating. For buried flanges, blind flanges and couplings, also apply in the field (after joint assembly) a wax

tape coating in accordance with AWWA C217. Use manufacturer's filler to eliminate voids and provide smooth surface for tape.

D. Blind Flanges:

1. In accordance with the appropriate standard determined by the maximum operating pressure.
2. Blind flanges for pipe sizes 12 inches and greater shall be provided with lifting handle or lifting eyes welded to the flange as shown on Drawings.

2.06 BOLTS AND NUTS FOR FLANGES

A. Carbon steel bolts per ASTM A193, Grade B7 and nuts per ASTM A194, Grade 2H.

B. Provide bolt length not less than 1/4-inch and not more than 1/2-inch projecting in a nut tightened position. Provide hexagonal bolt heads and nuts. Provide washers for each nut. Provide washers and nuts of the same material.

C. Lubricant for Bolt and Nut Threads: Chloride free and TRX-Synlube by Ramco, Anti-Seize by Ramco, Husk-It Husky Lube O-Seal, "or-equal."

D. Threaded Caps for Nuts and Bolts: Provide threaded grease caps for flange bolts and threaded rods and dismantling joints. Match grease cap threads to bolt threads. Fill caps with anticorrosive (NSF/ANSI 61 and 372) lubricant to prevent threads from corroding. Caps shall be suitable to use in exposed and submerged service at from minus 40 degrees F to 200 degrees F.

1. Bolts 1-1/4-Inch Diameter and Less: Use silicone rubber caps to match bolt and nut dimensions.
    a. 50 durometer Shore A hard, ASTM D2240.
    b. 800 psi min tensile strength, ASTM D412.
    c. 200 percent minimum elongation per ASTM D412.
    d. 75 psi minimum tear strength per ASTM D624.
    e. Manufacturer: MOCAP Silicone Rubber Caps.
2. Bolts Over 1-1/4-Inch Diameter: Use black high density polyethylene caps by either: Sap-Seal Products, Inc.; Advance Products and Systems, Inc., "Radolid"; "or-equal."

2.07 WELD LEAD OUTLETS

A. Show outlets for welding leads, if used, on Shop Drawings. Number and location of outlets to be determined at the Contractor's option.

B. Provide plugs used for closing weld lead outlets suitable for the internal pressure and allow zero leakage. Close weld plugs after completion of Work.

2.08 PIPE MARKING TAPE

A. As specified in Section 31 23 23.15, Trench Backfill.

2.09 PIPE BEDDING AND PIPE ZONE MATERIAL

A. As specified in Section 31 23 23.15, Trench Backfill.

2.10 TRENCH STABILIZATION MATERIAL

A. As specified in Section 31 23 23.15, Trench Backfill.

2.11 CATHODIC PROTECTION

A. Provide as shown on Drawings.

2.12 TEMPERATURE MEASURING INSTRUMENTS

A. Provide industrial thermocouple thermometer gauges or digital, infrared thermometers, aka, “heat guns” for field measurement of pipe temperatures.

B. Minimum Thermocouple Thermometer Gauge Requirements:
   1. Type K, wide probe, calibration in degrees F, maximum, minimum, hold, store and recall, clear.
   2. Accuracy to plus or minus 2 degrees F.
   3. Rugged and waterproof for field conditions.

C. Minimum Digital Infrared Thermometer Requirements:
   1. Temperature Range: No less than minus 20 degrees F to 200 degrees F.
   2. Accuracy to plus or minus 1 percent.
   3. Distance to spot ratio of no less than 20:1.
   4. Rugged and waterproof for field conditions.

2.13 STULLING (STRUTTING)

A. Materials:
   1. Shop-Lined Pipe: Wood stulls and wedges.
   2. Unlined Pipe: Steel or wood.

B. Install stulling for 30-inch and larger pipe, specials, and fittings in accordance with approved submittal and as soon as practical after pipe is fabricated or, for shop-lined pipe, after lining has been applied.

C. Install stulling in manner that will not harm lining by utilizing softeners such as carpet, rubber, or another barrier material to protect the lining.

2.14 COATINGS AND LININGS

A. Coating and Lining: In accordance with Section 09 90 00, Painting and Coating.

B. Pipeline shall be cement mortar lined unless specified otherwise on Drawings.
   1. General:
      a. Notify Jacobs at least 5 days prior to application of lining products.
      b. Holdback of lining from field-welded joints shall be as shown on Drawings.
   2. Shop-Applied:
      a. Applied centrifugally in conformance with AWWA C205. Thickness shall be in accordance with AWWA C205.
      b. Lining machine type that has been used successfully for similar work and approved by Engineer.
      c. Maintain pipe in round condition during lining operation and thereafter by suitable bracing or strutting.
      d. Provide polyethylene or other suitable bulkhead on ends of pipe and on special openings to prevent drying out of lining. Bulkheads shall be substantial enough to remain intact during shipping and storage until pipe is installed.
      e. Pipe shall be left bare where field joints occur.
      f. Ends of lining shall be left square and uniform. Feathered or uneven edges will not be permitted.

C. Field Coating and Lining of Joints: In accordance with Section 09 97 13.02, Pipeline Joint Coating.

2.15 SOURCE QUALITY CONTROL

A. Steel Toughness Testing for Thickness Equal to or Greater than 7/16 Inches:
   1. Include three impact specimens; conduct test in direction transverse to final direction of the coil rolling.
   2. Coils:
      a. Conduct Charpy Testing per ASTM A370 on an initial coil of each heat to establish uniformity of steel.
      b. Take test coupons from an initial coil of each heat at locations of outer and inner wrap of coil.
      c. For each coil that fails to meet acceptance criteria, conduct Charpy Testing on next two coils in that heat.
      d. Do not use coils that do not qualify in production of pipe.

3. Plate:
    a. Conduct Charpy Tests on each plate in accordance with ASTM A20/A20M.
    b. Conduct on full-size (10 mm by 10 mm) specimens from each plate in accordance with ASTM A20/A20M.
    c. Do not use plates that do not qualify in production of pipe.

B. Shop Hydrostatic Pressure Test: In accordance with AWWA C200 Section 5.2, except as follows:
    1. General: Unless specified otherwise, perform testing of pipe, fittings, and specials before lining and coating is applied.
    2. Pipe: Maintain test pressure for minimum of 5 minutes.
    3. Fittings and Specials:
        a. If fabricated from untested straight pipe, test to minimum pressure equal to field test pressure.
        b. Except as otherwise specified herein, no additional shop hydrostatic test will be required on fittings and specials fabricated from successfully tested straight pipe and where new welds are tested as specified.
        c. Hydrostatically test fittings and specials with crotch plates, regardless of whether or not straight pipe sections used were previously tested.
        d. Maintain test pressure for a minimum of 5 minutes or the length of time as required to perform a visual inspection of welds.
        e. No leakage is allowed.

C. Joints, Lap-Welded:
    1. Fit test minimum of 5 joints, selected by Jacobs' Engineer, of each pipe size used:
        a. Join pipe ends with proposed adjacent pipe end.
        b. Match-mark pipe ends.
        c. Record Actual Annular Space:
            1) Maximum space at a point.
            2) Minimum space at a point.
            3) Space at 90-degree intervals; top, bottom, and spring line on both sides.

D. Shop Nondestructive Testing:
    1. Welds: 100 percent visually examined by Field CWI to criteria in ASME BPVC SEC VIII, Division 1.

2. Butt-Joint Groove Welds: Spot radiographically examine pipe in accordance with ASME BPVC SEC VIII, Div. 1, Par. UW-52. 100 percent ultrasonically examine welds that, in opinion of Jacobs' Engineer, cannot readily be radiographically examined; acceptance criteria in accordance with ASME BPVC SEC VIII, Division 1, UW-53. All joints at tees and outlets shall receive 100 percent UT inspection. S
3. Fillet Welds: 100 percent examine using magnetic particle inspection method in accordance with ASME BPVC SEC VIII, Division 1, Appendix 6.
4. Air test collars and wrappers in accordance with AWWA C206.

PART 3 EXECUTION

3.01 GENERAL

A. Install piping complete with jointing materials and accessories, anchors and other appurtenances.

B. Prepare trench as specified in Section 31 23 16, Excavation. Keep trench dry until pipe installation is complete.

C. For field-welded joints, pipe 30 Inches in diameter and larger:
   a. Ensure minimum penetration of spigot end into bell end is achieved through use of painted circumferential marking on outside of spigot end or through use of shop-welded tabs on inside circumference of bell end.
   b. If welded metal tabs are used, remove tabs prior to welding inside of joint.

D. Stulling:
   a. Maintain stulling in place until pipe is completely backfilled and compacted.
   b. Reinstall stulls that were temporarily removed to facilitate interior welding prior to backfilling.

E. Perform electrical coating inspection of each pipe segment and fabricated special prior to placing pipe in trench.

3.02 LAYING PIPE

A. Trenching, Embedment, and Backfilling of Buried Piping: In accordance with Section 31 23 16, Excavation, Section 31 23 23.15, Trench Backfill, and Drawings. Do not install pipe when water is in the trench. Repair coating where required.

B. Before placement of pipe in the trench, ensure each pipe, fitting, and specials are clean of any foreign substance. Keep clean thereafter. For this purpose, cover the openings of pipes, fittings, and specials in the trench during non-working hours.

C. Handle pipe with proper equipment in a manner to prevent distortion or damage. Use of hooks, chains, wire ropes, or clamps that could damage pipe, damage coating or lining, or kink and bend pipe ends is not permitted. Use heavy canvas, or nylon slings of suitable strength for lifting and supporting materials.

D. Lift pipe during unloading or lifting into trench using one or more slings as required to prevent uncontrolled swinging, damage to pipe, or harm to workers. Slings shall bear uniformly against pipe.

E. If pipe zone material is CLSM, lay pipe directly on moist sand bag supports in preparation for CLSM. Place sand bag supports to provide at least 6 inches of CLSM below bottom of pipe. Space supports at a maximum interval of 8 feet and one set within 3 feet on both sides of each joint. Provide additional sand bags as needed to support pipe on line and grade. Provide buoyancy calculations prior to CLSM placement to verify that the pipe will not float during CLSM placement.

F. Form bell holes at the ends of pipe to prevent point loading at the bells or couplings. Make excavation outside normal trench section at field joints for field connections and application of coatings.

G. Out-of-Round Pipe: Install straight pipe that deviates from a true circle by more than 1 percent with its larger diameter vertical, or by using struts on continuous head and sill timbers to correct the vertical diameter where acceptable to Jacobs' Engineer. Perform final inspection, repair, and checking of interior lining after the struts have been removed.

H. Lay each section of pipe in the order and position shown on the shop drawings and pipe layout. Lay to the set line and grade. Confirm to installation tolerances as hereinafter specified.

I. Install horizontal and vertical deflections and fabricated angles on alignment, as shown except as may be required for beveling a single end either side of a deflection.

J. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, Jacobs' Engineer may change the alignment and/or the grades. Make changes by the deflection of joints, by the use of beveled joints, or by the use of fittings. No joint shall be misfit any amount that will be detrimental to the strength and water tightness of the finished joint, including the strength and water tightness of the protective lining at the finished joint.

K. Make minor field adjustments by pulling standard joints. The allowable deflection of field joints is as follows:

1. Maximum Allowable Angle: 75 percent of manufacturer's recommended, or angle that result from 3/4-inch pull out from normal joint closure, whichever is less.
2. Maximum Allowable Gap: 1/8 inch between bell and spigot at weld location.
3. No minor deflections (pulls) are allowed at beveled ends.

L. For grades exceeding 10 percent lay pipe in an uphill direction except for short runs that may be permitted by Jacobs' Engineer. Block pipe which is laid on a downhill grade and hold in place until sufficient support is furnished by the following pipe to prevent movement.

M. Whenever pipe laying is stopped at the end of the day, seal the open end of the line and close access manholes to prevent entry by unauthorized personnel, animals, dirt, and debris. Maintain continuous dewatering when necessary to prevent water from entering the pipeline. Remove water from the trench in accordance with Section 31 23 16, Excavation, and Section 31 23 19.01, Dewatering, prior to resuming pipe laying operations.

N. Alignment and Grade:
   1. Lay pipe to the lines and grades indicated on Drawings.
   2. Pipelines or runs intended to be straight are to be laid straight.
   3. Curves in push-on joint pipe may be formed by opening the joint.
   4. Maximum Joint Openings and Deflections: 75 percent of that recommended by the pipe manufacturer. In welded pipe, deflections up to 3.0 degrees at a single joint may be made by factory-mitering the bell end of one pipe.
   5. Use survey equipment to indicate alignment and grade. Take at least one elevation reading on each length of pipe. Make periodic elevation measurements with surveying instruments to verify accuracy of grades.
   6. Verify survey set up at least daily using an independent benchmark or temporary benchmark.

O. Tolerances:
   1. Alignment and Grade Tolerances:
      a. Plus or minus 0.20 foot in grade (elevation). High and low points will not be acceptable, except where indicated on Drawings.
      b. Plus or minus 0.33 foot in alignment, except where indicated differently on Drawings.
   2. Observe stricter tolerances than specified above as necessary to maintain minimum cover, to maintain required clearances, to place carrier pipe inside the casing pipe, to make pipe connections to existing piping, to maintain the correct slope in the run to prevent high or low points along the pipeline other than those locations indicated on Drawings.

P. Protection of Pipe: Take precautions to protect the pipe from damages at locations where the Contractor proposes to cross the installed pipeline with heavy equipment. Acceptable precautions include: backfilling the pipe trench as necessary to protect the pipe, concrete encasing the pipe, and placing steel plating over the pipe. Repair damage to the pipe.

Q. Pipe Deflection: After completion of backfilling and before acceptance of the Work, test for excessive deflection on pipes larger than 30 inches in diameter. Determine diametral deflection by measuring the inside diameter along the horizontal axis (Dx) and the vertical axis (Dy). The deflection, Δx, is then calculated by the following equation.

$$\Delta x = \left(\frac{Dx - Dy}{Dx + Dy}\right) x\,100$$

Do not exceed 75 percent of the AWWA allowable pipe diametral deflection, Δx, at any point in the pipe in accordance with AWWA M11. Correct diametral deflection percent to less than the required percent.

R. Cleaning: Remove stulling after the pipeline is completely backfilled and compacted, soil, loose mortar, and any other debris from inside the pipeline. Thoroughly sweep out and clean pipeline interior.

3.03 JOINTING

A. General: Interior joint welding after backfilling is allowed. Perform welding of joints in accordance with this section. See Section 09 81 12, Pipe Joint Coating.

B. Flanged Joints: Before the joint is assembled, thoroughly clean the flange faces of foreign material. Center the gasket in the connecting flanges and draw up watertight without unnecessarily stressing the flanges. Tighten bolts in a progressive diametrically opposite sequence with a suitable, approved and calibrated torque wrench. Torque values and method and required gasket clamping force as recommended by the gasket manufacturer. Apply clamping torque to the nuts only. Use bolt tightening techniques that assure that suitable clamping force is applied to the gasket. Gaskets shall be leak free after assembly. Leaking gasketed joints resulting at joint where only clamping torque is measured to determine proper bolt tension and clamping force shall be deem the result of improper transfer of torque to clamping force due to Subcontractor's bolt tightening methods.

C. Use wrenches in bolting couplings of a type and size recommended by the coupling manufacturer. Tighten coupling bolts so as to secure a uniform annular space between the follower rings and the body of the pipe with bolts tightened approximately the same amount. Tighten diametrically opposite bolts progressively and evenly. For final tightening, use a suitable, approved and calibrated torque wrench set for the torque recommended by the coupling manufacturer. Apply clamping torque to the nut only.

D. Welded Joints:

1. Perform welding only when the Field CWI is on-site and agreed that welding can proceed.
2. Use butt welds for welded joints in pipe assemblies and in the fabrication of bends and other specials and as indicated.

3. Field-welded joints to be either welded butt strap joints, welded butt joints, or welded lap joints as indicated on Drawings. Conform to AWS D1.1/D1.1M, AWWA C206, and approved welding procedures. AWS D1.1/D1.1M governs in case of conflict.
4. Determine preheat and interpass temperature requirements for unlisted base metals according to AWS D1.1/D1.1M, Annex H Guideline on Alternative Methods for Determining Preheat.
5. Repair and retest rejectable welds until sound weld metal has been deposited in accordance with appropriate welding codes.
6. Where double lap joint welds are performed, provide adequate space for welding and inspection of the joints.
7. When fitting up the ends of pipe to be welded or fitting butt-strap pieces, minor jacking or clamping will be allowed. Cold working the metal with sledges or localized application of heat will not be allowed. Shop fabricate and install special closure butt straps or mitered pieces if field displacement of joints where butt strap joints are indicated does not allow proper fit up with the tolerances indicated.
8. Welded Lap Joints: During installation of welded steel pipe in either straight alignment or on curves, lay the pipe so that at any point around the circumference of the joint there is a minimum lap as shown on Drawings. Hold back the toe of the weld from the nearest point of tangency of the bell radius as shown on Drawings.
9. Prior to beginning the welding procedure, equally distribute annular space between the faying surfaces of the bell and spigot around the circumference of the joint by shimming, jacking, or other suitable means. Perform welding in a manner that will maintain the equalized fitup.
10. Welded Lap Joints (General): During installation of welded steel pipe in either straight alignment or on curves, lay the pipe so that at any point around the circumference of the joint there is a minimum lap as shown on Drawings. Hold back the toe of the weld from the nearest point of tangency of the bell radius as shown on Drawings. Prior to beginning the welding procedure, equally distribute annular space between the faying surfaces of the bell and spigot around the circumference of the joint by shimming, jacking, or other suitable means. Perform welding in a manner that will maintain the equalized fitup.
11. Welded Butt Joints: CJP and groove welds.
12. Single Lap Welded Joints:
    a. Control of Temperature Stresses:
        1) Control temperature stresses in accordance with AWWA C206, the submitted and accepted temperature stress control submittal, and these Specifications.
        2) Provide and install thermocouple temperature gauges on the inside top of the pipe or use infrared thermometers to monitor the temperature of the steel pipe wall as it lays in the trench.

3) Measure the pipe temperature at the top of the steel cylinder. Meet specific temperature requirements for the pipeline steel cylinder during welding of the pipe joints. The following outlines the specific temperature control requirements:
   a) Proceed with placement of pipe zone and trench zone material in the direction of pipe laying from welded joints to unwelded joints.
   b) Place trench zone material to a minimum of 3 feet above the pipeline, or to a cover necessary to meet the required pipe temperature for welding of joints, whichever is greater.
   c) Prior to welding the pipe joints, maintain the temperature of the pipe sections to be welded at or below 80 degrees F and at or above 40 degrees F. Allow pipe to adjust to ground (backfill) temperature overnight, or longer if required, prior to welding joints. Maintain pipe temperature within in the specified range while welding the joint. Use thermocouple or infrared thermometer data to demonstrate to Jacobs the pipe temperature is within specified limits.

13. Welding Procedures:
    a. Contractor's Field Welding Inspector:
       1) Upon completion of each field-welded joint, record the welder's name, location on the weld, and results of VT.
       2) Maintain these records and submit to Owner each week.
    b. Allow Owner's inspectors and Jacobs' Engineer access to field welded joints to perform NDT.

3.04 REPAIR OF SHOP-APPLIED COATINGS

A. Inspect exterior surfaces of steel pipe, fittings, and specials upon delivery to Site and just prior to backfilling trench.

B. In accordance with coating system provided.
   1. Section 09 90 00, Painting and Coating.
   2. Section 09 81 12, Pipe Joint Coating.

C. Perform electrical coating inspection after coating repair.

3.05 COATING OF FIELD-WELDED JOINTS

A. Pipe with dielectric coating: Apply heat-shrinkable coating application as specified in Section 09 81 12, Pipe Joint Coating.

3.06 CATHODIC PROTECTION

A. Apply to pipe as shown on Drawings.

3.07 FIELD QUALITY CONTROL

A. Electrical Coating Inspection: Perform in accordance with Section 09 90 00, Painting and Coating.

B. Field Welding:
   1. Perform VT inspection on 100 percent of welds and mark to indicate acceptance or rejection.
   2. In the presence of Owner's inspector and Jacobs' Engineer, test butt-strap or double-welded lap joint welds by pressurizing connection between the two fillet welds in accordance with AWWA C206.
      a. Apply air or other Jacobs' Engineer-approved gas into connection between the two fillet welds.
      b. Paint welds with soap solution.
      c. Mark leaks indicated by escaping gas bubbles.
      d. Close threaded openings with flush pipe plugs or by welding them.
   3. Coordinate the Work with Field CWI to inspect 100 percent of butt joint groove welds with full circumference RT.
   4. Coordinate the Work with Field CWI to inspect 100 percent of single lap joint, interior and exterior double lap joint, and butt-strap joint welds with full circumference VT, and PT or MT.
   5. Weld Acceptance:
      a. VT: Perform VT per AWS D1.1/D1.1M Paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.
      b. UT: Perform UT of CJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 6.13.1.
      c. RT: Perform RT of CJP butt joint welds in accordance with AWS D1.1/D1.1M, Paragraph 6.12.1.
      d. PT or MT:
         1) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 6.10.
         2) Acceptance: In accordance with VT standards specified above.
      e. Remove defective welds in manner that permits proper and complete repair by welding.
      f. Caulking or peening of defective welds is not permitted.
      g. Retest unsatisfactory welds.

C. Hydrostatic Testing:
   1. Pipeline:
      a. General:
         1) Notify Jacobs in writing 5 days prior to testing. Perform testing in presence of Jacobs.

2) Test newly installed pipelines. Using water as test medium, pipes shall successfully pass a leakage test prior to acceptance.

3) Furnish testing equipment and perform tests in manner satisfactory to Jacobs. Testing equipment shall provide observable and accurate measurements of make-up water under specified conditions.

4) Isolate new pipelines that are connected to existing pipelines.

5) Conduct field hydrostatic test on buried piping after trench has been completely backfilled. Testing may, as approved by Jacobs, be done prior to placement of asphaltic concrete or roadway structural section.

6) Contractor may, if field conditions permit and as determined by Jacobs, partially backfill trench and leave joints open for inspection and conduct an initial service leak test. Final field hydrostatic test shall not, however, be conducted until backfilling has been completed as specified above.

7) Supply of temporary water shall be as stated in Section 01 50 00, Temporary Facilities and Controls.

8) Dispose of water used in testing in accordance with federal, state, and local requirements.

b. Procedure:

1) Maximum filling velocity shall not exceed 1 foot per second, calculated based on the full area of pipe.

2) Expel air from pipe system during filling. Expel air through air release valve or through corporation stop installed at high points and other strategic points.

3) Test Pressure: 70 psi but in no case less than 65 psi.

4) Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.

5) Maintain hydrostatic test pressure continuously for 2 hours minimum, adding additional make-up water only as necessary to restore test pressure.

6) Determine actual make-up water by measuring quantity of water necessary to maintain specified test pressure for duration of test.

7) If measured make-up water exceeds allowable or if leaks are visible, repair defective pipe section and repeat hydrostatic test.

c. Allowable Leakage: Pipe with welded and flanged joints shall have zero allowable leakage.

d. In the case of pipelines or pipeline sections that fail to pass the prescribed leakage test:

1) Determine the cause of the leakage and take corrective measures necessary to repair the leaks.

2) Retest the repaired section using the prescribed procedure.

3) Continue repair and retest procedures until the tested section passes the test.

3.08 MANUFACTURER'S SERVICES

A. Manufacturer's representative available at Site for installation assistance and training of pipe installation crews.

1. Coordinate pipe manufacturer's representative services.

2. Visit the Site and instruct, guide, and provide procedures for pipe handling, laying, and jointing at start of pipe installation by each crew.

END OF SECTION

SECTION 33 05 01.08
FIBERGLASS REINFORCED POLYMER PIPE AND FITTINGS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Water Works Association (AWWA):
      a. C950, Fiberglass Pressure Pipe.
      b. Manual M45, Fiberglass Pipe Design.
   2. ASTM International (ASTM):
      a. D2412, Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
      b. D3681, Standard Test Method for Chemical Resistance of "Fiberglass" (Glass-Fiber-Reinforced. Thermosetting-Resin) Pipe in a Deflected Condition.
      c. D3754, Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe.
      d. D4161, Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.
      e. E329, Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

1.02 DEFINITIONS

A. Pipe Stiffness Classification: Referred to as SN.

B. Pressure Class: Referred to as PN.

1.03 SUBMITTALS

A. Action Submittals:
   1. Detailed pipe fabrication drawings showing pipe details, special fittings and bends, joint types, dimensions, coatings, standards for design, and other pertinent information.
   2. Layout drawing showing location of each pipe section and, if special sections are provided, each special length.
   3. Pipe pressure class and pipe stiffness.
   4. Details for connections to centrifugally cast fiberglass mortar pipe material and other nonfiberglass pipe material.

5. Wall thickness calculations demonstrating that the submitted pipe complies with AWWA M45 for the project conditions. Utilize a maximum constrained soil modulus of 1,000 pounds per square inch. Calculations shall be sealed by a licensed professional engineer.
6. Product Data:
    a. Manufacturer's data for joints, couplings, fittings, saddles, gaskets, and other pipe accessories. Indicate maximum rated working pressure and test pressure for each item. Indicate storage requirements, installation, and repair instructions.
    b. Lining and coating data for protection of metallic fittings.

B. Informational Submittals:
1. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, that products furnished meet requirements of this section.
2. Provide historical data indicating that polyester resin systems have proven history of performance for use with pipe similar in construction and composition to proposed product.
3. Letter from independent testing agency certifying that pipe furnished meets requirements of this section.
4. Report from Contractor identifying vertical cross-section deflections after completion of backfilling and removal of dewatering systems.
5. Leakage Testing Submittals, as specified in Section 40 80 01, Process Piping Leakage Testing.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials specified in this section shall be products of:
1. Thompson Pipe Group, Flowtite; Zachary, LA, USA.
2. "Or-equal."

2.02 MATERIALS

A. Pipe:
1. Provide fiberglass reinforced polymer pipe manufactured according to standards of AWWA C950 and ASTM D3754 for the following service conditions and design requirements:
    a. Application: Wastewater process piping.
    b. Pressure Class: PN 50 psi unless shown otherwise.
    c. Stiffness Class: 72 psi.
    d. Strain Corrosion: The extrapolated 50-year strain corrosion value shall not be less than 0.9 percent as determined in accordance with ASTM D3681 and ASTM D3262.

2. Resin:
   a. Polyester resin.
   b. Use only resin system with proven history of performance for pipe manufacturer.
   c. Historical data shall have been acquired from composite material of similar construction and composition as proposed product.
3. Glass Reinforcement:
   a. Glass Fibers: Highest quality commercial Grade E glass filaments with binder and sizing compatible with impregnating resins.
4. Silica Sand: Minimum 98 percent silica with maximum moisture content of 0.2 percent.
5. Additives: Curing agents, pigments, dyes, fillers, thixotropic agents, when used, shall not detrimentally affect performance of product.
6. Lengths:
   a. Supply pipe in nominal lengths of 20 feet.
   b. Actual laying length shall be nominal plus 1 inch, minus 4 inches.
   c. Furnish a minimum of 90 percent of pipe in each pipe class of pipe in nominal length sections.
7. Pipe Ends: Pipe ends shall be square to the pipe axis with a maximum tolerance in accordance with ASTM D3754.

B. Joints:
1. In conformance with ASTM D3754 and ASTM D4161, rated for minimum working, test, and surge pressures, and stiffness equivalent to pipe barrel itself.
2. Unless otherwise shown, joints shall be restrained.
   a. For pipe diameters 54 inches and lower, utilize double bell coupling with elastomeric sealing gaskets and locking rods-groove system to maintain joint watertightness and to transfer axial loads.
      1) Restrained Coupling; Flowtite Keylock Coupling (KLJ), “or-equal.”
      2) Install in accordance with manufacturer requirements.
      3) Coupling shall be rated for same or greater pressure as the pipe.
   b. For pipe diameters larger than 54 inches, utilize fiberglass laminate wrap system to maintain joint watertightness and to transfer axial loads.
      1) Laminated Joint; Flowtite Butt Weld Joint (BWJ), “or-equal.”
      2) The number of layers of laminate required for each joint shall be specified by the FRP pipe manufacturer.
      3) Laminated joints shall be balanced with layers of laminate on both the interior and exterior of the pipe.

4) Install laminate joint in accordance with the manufacturers recommendations and as specified herein.

3. Joints and couplings shall be rated for working and test pressures, even under deflected conditions. Gaskets shall be suitable for service conditions and loads indicated.
   a. Joint Lubricant shall be suitable for service conditions and as recommended by manufacturer.
   b. Joints at tie-ins, when needed, may utilize gasket sealed closure couplings.
4. Gaskets: Elastomeric gaskets meeting ASTM F477 and supplied by a qualified gasket manufacturer. Suitable for service conditions and loads indicated.
5. Joint Lubricant: Suitable for service conditions and as recommended by manufacturer and approved by Jacobs' Engineer.
6. Flanged:
   a. Where indicated on Drawings.
   b. Rated for service conditions indicated.
   c. Compatible with other pipe material mating flanges as required.
7. Connections to Other Pipe Materials, Fittings, or Valves: Connecting joints as indicated on Drawings and approved Shop Drawings.

C. Fittings:
1. Manufactured according to same standards as pipe and rated for working conditions specified.
   a. Fitting Joints: Meet design requirements specified for straight pipe.
2. Flanges, elbows, reducers, tees, wyes, bifurcated wyes, laterals, and other fittings may be contact molded or manufactured from mitered sections of pipe joined by glass-fiber-reinforced overlays, as suitable for service conditions indicated.

2.03 SOURCE QUALITY CONTROL

A. Pipe supplied shall not be taken from manufacturer's inventory, but shall be fabricated specifically for this Project.

B. Inspection of Pipe Fabrication Procedure: Select and provide independent testing agency to observe pipe fabrication. Provide agency staff with experience in observation of pipe fabrication in accordance with ASTM E329. Representative of the agency shall be present full time while pipe is being fabricated and while protective coating and lining is applied. Provide a letter to Construction Manager and Jacobs' Engineer certifying that pipe furnished meets requirements of this section.

C. Plant inspection will be performed. Furnish desk and phone at pipe manufacturing facility during time inspection is occurring.

D. Manufacturer Factory Testing:
   1. Perform the following in-plant tests, according to ASTM D3754 and AWWA C950:
      a. Submit test results prior to delivery of pipe to Site.
      b. Factory testing shall be performed on pipe sections to be furnished for this Project.
      c. Production test.
      d. Long-term hydrostatic qualification test.
      e. Joint-tightness qualification test.
      f. Beam strength and longitudinal tensile strength qualification test.
      g. Hydrostatic leakage test.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
   1. Join pipe and fittings in accordance with pipe manufacturer's instructions, unless otherwise shown or specified.
      a. Pipe manufacturer shall make available services of manufacturer's representative to provide initial training to the Contractor on field fiberglass laminations and advise regarding aspects of installation including but not limited to required PPE, exposure hazards, safe handling, storing, cleaning, inspecting, and lining repairs.
   2. Inspect pipe and fittings before installation. Clean ends thoroughly and remove foreign matter and dirt from inside.

B. Buried Pressure Pipe: Unless otherwise shown or specified, install pipe in accordance with AWWA M45 and manufacturer's instructions.

C. Jointing:
   1. Unrestrained Coupling:
      a. Clean ends of pipe and joint components.
      b. Apply joint lubricant to pipe ends and the elastomeric seals of the coupling. Use only lubricants approved by the pipe manufacturer.
      c. Use suitable equipment and end protection to push the pipes together.
      d. Do not exceed forces recommended by the manufacturer for joining or pushing pipe.
      e. Join pipes in straight alignment. Deflection is not allowed.
   2. Key Lock Coupling:
      a. Clean ends of pipe and joint components.
      b. Apply joint lubricant to pipe ends and the elastomeric seals of the coupling. Use only lubricants approved by the pipe manufacturer.

c. Use suitable equipment and end protection to push the pipes together.

d. Do not exceed forces recommended by the manufacturer for joining or pushing pipe.

e. Join pipes in straight alignment. Insert the key bar with a hammer. Do not angularly deflect the pipes.

3. Laminated Joints:

a. Do not proceed with laminate installation until surface preparation on the fiberglass reinforced polymer pipe has been performed in accordance with the manufacturer's recommendations and as specified herein.

b. Prepare the surface of the pipe where the laminate will be applied with mechanical tools or abrasive discs to remove sheen and expose fibers of the fiberglass reinforced polymer pipe.

c. Surface shall be free of gloss, form-release agents, dust, dirt, grease, oil, moisture, and other contaminants incompatible with resin.

d. The joint of the pipe shall be filled with an epoxy paste if the gap exceeds 1/4 inch. In no case, shall the gap exceed 1/2 inch.

e. Join pipes in straight alignment. Deflection is not allowed.

f. Maintain dry conditions so that adhesion of resins is not inhibited. Portable barriers and blowers may be erected at the joints to dehumidify the surface of the pipe. The environment shall be maintained to meet the recommendations of the manufacturer. Surface temperature shall be at least 5 degrees F above the measured dew point.

g. Proper dust control and ventilation shall be secured.

h. Resins and catalysts shall be mixed according to the pipe manufacturer's installation instructions.

i. The first layer shall be the prepared resin follow by the fiberglass fabrics. Each ply of the fiberglass fabric shall be saturated with resin and into the surface to achieve intimate contact. Entrapped air shall be released or rolled without wrinkling of the fibers. There shall be a minimum circumferential overlap of 2 inches between layers.

j. Fabric kinks, folds or gaps shall not be permitted.

k. Following the application of the fiber layers, a final lay shall be applied over the whole laminate to seal all seams, edges, and exposed surfaces.

l. A visual inspection will be performed. Separation of the laminate and delamination of the edges are not allowed and shall be repaired in accordance with the manufacturer's recommendations.

D. Allowable Deflection:

1. Measure vertical cross-section deflection at the following locations: Where shown on Drawings.
    a. Initial vertical cross-section deflection measured within first 24 hours after completion of backfilling and removal of dewatering systems shall not exceed 3 percent of original pipe inside diameter.
    b. Vertical cross-section deflection measured 30 days after completion of backfilling and removal of dewatering systems shall not exceed 4 percent of original pipe inside diameter.
    c. Deflection in excess of allowable will be considered due to inadequate compaction of pipe zone material.
        1) If excessive deflection exists, remove and replace pipe zone material as required to limit deflection, in accordance with above requirements.

3.02 FIELD HYDROSTATIC TESTING

A. Hydrostatic test for pressure piping in accordance with Section 40 80 01, Process Piping Leakage Testing.

END OF SECTION

SECTION 33 05 01.09
POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
    a. C110, Ductile-Iron and Gray-Iron Fittings.
    b. C153, Ductile-Iron Compact Fittings, for Water Service.
    c. C217, Microcrystalline Wax and Petrolatum Tape Coating Systems for Steel Water Pipe and Fittings.
    d. C605, Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
    e. C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 Inches Through 12 Inches (100 mm Through 300 mm), for Water Transmission and Distribution.
    f. C905, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 Inches through 48 Inches (350 mm through 1,200 mm) for Water Transmission and Distribution.
    g. C907, Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 Inches through 12 Inches (100 mm Through 300 mm), for Water, Wastewater, and Reclaimed Water Service.
2. ASTM International (ASTM):
    a. D2241, Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
    b. D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
    c. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
    d. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
    e. D2672, Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement.
    f. D2855, Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
    g. D3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

3. NSF International (NSF).

1.02 SUBMITTALS

A. Action Submittals:
   1. Drawings showing pipe diameter, pipe class, dimension ratio (DR), compliance with referenced standards, and fitting details.
   2. Product Data: Manufacturer's data for couplings, saddles, gaskets, and other pipe accessories. Indicate maximum rated working pressure and test pressure for each item.

B. Informational Submittals:
   1. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
   2. Hydrostatic Testing Plan:
      a. Submit at least 15 days prior to testing and at minimum, include the following:
         1) Testing dates.
         2) Piping systems and section(s) to be tested.
         3) Method of isolation.
         4) Method of conveying water from source to system being tested.
         5) Method of disposing of test water.
         6) Calculation of maximum allowable leakage for piping section(s) to be tested.
   3. Certification of Calibration: Approved testing laboratory certificate if pressure gauge for hydrostatic test has been previously used. If pressure gauge is new, no certificate is required.
   4. Test report documentation.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Solvent Cement: Store in accordance with ASTM D2855.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pipe:
   1. PVC, conforming to requirements of AWWA C900.
   2. DR 18.

3. Pipe to be used for potable water conveyance shall meet the requirements of NSF 61.

B. Joints:
1. Rubber gasketed.
2. Conform to AWWA C900.

C. Fittings:
1. Thrust restrained, mechanical joint, ductile iron, conforming to AWWA C153 or AWWA C110. Refer to Section 40 27 00.01, Fusion-Bonded Epoxy Lined and Coated Ductile Iron Pipe and Fittings.
2. Lining and Coating: Fusion-bonded epoxy in accordance with AWWA C116.

D. Service Saddles:
1. Double strap type with minimum strap width of 2 inches.
2. Straps: Type 316 stainless steel.
3. Saddles: Ductile iron, epoxy-coated, 10 mils minimum thickness.
4. Minimum Pressure Rating: 235 psi.

E. Restrained Joints:
1. Provide pipe restraint by system designed specifically for use with PVC pipe using mechanical joint anchor gland followers with wedges. Do not use systems with set screws, gripper rings, or gripper gaskets.
2. Mechanical Joint Anchor Gland Follower: As specified in Section 40 27 00, Process Piping—General.
3. Restrain push-on gasketed joints with a restraint harness designed specifically for PVC pipe.
   a. EBAA IRON Series 1900 Restraint Harness.
4. Minimum Pressure Rating: 235 psi.

2.02 CORROSION PROTECTION

A. Petrolatum wax tape in accordance with AWWA C217.

PART 3 EXECUTION

3.01 GENERAL

A. Notify Jacobs' Engineer at least 2 weeks prior to field fabrication of pipe or fittings.

B. Furnish feeler gauges of proper size, type, and shape for use during installation for each type of pipe furnished.

C. Distributing Materials: Place materials along trench only as will be used each day, unless otherwise approved by Jacobs' Engineer. Placement of materials shall not be hazardous to traffic or to general public, obstruct access to adjacent property, or obstruct others working in area.

3.02 EXAMINATION

A. Verify size, material, joint types, elevation, and horizontal location of existing pipeline to be connected to new pipeline or new equipment.

B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

C. Damaged Coatings and Linings: Repair using coating and lining materials in accordance with manufacturer's instructions.

3.03 PREPARATION OF TRENCH

A. Prepare trench as specified in Section 31 23 16, Excavation.

B. Unless otherwise permitted by Jacobs' Engineer, maximum length of open trench shall not exceed 50 feet.

3.04 INSTALLATION

A. General:
   1. In accordance with AWWA C605, ASTM D2321, AWWA Manual 23.
   2. Solvent cement used for joints as recommended by pipe manufacturer.
   3. Joints:
      a. Rubber Gasketed: In accordance with manufacturer's written instructions.
      b. Solvent Cemented: In accordance with ASTM D2855.
      c. Restrained Joint Systems: In accordance with manufacturer's written instructions.
   4. Install individual pipe lengths in accordance with approved lay diagram. Misplaced pipe shall be removed and replaced.
   5. Inspect pipe and fittings before installation, clean ends thoroughly, remove foreign matter and dirt from inside.

B. Buried Pressure Pipe:

   1. Concrete Encased or Embedded Pipe: Do not encase joints in concrete, unless specifically shown on Drawings.

2. Placement:
    a. Keep trench dry until pipe laying and joining is completed.
    b. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.
    c. Measure for grade at pipe invert, not at top of pipe.
    d. Excavate trench bottom and sides of ample dimensions to permit proper joining, welding, visual inspection, and testing of entire joint.
    e. Prevent foreign material from entering pipe during placement.
    f. Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.
    g. In general, lay pipe upgrade with bell ends pointing in direction of laying.
    h. Maximum Joint Deflection at Mechanical Joint: 75 percent of manufacturer's recommended values.
    i. No deflection is allowed at push-on joints.
    j. If joint deflection at fittings will not accommodate horizontal or vertical curves in alignment, provide:
        1) Shorter pipe lengths.
        2) Special mitered joints.
        3) Standard or special fabricated bends.
    k. Check gasket position with feeler gauge to assure proper seating.
    l. After joint has been made, check pipe alignment and grade.
    m. Place sufficient pipe zone material to secure pipe from movement before next joint is installed.
    n. Prevent uplift and floating of pipe prior to backfilling.
3. Tolerances:
    a. Deflection from Horizontal Line: Maximum 2 inches.
    b. Deflection from Vertical Line: Maximum 1 inch(es).
4. Cover Over Top of Pipe: Minimum 3 feet, unless otherwise shown.
5. Disposal of Excess Excavated Material: As specified in Section 31 23 16, Excavation.

3.05 CORROSION PROTECTION

A. Ductile Iron Pipe Fittings and harnesses: Wrap with petrolatum wax tape in accordance with AWWA C217.

B. Wrap all metallic buried pipe, pipe sections, specials, fasteners, and fittings, valves, and all metallic appurtenances associated with buried non-metallic pipe with a petrolatum wax tape coating in accordance with AWWA C217.

3.06 INSPECTION AND HYDROSTATIC TESTING

A. General:

1. Notify Jacobs' Engineer in writing at least 5 days in advance of testing. Perform testing in presence of Jacobs' Engineer.
2. Using water as test medium, all newly installed pipelines must successfully pass hydrostatic leakage test prior to acceptance.
3. Conduct field hydrostatic test on buried piping after trench has been completely backfilled and compacted. Testing may, as approved by Jacobs' Engineer, be done prior to placement of asphaltic concrete or roadway structural section.
4. Contractor may, if field conditions permit and as approved by Jacobs' Engineer, partially backfill trench and leave joints open for inspection and conduct an initial informal service leak test. Final field hydrostatic test shall not, however, be conducted until backfilling has been completed as specified above.
5. Supply of Temporary Water: In accordance with Section 01 50 00, Temporary Facilities and Controls.
6. Dispose of water used in testing in accordance with federal, state, and local requirements.
7. Install temporary thrust blocking or other restraint as necessary to prevent movement of pipe and protect adjacent piping or equipment. Make necessary taps in piping prior to testing.
8. Wait a minimum of 5 days after concrete thrust blocking is installed to perform pressure tests. If high-early strength cement is used for thrust blocking, wait may be reduced to 2 days.
9. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.
10. New Piping Connected to Existing Piping:
    a. Isolate new piping with grooved-end pipe caps, blind flanges, or other means as acceptable to Jacobs' Engineer.
    b. Provide appropriate thrust blocking.

B. Hydrostatic Testing Procedure:

1. Furnish testing equipment, as approved by Jacobs' Engineer, which provides observable and accurate measurements of leakage under specified conditions.
2. Maximum Filling Velocity: 0.25 foot per second calculated based on full area of pipe.
3. Expel air from piping system during filling.
4. Test Pressure: As specified in the Piping Schedule as shown on Drawings.

5. Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.
6. Maintain hydrostatic test pressure continuously for 2 hours minimum, adding make-up water only as necessary to restore test pressure to within 5 psi of specified hydrostatic test pressure.
7. Determine actual leakage by measuring quantity of water necessary to maintain specified test pressure for duration of test.

C. Maximum Allowable Leakage:

$$L = \frac{ND(P)^{1/2}}{7400}$$

where:

L = Allowable leakage, in gallons per hour.
N = Number of joints in tested line.
D = Nominal diameter of pipe, in inches.
P = Average test pressure during leakage test, in pounds per square inch.

END OF SECTION

SECTION 33 05 13
MANHOLES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): M198, Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
2. ASTM International (ASTM):
    a. A36, Standard Specification for Carbon Structural Steel.
    b. A48, Standard Specification for Gray Iron Castings.
    c. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    d. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
    e. A240, Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
    f. A536, Standard Specification for Ductile Iron Castings.
    g. A615/A615M, Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement.
    h. B139, Standard Specification for Phosphor Bronze Rod, Bar, and Shapes.
    i. C14, Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
    j. C387, Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
    k. C443, Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
    l. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.
    m. C923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
    n. D4101, Standard Specification for Propylene Plastic Injection and Extrusion Materials.

o. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

p. F594, Standard Specification for Stainless Steel Nuts.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:

a. Concrete Mix Design.

b. Cast-in-Place Manholes: Details of construction.

c. Precast Manholes: Details of construction.

d. Precast Base, Cones, and Top Slab Sections: Details of construction.

e. Rubber gaskets, sealants, and external joint wrap.

f. Design of manhole frame to structure seals.

B. Informational Submittals:

1. Proposed curing method for cast-in-place concrete structures.

2. Precast Manhole Sections: Manufacturer's results of tests performed on representative sections to be furnished.

3. Calculations: Proposed details and design calculations for stresses in precast concrete members for loading conditions including earth pressures and transportation, handling, buoyancy, and erection. Calculations shall be stamped by engineer registered in the State of California.

PART 2 PRODUCTS

2.01 GENERAL

A. Materials of Construction and Service Conditions:

1. Screws, Bolts, or Nuts: Type 304 stainless steel conforming to ASTM F593 and ASTM F594.

2. Gaskets:

a. Internal and external seals shall be made of materials that have been proven to be resistant to the following exposures and conditions:

1) Sanitary sewage.

2) Corrosion or rotting under wet or dry conditions.

3) Gaseous environment in sanitary sewers and at road surfaces including common levels of ozone, carbon monoxide, and other trace gases at installation site.

4) Biological environment in soils and sanitary sewers.

5) Chemical attack by road salts, road oil, and common street spillages or solvents used in street construction or maintenance.

6) Temperature ranges, variations, and gradients in construction area.

7) Variations in moisture conditions and humidity.

8) Fatigue failure caused by a minimum of 30 freeze-thaw cycles per year.

9) Vibrations because of traffic loading.

10) Fatigue failure because of repeated variations of tensile, compressive and shear stresses, and repeated elongation and compression. Material shall remain flexible allowing repeated movement.

3. Materials shall be compatible with each other and manhole materials.

4. Designed to provide a 20-year service life.

B. Structures shall meet requirements of whichever is more stringent, ASTM C478, Section 03 21 00, Steel Reinforcement, Section 03 30 00, Cast-in-Place Concrete, this specification, and the following:

1. Design:

a. Design manhole and pump station manholes for soil loads shown in General Structural Notes on Drawings, including vehicle surcharge.

b. Design manholes and pump station manholes to resist buoyancy forces for flood elevation shown in General Structural Notes on Drawings. Size manhole foundations as required to resist buoyancy forces.

2. Concrete:

a. Cement: Meet requirements of ASTM C150/C150M.

b. Compressive Strength:

1) Minimum 4,500 psi.

2) Minimum strength shall be confirmed at 7 days by making two standard cylinders per manhole for testing.

c. Water-cement Ratio: 0.40 maximum.

d. Concrete Sulfate Exposure Class: S2.

1) Provide Type V cement or Type II cement with fly ash or slag as required to meet sulfate exposure class.

e. Concrete Chloride Exposure Class: C2.

f. Concrete mix design shall include Xypex C-500 or C-1000 based upon mix design at dosage recommended by manufacturer for installation.

3. Reinforcement: Grade 60, unless otherwise specified.
4. Ring: Custom made with openings to meet indicated pipe alignment conditions and invert elevations.
5. Floor: Minimum 6 inches below pipe to provide clearance for grouting channels.
6. Joint:
    a. Form joint contact services with machined castings.
    b. Surfaces shall be parallel with nominal 1/16-inch clearing and tongue equipped with recess for installation of O-ring rubber gasket.
7. Gasket: Meet requirements of ASTM C443.

2.02 PRECAST MANHOLES

A. Riser Sections:
1. Diameter as shown on Drawings. Minimum 48 inches inside diameter.
2. Fabricate in accordance with ASTM C478.
3. Minimum Wall Thickness: 4 inches or 1/12 times inside diameter, whichever is greater.
4. Top and bottom shall be parallel.
5. Joints: Confined O-ring with rubber gaskets meeting ASTM C443.
6. Heavy traffic rated, HS-20 rated.

B. Cone Sections:
1. Provide eccentric cones unless shown otherwise on Drawings.
2. Same wall thickness and reinforcement as riser section.
3. Top and bottom shall be parallel.
4. Heavy traffic rated, HS-20 rated.

C. Base Sections and Base Slab:
1. Base Sections: Base slab integral with sidewalls.
2. Fabricate in accordance with ASTM C478.
3. Heavy traffic rated, HS-20 rated.

D. Manhole Extensions:
1. Concrete grade rings; maximum 6 inches high.
2. Fabricate in accordance with ASTM C478.
3. Heavy traffic rated, HS-20 rated.

E. Joint Seal manufacturers and Products:
   1. Butyl Gaskets:
      a. Hamilton Kent of Nevada, Sparks, NV; Kent-Seal No. 2.
      b. Trelleborg Engineered Solutions, Park Hills, MO; NPC Bidco C 56.
   2. Confined Plastic or Rubber O-Ring:
      a. As recommended by precasting manufacturer.
      b. Meet requirements of ASTM C443.
   3. External Wrap:
      a. Sealing Systems, Inc., Loretto, MN; Gator Wrap.
      b. Trelleborg Engineered Solutions, Park Hills, MO; NPC External Joint Wrap.
      c. Cretex Specialty Products, Waukesha, WI; Cretex Wrap.

F. Source Quality Control:
   1. All test specimens shall be mat tested and meet permeability test requirements of ASTM C14.
   2. Conduct tests at point of manufacture prior to delivery of any section.
   3. Sections to be tested will be selected at random from stockpiled material to be supplied for the Project.

2.03 CAST-IN-PLACE MANHOLES

A. Reinforcing Steel: Furnish as specified in Section 03 21 00, Steel Reinforcement.

B. Concrete: Furnish as specified in Section 03 30 00, Cast-in-Place Concrete.

2.04 MANHOLE FRAMES AND COVER

A. Castings:
   1. Tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and defects.
   2. Cast Iron: ASTM A48 Class 30B.
   3. Ductile Iron: ASTM A536, Grade 60-40-12.
   4. Plane or grind bearing surfaces to ensure flat, true surfaces.
   5. Heavy traffic rated, HS-20 rated.

B. Cover: True and seat within ring at all points with the word SEWER in 2-inch raised letters.

2.05 WATERTIGHT FRAME FASTENERS

A. Galvanize after fabrication in conformance with ASTM A123.

2.06 MANHOLE FRAME CONNECTION TO STRUCTURE

A. Butyl Sealant:
   1. Conform to ASTM C1311, or AASHTO M198 and ASTM C990.
   2. Trowelable or cartridge applied.
   3. Manufacturers and Products:
      a. Tremco Commercial Sealants and Waterproofing, Beachwood, OH; Tremco Butyl Sealant.
      b. Bostik, Middleton, MA; Chem-Calk 300.
      c. Press-Seal Gasket Company, Fort Wayne, IN; EZ-Stik #3.

B. External Wrap:
   1. Meet requirements of ASTM C923.
   2. Construct of high quality rubber that will provide flexible watertight seal around joint.
   3. Thickness: Minimum 60 mils.
   4. Consist of a top and bottom section and be sealed to structure, frame top, and bottom with mastic as applicable.
   5. Length: Extend from manhole frame and extension ring to cone section.
   6. Bands: If required, constructed of minimum 16-gauge sheet if channeled, or 5/16-inch diameter if round.
   7. Manufacturers and Products:
      a. Sealing Systems, Inc., Loretto, MN; Infi-Shield.
      b. Trelleborg Engineered Systems, Milford, NH; NPC Flexrib Frame-Chimney Seals.
      c. Cretex Specialty Products, Waukesha, WI; X-85 Seal.

C. Internal Wrap or Sealing Membrane:
   1. Meet requirements of ASTM C923.
   2. Minimum internal thickness of 3/16 inch or as recommended by manufacturer for installation climate.
   3. Designed for application and have a demonstrated history of accommodating differential expansion between frame and concrete.
   4. Width: Minimum 8 inches.
   5. Expansive type wraps shall be fabricated of high quality rubber or urethane.

6. Bands: If required, constructed of minimum 16-gauge sheet if channeled, or 5/16-inch diameter if round.
7. Wrap shall not restrict access to manhole.
8. Manufacturers and Products:
    a. Sealing Systems, Inc., Loretto, MN; Flex-Seal Utility Sealant.
    b. Trelleborg Engineered Systems, Milford, NH; NPC Flexrib Frame-Chimney Seals.
    c. Cretex Specialty Products, Waukesha, WI; Internal Manhole Chimney Seal.

D. Frame to Structure Anchor Bolts:
1. 3/4-inch-diameter HAS stainless steel adhesive anchor bolts; minimum 6-5/8-inch embedment.
2. As specified in Section 05 05 19, Anchor Bolts.

2.07 MORTAR

A. Standard premixed in accordance with ASTM C387, or proportion one part portland cement to two parts clean, well-graded sand that will pass a 1/8-inch screen.

B. Admixtures:
1. May be included but do not exceed the following percentages of weight of cement:
    a. Hydrated Lime: 10 percent.
    b. Diatomaceous Earth or Other Inert Material: 5 percent.

C. Mix Consistency:
1. Tongue-and-Groove Type Joint: Such that mortar will readily adhere to pipe.
2. Confined Groove (Keylock) Joint: Such that excess mortar will be forced out of groove and support is not provided for section being placed.

2.08 CLEANOUT FRAMES AND COVERS

A. Castings:
1. Tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and defects.
2. Cast Iron: ASTM A48, Class 30B.
3. Ductile Iron: ASTM A536, Grade 65-40-12.
4. Plane or grind bearing surfaces to ensure flat, true surfaces.

B. Covers: True and seat within frame at all points.

2.09 BACKFILL AROUND AND UNDER MANHOLE

A. Granular fill as specified in Section 31 23 23, Fill and Backfill.

2.10 IMPORTED PIPE BASE

A. Furnish as specified in Section 31 23 23.15, Trench Backfill.

2.11 FLEXIBLE JOINTS

A. Manufacturers:
   1. "Kor-N-Seal" flexible rubber boot with stainless steel accessories as manufactured by NPC, Inc., Milford, New Hampshire.
   2. "Z-LOK XP" or "A-LOK" flexible connectors as manufactured by A-LOK Products, Inc., Tullytown, PA.

2.12 SOURCE QUALITY CONTROL

A. Concrete Testing: Test two concrete test cylinders for each manhole. Compressive strength shall be tested in accordance with ASTM C31/C31M, ASTM C39/C39M, and ASTM C192/C192M.

B. Inspection:
   1. Material Quality:
      a. Manufacturing process and finished sections shall be subject to inspection and approval by Design-Builder.
         1) Inspections may take place at manufacturer's plant, at Site after delivery, or at both.
         2) Sections not meeting requirements of this Specification or that are determined to have defects which may affect durability of structure are subject to rejection.
         3) Sections rejected after delivery shall be removed and replaced.
         4) Sections damaged after delivery will be rejected and if already installed shall be repaired to satisfaction of Design-Builder.
         5) If structure cannot be repaired it shall be removed and replaced entirely at Subcontractor's expense.
   2. At the time of inspection, the sections will be carefully examined for compliance with ASTM C478 and with manufacturer's drawings. Sections will be inspected for general appearance, dimensions, scratch strength, blisters, cracks, roughness, and soundness. Surface shall be dense and close textured.
   3. Imperfections may be repaired, subject to approval of Design-Builder, after demonstration by manufacturer that strong and permanent repairs result.

PART 3 EXECUTION

3.01 GENERAL

A. Prior to installation inspect materials:
   1. Sections not meeting requirements of this specification or that are determined to have defects which may affect durability of structure are subject to rejection.
   2. Sections damaged after delivery will be rejected and if already installed shall be repaired to satisfaction of Design-Builder.
   3. Remove and replace structure that cannot be repaired.

B. If needed, dewater excavation during construction and testing operations.

3.02 EXCAVATION AND BACKFILL

A. Excavation: As specified in Section 31 23 16, Excavation.

B. Backfill: As specified in Section 31 23 23, Fill and Backfill.

3.03 INSTALLATION OF PRECAST MANHOLES

A. Concrete Base:
   1. Cast-in-Place:
      a. Invert: Minimum 8 inches below lowest connecting pipe.
      b. First section of manhole shall be cast in concrete base.
   2. Precast:
      a. Place on compacted imported base material.
      b. Properly locate, ensure firm bearing throughout, and plumb first section.

B. Sections:
   1. Carefully inspect precast manhole sections to be joined.
   2. Thoroughly clean ends of sections to be joined.
   3. Do not use sections with chips or cracks in the tongue.

C. Preformed Plastic Gaskets or Rubber O-Ring:
   1. Use only pipe primer furnished by gasket manufacturer.
   2. Install gasket material in accordance with manufacturer's instructions.
   3. Completed Manholes shall be rigid and watertight.

D. External Joint Wraps: Install in accordance with manufacturer's instructions.

E. Extensions:

1. Provide on manholes in streets or other locations where a subsequent change in existing grade may be likely.
2. Install to height not exceeding 12 inches.
3. Lay grade rings in mortar with sides plumb and tops level.
4. Seal joints with mortar as specified for sections and make watertight.

3.04 MANHOLE INVERT

A. Construct with smooth transitions to ensure an unobstructed flow through manhole. Remove sharp edges or rough sections that tend to obstruct flow.

B. Where full section of pipe is laid through manhole, break out top section as shown and cover exposed edge of pipe completely with mortar. Trowel mortar surfaces smooth.

3.05 CAST-IN-PLACE MANHOLE

A. Reinforcing Steel: Install as specified in Section 03 21 00, Steel Reinforcement.

B. Concrete: Install as specified in Section 03 30 00, Cast-in-Place Concrete.

3.06 MANHOLE FRAMES AND COVERS

A. Set frames in three equally spaced beads of butyl sealant that run full circumference of frame.

B. Install grade rings as necessary to set tops of covers flush with surface of adjoining pavement or ground surface, unless otherwise shown or directed.

C. Anchor frame to manhole with specified bolts.

D. At locations shown, install manhole frame to structure seals in accordance with manufacturer's instructions.

3.07 MANHOLE PIPING

A. Drop Assembly:

1. Install where shown.
2. Extend pipe from the drop to a minimum of 3 feet beyond the manhole excavation into the trench and connect to sewer pipe with an adapter.
3. Support lower drop elbow with concrete monolithically-placed with manhole base.

B. Flexible Joints: Provide flexible joint in manhole wall for all pipe penetrations.

C. Stubouts for Future Connections:
   1. Provide same type and class of pipe as specified for use in service connection, lateral, main, or trunk sewer construction. Where there are two different classes of pipe at manhole use higher strength pipe.
   2. Grout pipe in precast walls or manhole base to provide watertight seal or use flexible joints as specified herein.
   3. Maximum Length: 1-1/2 feet outside manhole wall.
   4. Construct invert channels as shown.
   5. Test Plugs:
      a. Install rubber-gasketed plugs in end of stubouts with gasket joints similar to sewer pipe being used.
      b. Plugs shall withstand internal or external pressures without leakage.
      c. Adequately brace plugs against all hydrostatic or air test pressures.

D. Permanent Plugs:
   1. Clean interior contact surfaces of pipes to be cut off or abandoned as shown, and construct plug as follows:
      a. Pipe 18 Inches or Less in Diameter: Concrete plug in end, minimum 8 inches in length.
      b. Pipe 21 Inches and Larger:
         1) Construct plugs of common brick, concrete block, or concrete.
         2) Plaster exposed face of block or brick plugs with mortar.
      c. Plugs shall be watertight and capable of withstanding internal and external pressures without leakage.

3.08 MANHOLES OVER EXISTING PIPING

A. Maintain flow through existing pipelines at all times.

B. Concrete Pipe: Apply bonding agent on surfaces in contact with concrete.

C. Construct base under existing piping.

D. Construct manhole as detailed on Drawings.

E. Apply minimum of two complete wraps of hydrophilic waterstop centered on pipe in wall.

F. Place a minimum of 24 inches of concrete around each pipe penetration outside manhole against undisturbed soil or compacted aggregate unless otherwise detailed.

G. Grout channel through manhole.

H. Saw cut out or demolish existing pipe within new manhole using method approved by Engineer.

I. Protect new concrete or grout for 7 days after placing concrete.

3.09 CONNECTIONS TO EXISTING MANHOLES

A. Break out existing manhole bases or grouting as necessary.

B. Clean all surfaces and apply a bonding agent.

C. Regrout to provide smooth flow into and through manholes.

D. Provide diversion facilities and perform work necessary to maintain flow during connection.

E. Provide flexible joint for new piping into existing manhole.

3.10 FIELD QUALITY CONTROL

A. Conduct negative air pressure (vacuum) test on all manholes in accordance with ASTM C1244. Conduct tests in presence of Design-Builder.

END OF SECTION

SECTION 33 12 19
WATER UTILITY DISTRIBUTION FIRE HYDRANTS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Water Works Association (AWWA):
      a. C502, Dry-Barrel Fire Hydrants.
      b. C503, Wet Barrel Fire Hydrants.
      c. C600, Installation of Ductile-Iron Mains and Their Appurtenances.
      d. C605, Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
   2. ASTM International (ASTM): C94, Standard Specification for Ready-Mixed Concrete.
   3. City of San José: Department of Public Works, Standard Specifications, July 1992.
   4. FM Global Approved.
   5. NSF International (NSF):
      a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
      b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
   6. UL: 246, Standard for Hydrants for Fire-Protection Service.

1.02 SUBMITTALS

A. Action Submittals: Catalog cuts of system components.

B. Informational Submittal:
   1. Certificate of Compliance: Upon completion of the system installation, verify all fire department hose connections, and check all fire safety devices to ensure their readiness for emergency connection and operation.
   2. Calculations for concrete thrust blocking by a licensed engineer.

PART 2 PRODUCTS

2.01 HYDRANTS

A. Hydrant: Purchase and obtain hydrant from the City of San José Fire Department as specified in Section 102-3.01 of the City of San José Standard Specifications.

B. Main Valve:
   1. Depth of Bury: 3 feet.
   2. Equip with O-ring seals.
   3. Valve opens on counterclockwise rotation.

2.02 PRECAST CONCRETE PIER BLOCK

A. Nominal dimensions of 8-inch thickness by 16-inch square base.

B. Compressive Strength: 3,000 psi at 28 days.

2.03 GRAVEL FOR DRAINAGE

A. Washed 3/4-inch drainage gravel. Free of organic matter, sand, loam, clay, and other small particles that will restrict water flow through gravel.

2.04 FOUNDATION STABILIZATION MATERIAL

A. Furnish when existing trench material or imported pipe base material will not support soft or flooded spots in excavated trench.

B. Maximum 3-inch hard rock free from excessive clay material, but enough fines to bind larger fragments.

2.05 CONCRETE FOR THRUST BLOCKING

A. Ready-mix meeting ASTM C94, Alternative 2.

B. Compressive Strength: 3000 psi at 28 days.

C. Aggregate Size: 1-1/2 inches.

D. Slump: 2 inches to 4 inches.

PART 3 EXECUTION

3.01 GENERAL

A. Install hydrants in accordance with Section 4.3.7 and Section 4.3.8 of AWWA C600, and Section 8.5 and 9.3 of AWWA C605 unless specified otherwise.

3.02 EXCAVATION

A. Excavate to subgrade. Fill over excavated areas with foundation stabilization material. Tamp to provide firm foundation.

3.03 BASE BLOCK

A. Place on firm, level subgrade to ensure uniform support.

3.04 INSTALLATION OF HYDRANTS

A. Locate hydrants to provide accessibility and to minimize potential damage from vehicles.
   1. Relocate improperly set hydrants.
   2. Hydrant Located behind Curbs: Set barrel so pumper nozzle or hose nozzle caps are a minimum of 18 inches from gutter face of curb.
   3. Set hydrants so safety flange is a minimum of 2 inches above finished ground or sidewalk level.

B. Place hydrant on base block carefully to prevent the base block from breaking.

C. All joints shall be restrained. Joints shall conform to Section 8.5 of AWWA C605 and Section 33 05 01.09, Polyvinyl Chloride Pressure Pipe and Fittings. When ductile iron pipe is used, joints shall conform to Section 4.3.4 of AWWA C600.

D. Maintain hydrant in a plumb position during subsequent Work.

3.05 GRAVEL FOR DRAINAGE

A. Place gravel around base block and hydrant bottom in accordance with Section 4.3.7 of AWWA C600.

3.06 CONCRETE THRUST BLOCKING

A. Place blocking after hydrant is set in final position and join to pipe.

B. Concrete thrust block shall have a minimum of 4 square feet of bearing area against undisturbed earth for a standard pressure installation.
   1. Subcontractor to calculate required bearing area for high pressure installation for Jacobs' Engineer to review.

END OF SECTION

SECTION 33 13 00
DISINFECTING OF WATER UTILITY DISTRIBUTION

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Water Works Association (AWWA):
      a. B300, Hypochlorites.
      b. B301, Liquid Chlorine.
      c. B302, Ammonium Sulfate.
      d. B303, Sodium Chlorite.
      e. C651, Disinfecting Water Mains.
      f. C652, Disinfection of Water Storage Facilities.
      g. C653, Disinfection of Water Treatment Plants.
   2. NSF International (NSF):
      a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
      b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
   3. Standard Methods for the Examination of Water and Wastewater, as published by American Public Health Association, American Water Works Association, and the Water Environment Federation.

1.02 SUBMITTALS

A. Informational Submittals:
   1. Plan describing and illustrating conformance to appropriate AWWA standards and this Specification.
   2. Procedure and plan for cleaning system.
   3. Procedures and plans for disinfection and testing.
   4. Proposed locations within system where Samples will be taken.
   5. Type of disinfecting solution and method of preparation.
   6. Method of disposal for highly chlorinated disinfecting water.
   7. Certified Bacteriological Test Results:
      a. Facility tested is free from coliform bacteria contamination.
      b. Forward results directly to Design-Builder.

1.03 SEQUENCING

A. Commence disinfection after completion of following:
   1. Completion and acceptance of internal painting of system(s).
   2. Flushing, hydrostatic and pneumatic testing, pressure testing, functional and performance testing and acceptance of pipelines, pumping systems, structures, and equipment.

PART 2 PRODUCTS

2.01 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
   1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 WATER FOR DISINFECTION AND TESTING

A. Clean, uncontaminated, and potable.

PART 3 EXECUTION

3.01 GENERAL

A. Conform to AWWA C651 for pipes and pipelines except as modified in these Specifications.

B. Contractor's Equipment: Furnish chemicals and equipment, such as pumps and hoses, to accomplish disinfection.

C. Water used to fill pipeline may be supplied using a temporary connection to existing distribution system. Provide protection against cross-connections as required by AWWA C651.

D. Disinfect the following items installed or modified under this Project, intended to hold, transport, or otherwise contact potable water:
   1. Pipelines: Disinfect new potable water pipelines that connect to existing pipelines up to point of connection.

2. Disinfect surfaces of materials that will contact potable water, both during and following construction, using one of the methods described in AWWA C652 and C653. Disinfect prior to contact with finished water. Take care to avoid recontamination following disinfection.

E. Prior to application of disinfectants, clean pipelines of loose and suspended material.

F. Allow freshwater and disinfectant solution to flow into pipe or vessel at a measured rate so chlorine-water solution is at specified strength. Do not place concentrated liquid commercial disinfectant in pipeline or other facilities to be disinfected before it is filled with water.

3.02 TURBIDITY

A. Cleaning of equipment and facilities shall include removal of materials that result in a turbidity exceeding limits stated in Article Testing.

3.03 PIPING

A. Cleaning:
   1. Before disinfecting, clean all foreign matter from pipe in accordance with AWWA C651.
   2. If the continuous feed method or the slug method of disinfection, as described in AWWA C651 are used, flush pipelines with potable water until clear of suspended solids and color. Provide hoses, temporary pipes, ditches, and other conduits as needed to dispose of flushing water without damage to adjacent properties.
   3. Flush service connections and hydrants. Flush distribution lines prior to flushing hydrants and service connections. Operate valves during flushing process at least twice during each flush.
   4. Flush pipe through flushing branches and remove branches after flushing is completed.

B. Disinfecting Procedure: In accordance with AWWA C651, unless herein modified.

3.04 DISPOSAL OF HEAVILY CHLORINATED WATER

A. Do not allow flow into a waterway without neutralizing disinfectant residual.

B. See the appendix of AWWA C651 for acceptable neutralization methods.

3.05 TESTING

A. Collection of Samples:
   1. Coordinate activities to allow Samples to be taken in accordance with this Specification.
   2. Provide valves at sampling points.
   3. Provide access to sampling points.

B. Test Equipment:
   1. Clean containers and equipment used in sampling and make sure they are free of contamination.
   2. Obtain sampling bottles with instructions for handling from City's laboratory.

C. Chlorine Concentration Sampling and Analysis:
   1. Collect and analyze Samples in accordance with AWWA C651.
   2. Analysis to be performed by City's laboratory. Samples will be analyzed using amperometric titration method for free chlorine as described in latest edition of Standard Methods for Examination of Water and Wastewater.

D. Turbidity Sampling and Analysis:
   1. After pipelines have been cleaned, disinfected, and refilled with potable water, the City's laboratory will take water Samples and have them analyzed for conformance to turbidity limitations for public drinking water supplies. Turbidity shall not exceed 0.3 NTU.
   2. If turbidity is in excess of the limit, dispose of the water in accordance with this Specification and applicable regulations, take action to remove source of turbidity, refill system, and retest.

E. Bacteriological Sampling and Analysis:
   1. After pipelines have been cleaned, disinfected, and refilled with potable water, the City's laboratory will take water Samples and have them analyzed for conformance to bacterial limitations for public drinking water supplies.
   2. Samples shall be collected in accordance with applicable AWWA Standard.
   3. Samples shall be analyzed for coliform concentrations in accordance with latest edition of Standard Methods for the Examination of Water and Wastewater.
   4. Obtain and analyze a minimum of two Samples on each of 2 consecutive days every 1,000 feet of pipeline by standard procedures outlined by state and local regulatory agencies.

5. If minimum Samples required above are bacterially positive, disinfecting procedures and bacteriological testing shall be repeated until bacterial limits are met.

END OF SECTION

SECTION 33 41 01
STORM DRAIN, SANITARY SEWER, AND GRAVITY DRAINAGE PIPING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:

1. American Association of State Highway and Transportation Officials (AASHTO):
    a. M36M, Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains.
    b. M190M, Standard Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.
    c. M196M, Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains.
2. American Water Works Association (AWWA):
    a. C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
    b. C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems.
    c. C110/A21.10, Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. (75 mm Through 1200 mm) for Water and Other Liquids.
    d. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
    e. C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast, for Water.
3. ASTM International (ASTM):
    a. A746, Standard Specification for Ductile Iron Gravity Sewer Pipe.
    b. C14, Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
    c. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
    d. C150, Standard Specification for Portland Cement.
    e. C311, Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete.
    f. C361, Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.

g. C425, Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.

h. C443, Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

i. C497, Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.

j. C507, Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.

k. C595, Standard Specification for Blended Hydraulic Cements.

l. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.

m. C655, Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe.

n. C700, Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.

o. C1012, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.

p. D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.

q. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

r. D2412, Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

s. D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

t. D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

u. F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

v. F679, Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

w. F794, Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

x. F894, Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe.

1.02 SUBMITTALS

A. Informational Submittals: Manufacturer's Certification of Compliance, in accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS

A. As specified in the Data Sheets following "End of Section."

2.02 SERVICE AND DRAIN CONNECTIONS

A. Pipe and fittings for individual service connection shall be of one type of material throughout.

B. Polyvinyl chloride pipe.

C. Building Service: 4 inches.

2.03 SERVICE CONNECTION MARKERS

A. New 2 by 4 lumber construction grade or better.

PART 3 EXECUTION

3.01 INSTALLATION OF PIPE, FITTINGS, AND APPURTENANCES

A. General:

1. Pipe laying shall proceed upgrade with spigot ends pointing in direction of flow.
2. Excavate bell holes at each joint to permit correct assembly and inspection of entire joint.
3. Pipe invert may deviate from line or grade up to 1/2 inch for line and 1/4 inch for grade, provided that finished pipe line will present a uniform bore, and such variation does not result in a level or reverse sloping invert, or less than minimum slope shown.
4. Pipe bedding shall form continuous and uniform bearing and support for pipe barrel between joints. Pipe shall not rest directly on bell or pipe joint.
5. Prevent entry of foreign material into gasketed joints.
6. Plug or close off pipes that are stubbed off for manhole, concrete structure, or for connection by others, with temporary watertight plugs.

B. Ductile Iron Pipe Corrosion Protection:

1. Remove foreign material from the exterior of the pipe.
2. Wrap pipe with polyethylene encasement tube 2 feet longer than the pipe section prior to laying pipe section

3. After assembling the pipe joint, overlap encasement tube with adjacent tube and seal joints with securing tape.
4. Provide additional securing tape at 3-foot intervals along the pipe.
5. Repair rips, punctures, or other damage to the polyethylene with securing tape.
6. Fittings may be wrapped with a flat sheet or split tube provided all seams are securely taped.

C. Concrete Closure Collars: Only use concrete closure collars where shown or authorized by Jacobs' Engineer.

D. Service Connections:
1. Minimum Slope: 1/4 inch per foot.
2. Markers:
a. Paint the top portion of the marker immediately after its installation with first-quality white, quick-drying enamel.
b. If marker is broken or knocked out of vertical alignment during backfilling operation, reopen trench and place marker in accordance with Sewer Service Connection Details shown on Drawings.
3. Disconnecting and Reconnecting Existing Service Connections:
a. Locate the existing service connections prior to constructing the tee in the new sewerline.
b. Disconnect existing service connections from existing sewers to be abandoned and reconnect them to the new sewers.

E. Square-End Underdrains: Cover top and sides of the joints with a strip of asphalt-saturated 30-pound roofing felt.

F. Perforated Underdrain: Lay with open joints and with perforations down.

3.02 PRESSURE TESTING

A. As specified in Section 40 80 01, Process Piping Leakage Testing, and as directed in the Piping Schedule as shown on Drawings.

3.03 REPAIR AND RETESTING

A. Sections of pipe not meeting the pressure test requirements shall be replaced or have individual joints tested and sealed.

B. Following repairs, sections shall be retested as specified.

3.04 SEWER CLEANING

A. Prior to final acceptance and final manhole-to-manhole inspection of the sewer system by Jacobs' Engineer, flush and clean all parts of the system. Remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the sewer system at or near the closest downstream manhole. If necessary, use mechanical rodding or bucketing equipment.

B. Upon Jacobs' Engineer's final manhole-to-manhole inspection of the sewer system, if any foreign matter is still present in the system, reflush and clean the sections and portions of the lines as required.

3.05 SUPPLEMENTS

A. Data Sheets.

Number	Title
-.03	Polyvinyl Chloride (PVC)
-.05	Reinforced Concrete
-.09	Glass Fiber Reinforced Plastic (GRP)

END OF SECTION

SECTION 33 41 01.03 POLYVINYL CHLORIDE (PVC)	
Item	**Description**
Pipe: 15-inch diameter and under	ASTM D3034: Standard dimension ratio less than 26, except that the cell classification shall be 12454-B or 12454-C as defined in ASTM D1784.
Pipe: 18- through 24-inch diameter	ASTM F679: Standard dimension ratio less than 35, except that the cell classification shall be 12454-C as defined in ASTM D1784.
Joints	ASTM D3212 rubber gasketed.
Gaskets	ASTM F477. Lubricants: As approved by manufacturer.
Fittings	PVC, gasketed. Provide plug when service piping is not required.
Plugs	Removable. Removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.
Source Quality Control Testing	In accordance with specified ASTM.

END OF SECTION

SECTION 33 41 01.05 REINFORCED CONCRETE	
Item	**Description**
Pipe	ASTM C76, Wall B, class as shown. Mark each joint with pipe class. Rotating packer or platform not allowed.
Cement	ASTM C150, Type II, or ASTM C150, Type I, with fly ash; maximum 12 percent Tricalcium Aluminate, or ASTM C595 Rev A, Type IP, with fly ash; Cement: ASTM C150. Minimum 564 pounds per cubic yard without fly ash. Minimum 479 pounds per cubic yard with fly ash.
Ratio: Water to Cementitious Materials	Not over 0.49.
Fly Ash	ASTM C618, Class C or Class F, Tables 1 and 2 modified as follows: Loss on Ignition: Maximum 3 percent Water Requirement: Maximum 100 percent of control Ratio Percent CaO/Fe_2O_3: Maximum 1.5 or test cement fly ash mix in accordance with ASTM C1012. Mix: Equal to or better than ASTM C150, Type II cement. 85 pounds per cubic yard minimum, 160 pounds per cubic yard maximum. Test: ASTM C311 and ASTM C618.
Joints	ASTM **[A: C443 Rev A.] [B: C361.]** Captive gasket in groove.
Rubber Gaskets	ASTM C443.
Tee Fittings	Reinforced concrete, rubber gasketed. Provide plug when service piping is not required.
Plugs	Removable. Removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.
Circumferential Reinforcement	Not closer than 1 inch to inside surface of pipe. Area of outer circular reinforcing cage not less than 75 percent of inner cage.
Elliptical Reinforcement	Not allowed.

SECTION 33 41 01.05 REINFORCED CONCRETE	
Item	**Description**
Source Quality Control Testing	Load Bearing 0.01-inch Crack, Compressive Strength and Absorption: ASTM **[A: C76.] [B: C507.] [C: C655.]** Load Bearing Ultimate: ASTM **[D: C76.] [E: C507.] [F: C655.]** Permeability: ASTM C497. Voids: Longitudinally sawcut one pipe from each 100 lengths of pipe manufactured in half with saw that will not damage the concrete or reinforcing steel. Inspect for voids adjacent to circumferential bars. Voids will be considered continuous if a 1/16-inch diameter pin can be inserted 1/4 inch deep. If voids exist adjacent to more than 10 percent of the circumferential bars, two additional pipes shall be tested. If either of the two pipes fail, the entire 100 lengths will be rejected.

END OF SECTION

SECTION 33 41 01.09 GLASS FIBER REINFORCED PLASTIC (GRP)	
Item	**Description**
Pipe	Manufactured and tested in accordance with ASTM D3262. Pipe Stiffness (SN) shall be a minimum of 36 psi. Pressure Class shall be a minimum of 18 psi.
Resin Systems	The manufacturer shall use polyester resin or vinylester resin systems with a proven history of performance in this particular application. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product.
Glass Reinforcements	The reinforcing glass fibers used to manufacture the structural wall shall be of highest quality commercial Grade E glass filaments with binder and sizing compatible with impregnating resins.
Silica Sand	Sand shall be minimum 98 percent silica with a maximum moisture content of 0.2 percent.
Additives	Resin additives such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used, shall not detrimentally affect the performance of the product.
Joints	ASTM D4161 and ASTM D3262: Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings or bell-spigot joints that utilize elastomeric sealing gaskets as the sole means to maintain joint watertightness. Joints shall be rated for working and test pressures, even under deflected conditions. Gaskets shall be suitable for service conditions and loads indicated. Joint Lubricant shall be suitable for service conditions and as recommended by manufacturer. Joints at tie-ins, when needed, may utilize gasket sealed closure couplings.
Lining	ASTM D3681: Reinforced thermoset liner highly resistant to exposure to sulfuric acid. With Glass Reinforcement Grade C or E.
Gasket	ASTM F477: Elastomeric gaskets Suitable for service conditions and loads indicated.
Fittings	May be contact molded or manufactured from mitered sections of pipe joint by glass fiber reinforced overlay.
End Squareness and Lengths	Pipe ends shall be square to the pipe axis with a maximum tolerance of 1.5 mm. Pipe shall be supplied in nominal lengths of 10 to 50 feet. Actual laying length shall be nominal +1, -4 inches. At least 90 percent of the total footage of each size and class of pipe, excluding special order lengths, shall be furnished in nominal length sections.

SECTION 33 41 01.09 GLASS FIBER REINFORCED PLASTIC (GRP)	
Item	**Description**
Strain Corrosion	The extrapolated 50-year strain corrosion value shall be in accordance with ASTM D3681 and ASTM D3262.
Acceptable Products	Hobas Pipe USA: Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe; or USCPS Flowtite Fiberglass Reinforced Pipe.
Source Quality Control Testing	ASTM D3262: Perform and supply submittals of test results prior to delivery. Test to be performed are production test, long-term hydrostatic qualification test, joint tightness qualification test, and beam strength and longitudinal tensile strength qualification test.

END OF SECTION

SECTION 33 44 13.13
CATCH BASINS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:
   1. American Welding Society (AWS): Code for Welding in Building Construction.
   2. ASTM International (ASTM):
      a. A36/A36M, Standard Specification for Carbon Structural Steel.
      b. A48/A48M, Standard Specification for Gray Iron Castings.
      c. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
      d. C94/C94M, Standard Specification for Ready-Mixed Concrete.
      e. C387/C387M, Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
      f. C478, Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.

PART 2 PRODUCTS

2.01 CONCRETE

A. In accordance with Section 03 30 00, Cast-in-PlaceConcrete.

2.02 FORMS

A. Exposed Surfaces: Plywood.

B. Other Surfaces: Steel, matched boards, plywood, or other acceptable material.
   1. Trench walls, large rock, and earth are not acceptable form material.

C. Form vertical surfaces.

D. Provide fillets on re-entrant angles.

2.03 REINFORCING STEEL

A. In accordance with Section 03 21 00, Steel Reinforcement.

2.04 PRECAST UNITS

A. At the option of Subcontractor, approved precast units may be substituted for cast-in-place units.

B. Conform to ASTM C478 except dimensions shall be as shown. Submit details of proposed units to Jacobs' Engineer for review.

C. Concrete Risers for Extensions: 6 inches high maximum and of same quality as sections.

1. Confirm acceptability of risers with Jacobs' Engineer before installation.

D. Heavy traffic rated, HS-20 rated.

2.05 MORTAR

A. Standard premixed mortar conforming to ASTM C387/C387M, Type S, or proportion one part portland cement to two parts clean, well-graded sand which will pass a 1/8-inch screen.

B. Admixtures may be used if not exceeding the following percentages of weight of cement:

1. Hydrated Lime: 10 percent.
2. Diatomaceous Earth or Other Inert Materials: 5 percent.

C. Consistency of Mortar: As required to readily adhere to concrete.

2.06 FLEXIBLE PIPE CONNECTIONS

A. Manufacturer and Product: NPC, Inc., Milford, New Hampshire; Kor-N-Seal flexible rubber boot with stainless steel accessories.

2.07 FRAMES AND GRATINGS

A. Frames and Grates for Catch Basins and Storm Drain Inlets: Cast iron conforming to ASTM A48/A48, Class 30.

B. Bearing Surfaces: Clean and provide uniform contact.

C. Castings: Tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and defects.

D. Heavy traffic rated, HS-20 rated.

PART 3 EXECUTION

3.01 EXCAVATION AND BACKFILL

A. Excavate as required to accomplish construction. Backfill as specified for adjoining pipe trench per Section 31 23 23, Fill and Backfill.

3.02 CONSTRUCTION OF CATCH BASINS AND INLETS

A. Construct inlets and catch basins at locations shown and in accordance with Drawings. Construct tight and well-braced forms to dimensions and elevations required. Chamfer form corners.

B. Prior to placing concrete, remove water and debris from forms. Moisten forms just prior to placing concrete. Handle concrete from transporting vehicle to forms in a continuous manner as rapidly as practical without segregation or loss of ingredients. Immediately after placing, compact concrete with mechanical vibrator. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation.

C. Screed top surface of exposed slabs and walls. When initial water has been absorbed, float surfaces with wood float and lightly trowel with steel trowel to smooth finish free from marks or irregularities. Finish exposed edges with steel edging tool. Remove forms and patch defects in concrete with mortar mixed in same proportions as original concrete mix.

D. Use a membrane-forming curing compound to prevent loss of moisture for 7 days. Apply curing compound immediately after removal of forms or finishing of slabs. Protect concrete from damage during curing period.

3.03 PLACING PRECAST UNITS

A. If material in bottom of trench is unsuitable for supporting unit, excavate and backfill to required grade with 3-inch minus, clean, pit-run material. Set units to grade at locations shown.

3.04 PIPE CONNECTIONS

A. Provide flexible pipe connections in catch basin wall at all pipe penetrations.

3.05 EXTENSIONS

A. Install watertight extensions to height determined by Jacobs' Engineer. Lay risers in mortar with sides plumb and tops to grade. Seal joints with mortar, with interior and exterior troweled smooth. Prevent mortar from drying out and cure by applying a curing compound.

3.06 INSTALLATION OF FRAMES AND GRATINGS

A. Set frames and grates at elevations indicated or as determined in field and in conformance with Drawings.

B. Frames may be cast in or set in mortar.

3.07 CLEANING

A. Upon completion, clean structure of silt, debris, and foreign matter.

END OF SECTION

SECTION 33 47 13.06
POND AND RESERVOIR LINERS—SOIL-LIME FOR EMERGENCY BASIN LINING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):

a. C837, Standard Test Method for Methylene Blue Index of Clay.

b. D422, Standard Test Method for Particle-Size Analysis of Soils.

c. D1556, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.

d. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

e. D2216, Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

f. D5084, Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.

g. D5093, Standard Test Method for Field Measurement of Infiltration Rate Using a Double-Ring Infiltrometer with a Sealed-Inner Ring.

h. D6391, Standard Test Method for Field Measurement of Hydraulic Conductivity Limits of Porous Materials Using Two Stages of Infiltration from a Borehole.

i. D6938, Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.02 DEFINITIONS

A. Grain Size: Determined by ASTM D422.

B. Imported Material: Meets requirements of this Specification and is obtained offsite and transported to Site.

C. Natural Moisture Content: Determined by ASTM D2216.

D. Optimum Moisture Content: Determined by ASTM D1557.

E. Relative Compaction: Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density, as determined by ASTM D1557.

F. Soil Admixture: Natural onsite clay material, as specified in this section, that when mixed with lime, produces soil-lime material.

G. Soil-Lime Barrier Layer: Compacted liner consisting of soil and lime materials, designed, formulated, and constructed to provide low-permeability barrier against infiltration of liquids or contaminants.

H. Soil-Lime Material: Mixture of natural onsite soil and powdered lime that produces low-permeability and high strength material.

1.03 SUBMITTALS

A. Informational Submittals:
   1. Quality Assurance Plan.
      a. Installer Qualifications: Demonstrate successful completion of at least three similar projects, each having at least 10,000 cubic yards of soil-lime placed.
      b. Manufacturer and properties of proposed lime material.
      c. Soil-lime processing, compaction, and moisture control equipment, to include the following as appropriate for each equipment type:
         1) Manufacturer's name and address.
         2) Catalog and manufacturer data sheets.
         3) Equipment operating data from similar projects.
         4) Dimensions and weight.
   2. Moisture Control Plan: Method to prevent drying, cracking, saturation, or other damage prior to installation of permanent covering, if any.
   3. Topographic surveys.
   4. Field test results.

PART 2 PRODUCTS

2.01 COMPONENTS

A. Soil: Existing emergency basin soils, free from roots, organic matter, debris, rocks or slag larger than 1 inch, and other deleterious material. Remove, grub, and clear any surficial vegetation and root layers prior to mixing. Dispose of material in designated onsite soil disposal areas.

B. Lime: Dry lime powder, quicklime, or kiln dust.

2.02 MIX

A. Combine lime with native soil to produce a well-mixed material with coefficient of permeability of 1 by 10^{-7} centimeters per second or less, when compacted to 95 percent relative compaction.

2.03 SOURCE QUALITY CONTROL

A. Provide services of an independent soils testing agency.

B. Soil-Lime Mix:

1. Prepare Samples for use in determining design application rate of lime by compacting test specimens to 95 percent relative compaction at moisture content within range of optimum moisture to 5 percentage points above optimum.
2. Perform specified permeability testing.

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

A. Grade existing ground surface to meet designated grades beneath soil-lime barrier layer shown.

B. Excavate areas abovegrade as specified in Section 31 23 16, Excavation.

C. Prepare subgrade as specified in Section 31 23 13, Subgrade Preparation.

D. Where fill is required to bring subgrade up to grade, fill these belowgrade areas with earthfill in accordance with Section 31 23 23, Fill and Backfill.

E. Compact surface to density of at least 90 percent relative compaction.

3.02 INSTALLATION

A. Processing and Placement Using In-Place Mixing Method:

1. Condition moisture content of soil prior to application of lime, as specified.
2. Spread lime uniformly, using agricultural lime, seed spreader, or other approved method, across prepared sub grade surface at minimum application rate as determined by design mix tests. Place tarpaulin or drop cloth panels at different locations across the area where materials are to be spread. Weigh materials collected on test panels and divide this weight by the area of the panels to verify proper dosage being applied.

3. Thoroughly mix soil-lime mixture to specified depth of 12-inches minimum using rotovator or other suitable equipment that, by actual demonstration, produces thorough and uniform mixture of soil and lime, free from lumps or pockets of unmixed materials. Mix by tilling in two directions roughly perpendicular using overlapping passes.

B. Compaction:

1. Compact each lift of soil-lime mixture to minimum density of 95 percent relative compaction at moisture content range of optimum moisture to 5 percentage points above optimum.
2. Overlap joints between adjacent soil-lime layers at least 5 feet.
3. Scarify surface of each lift with rotovator to depth of 2 inches prior to placing subsequent lift of soil-lime material.
4. Work only on an area that can be completed in 1 working day. Completion is defined as soil admixture moisture conditioning, mixing and spreading of soil and lime, and compaction of soil-lime barrier layer.
5. Compact exposed surfaces to protect soil-lime from moisture changes, loss or gain.
6. If soil-lime layer becomes cracked or becomes softened due to moisture changes, scarify with rotovator for full depth of lift and recompact as previously specified.
7. Surface of final lift shall be smooth and free from roller marks, holes, depressions more than 1/2 inch deep, or protrusions extending above surface more than 1/2 inch.
8. Minimum thickness of completed soil-lime barrier layer shall be 12 inches.

C. Moisture Control:

1. Implement Moisture Control Plan.
2. During compacting operations, maintain moisture content in each lift of soil-lime material within range specified.
3. If too dry, add water to material by sprinkling fill, then mixing to make moisture content uniform throughout lift.
4. If too wet, aerate material by blading, discing, harrowing, or other methods, to hasten drying process.

3.03 TOLERANCES

A. Construct material limits within tolerance of 0.5 foot horizontal and 0.1 foot vertical, except where shown or specified, as a minimum.

3.04 FIELD QUALITY CONTROL

A. Provide services of independent soils testing agency.

B. Density and Moisture Content Tests:

1. Perform in-place density and moisture content tests on soil-lime barrier layer at a frequency of at least one test for each 10,000 square feet or portion thereof, of each lift.
2. Determine in-place density and moisture content by any one or combination of following methods: ASTM D6938, ASTM D1556, ASTM D2216, or other methods approved by Engineer. If nuclear gauge method (ASTM D6938) is used to determine in-place density, moisture content readings shall be calibrated for soil-lime with at least two oven-dried moisture content tests each day.

3.05 MANUFACTURER'S SERVICES

A. Furnish lime manufacturer's representative at Site as required for initial soil-lime barrier layer installation to instruct Contractor's personnel on product application techniques.

3.06 TOPOGRAPHIC SURVEYS

A. Conduct detailed topographic surveys of Site to document suitable thickness of installed soil-lime barrier layer as follows:

1. At a minimum, conduct survey at completion of subgrade preparation and at completion of soil-lime barrier layer placement.
2. Measure elevations on minimum 50-foot grid over entire area and at all breaks in grade.
3. Survey Accuracy: Within 0.1 foot vertical and 0.5 foot horizontal in accordance with national surveying standards.

3.07 PROTECTION OF WORK

A. Do not route or allow construction traffic on top of soil-lime barrier layer once material has been placed and compacted.

END OF SECTION

SECTION 35 20 16.25
FABRICATED SLIDE GATES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Water Works Association (AWWA): C561, Fabricated Stainless Steel Slide Gates.
   2. ASTM International (ASTM):
      a. A193/A193M, Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
      b. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and General Applications.
      c. A276, Standard Specification for Stainless Steel Bars and Shapes.
      d. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
   3. National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).

1.02 DEFINITIONS

A. Self-Contained: The arrangement of gate operator, supported by gate frame, such that operating thrust loads are not applied external to the assembly.

B. Slenderness Ratio: The ratio of the maximum unsupported stem length to the stem cross-section radius of gyration.

1.03 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Make, model, weight, and horsepower of each equipment assembly.
      b. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction.
      c. Detailed structural, mechanical, and electrical drawings showing the equipment fabrications and interface with other items. Include dimensions, size, and locations of connections to other work, and weights of associated equipment associated therewith.
      d. Gate operator and stem calculations for each gate and service condition.
      e. Gate opening and closing thrust forces that will be transmitted to the support structure with operator at extreme positions and load.

f. Functional description of internal and external instrumentation and controls to be supplied including list of parameters monitored, controlled, or alarmed.

g. Power and control wiring diagrams, including terminals and numbers with indication of terminals with customer connections.

h. Submit anchorage and bracing drawings and cut sheets as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Submit anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
3. Special shipping, storage and protection, and handling instructions.
4. Manufacturer's written/printed installation instructions.
5. Routine maintenance requirements prior to plant startup.
6. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
7. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

1.04 SYSTEM DESCRIPTION

A. Coordinate such that electric motor operators are fully assembled and tested, including motor, at the factory.

PART 2 PRODUCTS

2.01 SUPPLEMENTS

A. See supplements to this section for additional product information.

2.02 MATERIALS

A. Stainless Steel:

1. Plate, Sheet, and Strip: ASTM A240/A240M, Type 316 or Type 316L.
2. Bars and Shapes: ASTM A276, Type 316 or Type 316L.
3. All welded stainless steel components shall be Type 316L.

2.03 PERFORMANCE REQUIREMENTS

A. Leakage shall not exceed 0.05 gallon per minute per foot of gate periphery under either seating or unseating head conditions.

2.04 SLIDE GATES

A. Rising stem type, with assembly styles designated as follows:
   1. See the Slide Gate Schedule for designation of gate as self-contained versus non-self-contained.
   2. Style A: Upward acting type for wall surface mounting on the concrete structures, including a top of gate seal for use on submerged openings. Embedded bottom frame where indicated on Drawings.
   3. Style B: Upward acting type for mounting in channels with concrete embedded frame and invert. Where indicated on the Slide Gate Schedule, provide a top of gate seal for use on submerged openings.
   4. Style C: Downward acting weir gate type with invert seal for wall surface mounting on the concrete structures.
   5. Style D: Downward acting weir gate type with invert seal for embedded side frame mounting in concrete structures. “P” seals are not allowed.

B. Guide Frames:
   1. Stainless steel.
   2. Vertical Guides: Design for maximum rigidity, and extend in one continuous piece from the gate invert to form posts for support of gate operators of self-contained gates. When guides extended above the operating floor, they shall be sufficiently strong so that no further reinforcements are required.
      a. Weight: Not less than 13 pounds per linear foot for wall mounted frames, and not less than 6.5 pounds per linear foot for channel-mounted (embedded) guides. Unless indicated otherwise in the Slide Gate Schedule.
      b. Incorporate a replaceable, self-adjusting, UV stabilized UHMW polyethylene seal with nitrile compression cord. Seal shall be mechanically fastened in the guide slot on both the upstream and downstream sides of the disc. No wedges, pressure pads or similar wedging devices are allowed.
      c. Seal systems incorporating “J bulb”, “P seals”, “d seals”, or similar rubber seals are not acceptable.
   3. Frame Invert: For flush bottom gate, furnish a neoprene insert to function as a seating surface for the gate disc.
      a. Weight: Not less than 13 pounds per linear foot for wall mounted frames, and not less than 6.5 pounds per linear foot for channel-mounted (embedded) inverts.
   4. Join vertical guide frames and invert with factory welded corners.
   5. Size guided slot to provide a minimum disc engagement of 1 inch on each side.

C. Disc:

1. Disc Plate (Sliding Member): One-piece stainless steel plate. Reinforce as required so that the disc will not deflect more than 1/720 of the gate span, or 1/16-inch, whichever is less, when the upstream liquid depth (seating head side) is as shown on the schedule and the downstream liquid depth is less than 1/2 inch.
2. Reinforce gate disc with one-piece stainless steel angles or channels welded to the disc plate. Bolted reinforcements will not be permitted.
3. The portion of the slide that engages the frame shall have a minimum thickness of 1/2-inch.

D. Operator Support Yoke:

1. For self-contained gate operators, attached to the vertical extensions of the guide frames.
2. Constructed from at least two stainless steel channels, or two other suitable shapes, and weld or bolt in place to provide a rigid assembly. Angles are not acceptable for yoke members.
3. Maximum Deflection: Not to exceed 1/16 inch under full operator applied loading.

E. Stems:

1. 1-1/2 -inch minimum diameter, ASTM A276, Type 316 stainless steel. Unless indicated otherwise in the Slide Gate Schedule.
2. Threads: Acme type with RMS surface roughness of 16 microinches or less on the flanks.. Extend threaded portion of stem 2 inches above operator when gate is in CLOSED position.
3. Ratio of the unsupported stem length to the radius of gyration, both in inches, shall not exceed 200.
4. Stems to withstand in compression, without damage, the thrust equal to at least 2-1/2-times the rated output of the hoisting mechanism, with a 40-pound effort applied to the handwheel or crank.
5. Design electric motor-driven floor stands to withstand at least 1.25 times the output thrust of the motor in the stalled condition.
6. Equip operating stems with stainless steel, bushed stem guides, mounted on stainless steel brackets; adjustable in two directions and spaced so that the L/r ratio does not exceed 200.
7. Adjustable stop collar for the CLOSED position.
8. Connect the stems to the disc plate with a yoke, bolted to the stem and welded to the disc.
9. Slide gates having a width greater than twice the height or width greater than 84 inches shall have dual stems. For downward opening weir type gates, locate stems near outside edges of gate.

F. Stem Covers:
   1. Transparent plastic, vented pipe stem cover and cap.
   2. Provide with OPEN/CLOSED designators with 1-inch graduations on clear mylar pressure sensitive, adhesive tape, suitable for outdoor application.

G. Manufacturers:
   1. RW Gate.
   2. Whipps, Inc.

2.05 GATE OPERATORS

A. General:
   1. Components: Withstand a minimum of 250 percent of design torque or thrust at extreme operator positions without damage.
   2. Mount at walkway level, 36 inches above floor, unless otherwise indicated or required.
   3. Gear train and gate stem sections shall produce a self-locking drive train.
   4. Lift Nuts: Internally threaded with cut or cold-rolled Acme threads corresponding to stem threading.
   5. Roller Bearings: Ball-thrust or tapered above and below lift nut to support both opening and closing thrusts.
      a. Grease lubrication fittings for bearings.
      b. Input pinions with needle or ball bearings.
   6. Lubrication: Furnish rising stem gates with an insert lubricator flange in lift, with grease fitting for greasing stem threads below stem nut.
   7. Manual Operator Limit Switches:
      a. Mounted on an angle adjacent to stem and actuated through limit switch wands by stop collar.
      b. Single-pole, double-throw type, with contacts rated 2 amps at 24V dc.
      c. Provide two switches, one for gate full OPEN, and one for gate full CLOSED, where indicated.

B. Type 1, Handwheel-Operated Bench Stands:
   1. Direct drive.
   2. Sealed, ball thrust, roller or needle bearing type and equipped with bronze lift nut, internally threaded with Acme threads.
   3. Furnish mechanical seals at housing penetrations.
   4. Handwheel and Baseplate: Cast iron or cast aluminum.
   5. Manual Effort: Not to exceed 40 pounds.

C. Type 2, Crank-Operated Bench Stands:
   1. Weatherproof housings, mounted on cast aluminum or cast iron base to the top horizontal member of the slide gate frame as described under paragraph Operator Support Yoke.
   2. Solid Bronze Lift Nut: Integrally threaded with Acme threads.
   3. Ball Thrust or Tapered Roller Bearings:
      a. Locate above and below operating nut flange to support opening and closing thrusts.
      b. Include grease lubrication fittings and input pinions.
   4. Manual Crank Effort: Not to exceed 40 pounds.
   5. Suitable for portable electric drill operation after removal of handcrank.

D. Type 3, Geared Floor Stands:
   1. Crank-operated, with weatherproof housings with solid bronze lift nut.
   2. Mount on fabricated stainless steel pedestal or base.
   3. Maximum manual crank effort to operate gate shall not exceed 40 pounds.
   4. Lift Nut: Internally threaded with Acme threads.
   5. Furnish ball thrust or tapered roller bearings above and below the lift nut to support both opening and closing thrusts.
      a. Grease lubrication fittings for bearings.
      b. Input pinions with needle or ball bearings.
      c. Mechanical seals at housing penetrations.

E. Type 4, Electric Motor Operators: See Section 40 27 02, Process Valves and Operators, for 480-volt Electric Motor Operators.

2.06 APPURTENANCES

A. Lifting Lugs: Furnish suitably attached for equipment assemblies and components weighing over 100 pounds.

B. Anchor Bolts: For anchor bolt and post-installed concrete and masonry anchor requirements, refer to Specification Section 05 05 19, Anchor Bolts.

2.07 SHOP/FACTORY FINISHING

A. Mechanically descale and passivate all weld burn and weld slag in accordance with ASTM A380 to provide uniform finish.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with the manufacturer’s written instructions.

B. Disassemble factory assembled gate components before installation.

C. Field mount operators after installing gates.

D. Brace thimbles internally during concrete placement.

E. Accurately place anchor bolts using templates furnished by the manufacturer and as specified in Section 05 05 19, Anchor Bolts.

F. Lubricate stems before operating.

3.02 FIELD QUALITY CONTROL

A. Functional Tests: Conduct on each slide gate.

B. Performance Test:
   1. Conduct on each slide gate.
   2. Perform under actual or approved simulated operating conditions.
   3. Test for a continuous one 15-minute period without malfunction.
   4. Adjust, realign, or modify units and retest if necessary.

3.03 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this Specification.
   1. Slide Gate Schedule.

END OF SECTION

Slide Gate Schedule									
Gate Tag No.	P&ID No.	Assembly Style	Wall Opening (width/height inches)	Gate Slide Height (inches)	Flow Stream	Design Operating Head (feet) Seating/ Unseating Condition	Travel Time (inches/ minute)	Operator Type/ Control Style	Remarks
14GTE9550-00	N-001-09	A – Self-Contained	120 Diameter	120	RS	10 Seating	12	4/Open-Close	Gate travel is 120 inches
14GTE9501-01	N-005-09	B – Self-Contained	48/252	168	RS	10 Seating	12	4/Open-Close	Gate travel is 144 inches, Provide with local remote control station.
14GTE9501-02	N-005-09	B – Self-Contained	48/252	168	RS	10 Seating	12	4/Open-Close	Gate travel is 144 inches, Provide with local remote control station.
14GTE9501-03	N-005-09	B – Self-Contained	48/252	168	RS	10 Seating	12	4/Open-Close	Gate travel is 144 inches, Provide with local remote control station.
14GTE9505-01	N-007-09	B – Self-Contained	48/252	168	RS	10 Seating	12	4/Open-Close	Gate travel is 144 inches, Provide with local remote control station.

14GTE9505-02	N-007-09	B – Self-Contained	48/252	168	RS	10 Seating	12	4/Open-Close	Gate travel is 144 inches, Provide with local remote control station.
14GTE9505-03	N-007-09	B – Self-Contained	48/252	168	RS	10 Seating	12	4/Open-Close	Gate travel is 144 inches, Provide with local remote control station.
11-SLG-208	N-030-09	A – Self-Contained	96 Diameter	Unknown	RS	15 Seating/ Unseating	12	4/Open-Close	Retrofit existing gate with new electrical actuator
14GTE9530-01	N-019-09	B – Self-Contained	54/120	72	RS	6 Seating	12	4/Open-Close	
14GTE9530-02	N-019-09	B – Self-Contained	54/120	72	RS	6 Seating	12	4/Open-Close	
14GTE9530-03	N-020-09	B – Self-Contained	54/120	72	RS	6 Seating	12	4/Open-Close	
14GTE9530-04	N-020-09	B – Self-Contained	54/120	72	RS	6 Seating	12	4/Open-Close	
14GTE9530-05	N-021-09	B – Self-Contained	54/120	72	RS	6 Seating	12	4/Open-Close	
14GTE9530-06	N-021-09	B – Self-Contained	54/120	72	RS	6 Seating	12	4/Open-Close	
14GTE9650-01	N-012-09	B – Self-Contained	57.5/120	124	RS	22t Seating	24	4/Open-Close	15 pounds/ft vertical guide; 2-1/2” stem (minimum)

14GTE9649-01	N-012-09	B – Self-Contained	57.5/120	124	RS	22 Seating	24	4/Open-Close	15 pounds/ft vertical guide; 2-1/2" stem (minimum)
14GTE9650-02	N-013-09	B – Self-Contained	57.5/120	124	RS	22 Seating	24	4/Open-Close	15 pounds/ft vertical guide; 2-1/2" stem (minimum)
14GTE9649-02	N-013-09	B – Self-Contained	57.5/120	124	RS	22 Seating	24	4/Open-Close	15 pounds/ft vertical guide; 2-1/2" stem (minimum)
14GTE9650-03	N-014-09	B – Self-Contained	57.5/120	124	RS	22 Seating	24	4/Open-Close	15 pounds/ft vertical guide; 2-1/2" stem (minimum)
14GTE9649-03	N-014-09	B – Self-Contained	57.5/120	124	RS	22 Seating	24	4/Open-Close	15 pounds/ft vertical guide; 2-1/2" stem (minimum)
14GTE9650-04	N-015-09	B – Self-Contained	57.5/120	124	RS	22 Seating	24	4/Open-Close	15 pounds/ft vertical guide; 2-1/2" stem (minimum)
14GTE9649-04	N-015-09	B – Self-Contained	57.5/120	124	RS	22 Seating	24	4/Open-Close	15 pounds/ft vertical guide; 2-1/2" stem (minimum)
14GTE9650-05	N-016-09	B – Self-Contained	57.5/120	124	RS	22 Seating	24	4/Open-Close	15 pounds/ft vertical guide; 2-1/2" stem (minimum)

14GTE9649-05	N-016-09	B – Self-Contained	57.5/120	124	RS	22 Seating	24	4/Open-Close	15 pounds/ft vertical guide; 2-1/2" stem (minimum)
12GTEXXXX – Backwash Junction Box Gate	N-003-09	A – Self-Contained	84 Diameter	84	RS	15 Seating	N/A	4/Manual	Field verify Gate width and gate slide height to cover existing pipe and anchor frame to new concrete structure
14GTE9533-01	N-019-09	A – Self-Contained	48/48	48	RS	13 Seating	12	4/Open-Close	

See Drawings for configuration and invert and operator elevations.

SECTION 40 05 15
PIPING SUPPORT SYSTEMS

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Related sections include, but not limited to, the following:
   1. Division 01, General Requirements.
   2. Section 05 50 00, Metal Fabrications.
   3. Section 09 90 00, Painting and Coating.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads for Buildings and Other Structures.
   2. American Society of Mechanical Engineers (ASME): B31.1, Power Piping.
   3. ASTM International (ASTM):
      a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      b. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
      c. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
   4. International Code Council (ICC):
      a. International Building Code (IBC).
      b. International Mechanical Code (IMC).
   5. Manufacturers' Standardization Society (MSS):
      a. SP 58, Pipe Hangers and Supports—Materials, Design and Manufacture.
      b. SP 127, Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, and Application.

1.03 DEFINITIONS

A. Wetted or Submerged: Submerged, less than 1 foot above liquid surface, below top of channel wall, under cover or slab of channel or tank, or in other damp locations.

1.04 SUBMITTALS

A. Action Submittals:
   1. Catalog information and drawings of piping support system, locating each support, sway brace, seismic brace, hanger, guide, component, and anchor for all piping. Identify support, hanger, guide, and anchor type by catalog number and Shop Drawing detail number.
   2. Revisions to support systems resulting from changes in related piping system layout or addition of flexible joints.

B. Informational Submittals: Maintenance information on piping support system.

1.05 DESIGN REQUIREMENTS

A. General:
   1. Locate piping support systems throughout facility, in accordance with design drawings.
   2. Supports are shown only where specific types and locations are required; additional pipe supports may be required. Where supports are not shown, suggested support details have been called out.
   3. Meet requirements of MSS SP 58 and ASME B31.3 or as modified by this section.

B. Pipe Support Systems:
   1. Maximum Support Spacing and Minimum Rod Size: In accordance with MSS SP 58 Table 3 and Table 4.
      a. Ductile-iron Pipe 8 Inches and Under: Maximum span limited to that for standard weight steel pipe for water service.
      b. Ductile-iron Pipe 10 Inches and Larger: Maximum span limited to 20 feet.
      c. Apply spacing guidelines to vertical piping as well.
      d. Unless spacing shown otherwise on Drawings.

C. Vertical Sway Bracing: 10-foot maximum centers or as shown.

PART 2 PRODUCTS

2.01 GENERAL

A. When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated.

B. Special support and hanger details may be required for cases where standard catalog supports are not applicable.

C. Materials: In accordance with the Material Selection Table as shown in the General Section of Drawings.

2.02 HANGERS

A. Clevis:
   1. MSS SP 58, Type 1:
      a. Anvil; Figure 260 for steel pipe and Figure 590 for ductile-iron pipe, sizes 1/2 inch through 30 inches.
      b. Insulated Steel Pipe: Anvil; Figure 260 with insulated saddle system (ISS), sizes 1/2 inch through 16 inches.
      c. B-Line; Figure B3100, sizes 1/2 inch through 30 inches.

B. Adjustable Swivel Split-Ring Pipe Clamp:
   1. MSS SP 58, Type 6:
      a. Anvil; Figure 104, sizes 3/4 inch through 8 inches.
      b. B-Line; Figure B3171, sizes 3/4 inch through 8 inches.

C. Steel Yoke Pipe Rolls and Roller Supports:
   1. MSS SP 58, Type 41 or Type 43:
      a. Anvil; Figure 181 for sizes 2-1/2 inches through 24 inches.
      b. B-Line; Figure B3110 for sizes 2 inches through 24 inches.

D. Pipe Rollers and Supports:
   1. MSS SP 58, Type 44:
      a. Anvil; Figure 175, sizes 2 inches through 30 inches.
      b. B-Line; Figure B3120, sizes 2 inches through 24 inches.

2.03 WALL BRACKETS, SUPPORTS, AND GUIDES

A. Welded Steel Wall Bracket:
   1. MSS SP 58, Type 33 (heavy-duty):
      a. Anvil; Figure 199, 3,000-pound rating.
      b. B-Line; Figure B3067, 3,000-pound rating.

B. Adjustable “J” hanger MSS SP 58, Type 5:
   1. Anvil; Figure 67, sizes 1/2 inch through 8 inches.
   2. B-Line; Figure B3690, sizes 1/2 inch through 8 inches.

C. Offset Pipe Clamp: Anvil; Figure 103, sizes 3/4 inch through 8 inches.

D. Channel Type:
   1. Unistrut.
   2. Anvil; Power-Strut.
   3. B-Line; Strut System.
   4. Aickinstrut (FRP).

2.04 PIPE SADDLES

A. Saddle Supports, Pedestal Type:
   1. Minimum standard weight pipe stanchion, saddle, and anchoring flange.
   2. Nonadjustable Saddle:
      a. MSS SP, Type 37 with U-bolt:
         1) Anvil; Figure 259, sizes 4 inches through 36 inches with Figure 63C base.
         2) B-Line; Figure B3095, sizes 1 inch through 36 inches with Figure B3088S base.
   3. Adjustable Saddle:
      a. MSS SP 58, Type 38 without clamp:
         1) Anvil; Figure 264, sizes 2-1/2 inches through 36 inches with Figure 62C base.
         2) B-Line; Figure B3092, sizes 3/4 inch through 36 inches with Figure B3088S base.

2.05 CHANNEL TYPE SUPPORT SYSTEMS

A. Channel Size: 12-gauge, 1-5/8-inch wide minimum steel, or 1-1/2-inch wide, minimum FRP.

B. Fasteners: Vinyl ester fiber, polyurethane base composite nuts and bolts, or encapsulated steel fasteners.

C. Manufacturers and Products:
   1. B-Line; Strut System.
   2. Unistrut.
   3. Anvil; Power-Strut.
   4. Aickinstrut (FRP System).
   5. Enduro-Durostrut (FRP Systems).

2.06 FRP PIPE SUPPORTS SYSTEMS

A. General:
   1. FRP with UV additive, protective veil, and vinyl ester resins resistance to chemicals listed in Supplement at end of section.
   2. Fire Retardant: ASTM E84.
   3. Include hangers, rods, attachments, and fasteners.

B. Clevis Hangers:
   1. Factor of Safety: 3 to 1.
   2. Minimum Design Load: 200 pounds.

C. Layout:
   1. Layout pipe supports spacing, hanger rod sizing based upon manufacturer's recommendations. Provide these manufacturer's recommendations in the Submittal.
   2. Identify and highlight non-FRP fasteners or components in Submittal.

D. Manufacturers:
   1. Aickinstrut.
   2. Enduro.
   3. Century Composite.

2.07 PIPE CLAMPS

A. Riser Clamp: MSS SP 58, Type 8.
   1. Anvil; Figure 261, sizes 3/4 inch through 24 inches.
   2. B-Line; Figure B3373, sizes 1/2 inch through 30 inches.

2.08 ELBOW AND FLANGE SUPPORTS

A. Elbow with Adjustable Stanchion: Sizes 2 inches through 18 inches, Anvil; Figure 62C base.

B. Elbow with Nonadjustable Stanchion: Sizes 2-1/2 inches through 42 inches, Anvil; Figure 63A or Figure 63B base.

C. Flange Support with Adjustable Base: Sizes 2 inches through 24 inches, Standon; Model S89.

2.09 INTERMEDIATE PIPE GUIDES

A. Type: Hold down pipe guide.
   1. Manufacturer and Product: B-Line; Figure B3552, 1-1/2 inches through 30 inches.

B. Type: U-bolts with double nuts to provide nominal 1/8-inch to 1/4-inch clearance around pipe; MSS SP 58, Type 24.
   1. Anvil; Figure 137 and Figure 137S.
   2. B-Line; Figure B3188 and Figure B3188NS.

2.10 PIPE ALIGNMENT GUIDES

A. Type: Spider.

B. Manufacturers and Products:
   1. Anvil; Figure 255, sizes 1/2 inch through 24 inches.
   2. B-Line; Figure B3281 through Figure B3287, sizes 1/2 inch through 24 inches.

2.11 PIPE ANCHORS

A. Type: Anchor chair with U-bolt strap.

B. Manufacturer and Product: B-Line; Figure B3147A or Figure B3147B.

2.12 ACCESSORIES

A. Anchor Bolts: Refer to Section 05 05 19, Anchor Bolts, for anchor bolt and post installed concrete anchor requirements.

B. Dielectric Barriers:
   1. Plastic coated hangers, isolation cushion, or tape.
   2. Manufacturer and Products:
      a. B-Line; B1999 Vibra Cushion.
      b. B-Line; Iso Pipe, Isolation Tape.

C. Insulation Shields:
   1. Type: Stainless steel, MSS SP 58, Type 40.
   2. Manufacturers and Products:
      a. Anvil; Figure 167, sizes 1/2 inch through 24 inches.
      b. B-Line; Figure B3151, sizes 1/2 inch through 24 inches.

D. Welding Insulation Saddles:
   1. Type: MSS SP 58, Type 39.
   2. Manufacturers and Products:
      a. Anvil; Figure Series 160, sizes 1 inch through 36 inches.
      b. B-Line; Figure Series B3160, sizes 1/2 inch through 24 inches.

E. Plastic Pipe Support Channel:
   1. Type: Continuous support for plastic pipe and to increase support spacing.
   2. Manufacturer and Product: B-Line; Figure Series B3106V, sizes 1/2 inch through 6 inches with Figure B3106 Vee bottom hanger.

F. Pipe Protection Barrier:
   1. Type: Protect plastic piping from contact with support.
   2. Manufacturer and Product: Wrap pipe with 1/8-inch-thick neoprene. Use stainless steel hose clamps to clamp two Anvil Figure 167 insulation shields around neoprene.

G. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.

H. Attachments:
   1. I-Beam Clamp: Concentric loading type, MSS SP 58, Type 21, Type 28, Type 29, or Type 30, which engage both sides of flange.
   2. Concrete Insert: MSS SP 58, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.
   3. Welded Beam Attachment: MSS SP 58, Type 22.
      a. Anvil; Figure 66.
      b. B-Line; Figure B3083.
   4. U-Channel Concrete Inserts: As specified in Section 05 50 00, Metal Fabrications.
   5. Concrete Attachment Plates:
      a. Anvil; Figure 47, Figure 49, or Figure 52.
      b. B-Line; Figure B3084, Figure B3085, or Figure B3086.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
   1. Install support systems in accordance with MSS SP 58, unless shown otherwise.

2. Install pipe hanger rods plumb, within 4 degrees of vertical during shut down, start up or operations.
3. Support piping connections to equipment by pipe support and not by equipment.
4. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
5. Support no pipe from pipe above it.
6. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.
7. Do not use adhesive anchors for attachment of supports to ceiling or walls.
8. Do not install pipe supports and hangers in equipment access areas or bridge crane runs.
9. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.
10. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
11. Repair mounting surfaces to original condition after attachments are completed.

B. Accessories:
1. Insulation Shield: Install on insulated piping with oversize rollers and supports.
2. Pipe Protection Barrier: Install on plastic piping where piping contacts support.
3. Welding Insulation Saddle: Install on insulated steel pipe with oversize rollers and supports.
4. Dielectric Barrier:
a. Provide between painted or galvanized carbon steel members and copper or stainless steel pipe or between stainless steel supports and nonstainless steel ferrous metal piping.
b. Install rubber wrap between submerged metal pipe and oversized clamps.

3.02 FIELD FINISHING

A. Paint atmospheric exposed surfaces hot-dip galvanized steel components as specified in Section 09 90 00, Painting and Coating.

END OF SECTION

SECTION 40 27 00
PROCESS PIPING—GENERAL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:

1. Air Force: A-A-58092, Tape Antiseize, Polytetrafluorethylene.
2. American Association of State Highway and Transportation Officials (AASHTO): HB-17, Standard Specifications for Highway Bridges.
3. American Petroleum Institute (API): SPEC 5L, Specification for Line Pipe.
4. American Society of Mechanical Engineers (ASME):
    a. Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels.
    b. Boiler and Pressure Vessel Code, Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
    c. B1.20.1, Pipe Threads, General Purpose (Inch).
    d. B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250).
    e. B16.3, Malleable Iron Threaded Fittings Classes 150 and 300.
    f. B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.
    g. B16.9, Factory-Made Wrought Buttwelding Fittings.
    h. B16.11, Forged Fittings, Socket-Welding and Threaded.
    i. B16.15, Cast Bronze Threaded Fittings Classes 125 and 250.
    j. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
    k. B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
    l. B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500, and 2500.
    m. B16.25, Butt Welding Ends.
    n. B16.42, Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300.
    o. B31.3, Process Piping.
    p. B31.9, Building Services Piping.
    q. B36.10M, Welded and Seamless Wrought Steel Pipe.
    r. B36.19M, Stainless Steel Pipe.
5. American Society for Nondestructive Testing (ASNT): SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing.

6. American Water Works Association (AWWA):
   a. C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
   b. C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems.
   c. C110/A21.10, Ductile-Iron and Gray-Iron Fittings for Water.
   d. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   e. C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
   f. C116/A21.16, Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.
   g. C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast, for Water.
   h. C153/A21.53, Ductile-Iron Compact Fittings for Water Service.
   i. C207, Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
   j. C217, Microcrystalline Wax and Petrolatum Tape Coating Systems for Steel Water Pipe and Fittings.
   k. C606, Grooved and Shouldered Joints.
7. American Welding Society (AWS):
   a. Brazing Handbook.
   b. A5.8/A5.8M, Specification for Filler Metals for Brazing and Braze Welding.
   c. QC1, Standard for AWS Certification of Welding Inspectors.
8. ASTM International (ASTM):
   a. A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
   b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   c. A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications.
   d. A106/A106M, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
   e. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   f. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   g. A181/A181M, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
   h. A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
   i. A183, Standard Specification for Carbon Steel Track Bolts and Nuts.

j. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.

k. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

l. A197/A197M, Standard Specification for Cupola Malleable Iron.

m. A216/A216M, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.

n. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

o. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

p. A276, Standard Specification for Stainless Steel Bars and Shapes.

q. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

r. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

s. A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.

t. A320/A320M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service.

u. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.

v. A395/A395M, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

w. A403/A403M, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.

x. A409/A409M, Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service.

y. A536, Standard Specification for Ductile Iron Castings.

z. A563, Standard Specification for Carbon and Alloy Steel Nuts.

aa. A587, Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry.

bb. B32, Standard Specification for Solder Metal.

cc. B43, Standard Specification for Seamless Red Brass Pipe, Standard Sizes.

dd. B61, Standard Specification for Steam or Valve Bronze Castings.

ee. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

ff. B75, Standard Specification for Seamless Copper Tube.

gg. B88, Standard Specification for Seamless Copper Water Tube.

hh. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes.

ii. B462, Standard Specification for Forged or Rolled UNS N06030, UNS N06022, UNS N06035, UNS N06200, UNS N06059, UNS N06686, UNS N08020, UNS N08024, UNS N08026, UNS N08367, UNS N10276, UNS N10665, UNS N10675, UNS N10629, UNS N08031, UNS N06045, UNS N06025, and UNS R20033 Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service.

jj. B464, Standard Specification for Welded UNS N08020, N08024, and N08026 Alloy Pipe.

kk. B474, Standard Specification for Electric Fusion Welded Nickel and Nickel Alloy Pipe.

ll. D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers Tension.

mm. D413, Standard Test Methods for Rubber Property Adhesion to Flexible Substrate.

nn. D543, Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.

oo. D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.

pp. D1330, Standard Specification for Rubber Sheet Gaskets.

qq. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

rr. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

ss. D2000, Standard Classification System for Rubber Products in Automotive Applications.

tt. D2464, Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

uu. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

vv. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.

ww. D2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.

xx. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

yy. D4101, Standard Specification for Polypropylene Injection and Extrusion Materials.

zz. D4894, Standard Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials.

aaa. D4895, Standard Specification for Polytetrafluoroethylene (PTFE) Resin Produced from Dispersion.

bbb. F436, Standard Specification for Hardened Steel Washers.

ccc. F437, Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

ddd. F439, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

eee. F441/F441M, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

fff. F493, Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.

ggg. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

9. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS): SP-43, Wrought Stainless Steel Butt-Welding Fittings.
10. NSF International (NSF): 61 Drinking Water System Components—Health Effects.
11. National Electrical Manufacturers Association (NEMA): LI 1, Industrial Laminating Thermosetting Products.
12. National Fire Protection Association (NFPA): 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

1.02 DEFINITIONS

A. Submerged or Wetted: Zone below elevation of top face of channel walls and cover slabs.

1.03 DESIGN REQUIREMENTS

A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:
   1. Process Piping: ASME B31.3, Normal Fluid Service Category unless otherwise specified.
   2. Building Service Piping: ASME B31.9, as applicable.
   3. Sanitary Building Drainage and Vent Systems: ICC International Plumbing Code or Local plumbing code.
   4. Buried Piping: H20-S16 traffic load with 1.5 impact factor, AASHTO HB-17, as applicable.
   5. Thrust Restraints:
      a. Design for test pressure shown in Piping Schedule on Drawings.
      b. Allowable Soil Pressure: 1,000 pounds per square foot.
      c. Low Pressure Pipelines:
         1) When bearing surface of the fitting against soil provides an area equal to or greater than area required for thrust restraint, concrete thrust blocks will not be required.

2) Determine bearing area for fittings without thrust blocks by projected area of 70 percent of internal diameter multiplied by chord length for fitting centerline curve.

1.04 SUBMITTALS

A. Action Submittals:
   1. Shop Fabricated Piping: Detailed pipe fabrication or spool drawings showing special fittings and bends, dimensions, coatings, and other pertinent information.
   2. Hydraulic Thrust Restraint for Restrained Joints: Details including materials, sizes, assembly ratings, and pipe attachment methods.
   3. Dissimilar Buried Pipe Joints: Joint types and assembly drawings.
   4. Pipe Corrosion Protection: Product data.
   5. Submit anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:
   1. Manufacturer's Certification of Compliance: Pipe and fittings.
   2. Qualifications:
      a. Weld Inspection and Testing Agency: Certification and qualifications.
      b. Welding Inspector: Certification and qualifications.
      c. Welders:
         1) Current Welders Log.
         2) Test records, conducted by the Contractor or manufacturer for qualified welder(s) and weld type(s) for factory and field welding.
   3. Weld Procedures: Records in accordance with ASME Boiler and Pressure Vessel Code, Section IX for weld type(s) and base metal(s).
   4. Nondestructive inspection and testing procedures.
   5. Test logs.
   6. Certified welding inspection and test results.

1.05 QUALITY ASSURANCE

A. Qualifications:
   1. Independent Inspection and Testing Agency:
      a. Ten years' experience in field of welding and welded pipe and fittings' testing required for this Project.
      b. Calibrated instruments and equipment, and documented standard procedures for performing specified testing.
      c. Certified in accordance with ASNT SNT-TC-1A for testing procedures required for this Project.
      d. Testing Personnel: Qualified for nondestructive test methods to be performed.

e. Inspection Services: Qualified welding inspector.

2. Welding Inspector: AWS certified, AWS QC1 qualified, with prior inspection experience of welds specified.

3. Welder and Welding Operator Qualifications: Qualified by the Contractor, or on behalf of the Contractor by and independent testing agency before starting Work in accordance with Section IX, Article III of the ASME Boiler and Pressure Vessel Code.

B. Quality Control: Provide services of independent inspection and testing agency for welding operations.

1.06 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01 61 00, Common Product Requirements, and:

1. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.
2. Threaded or Socket Welding Ends: Fit with metal, wood, or plastic plugs or caps.
3. Cement Linings and Coatings: Prevent drying and cracking.
4. Cold Weather Storage: Locate products to prevent coating from freezing to ground.
5. Handling: Use heavy canvas or nylon slings to lift pipe and fittings.

PART 2 PRODUCTS

2.01 PIPING

A. As specified on Piping Data Sheet(s) and Piping Schedule on Drawings.

B. Diameters Shown:

1. Standardized Products: Nominal size.
2. Fabricated Steel Piping (Except Cement-Lined): Outside diameter, ASME B36.10M.

2.02 JOINTS

A. Grooved End System:

1. Rigid type.
2. Use of flexible grooved joints will only be allowed where shown on Drawings or with prior approval by Design-Builder.
3. Flanges: When required, furnish with grooved type flange adapters of same manufacturer as grooved end couplings.

B. Flanged Joints:

1. Flat-faced, carbon steel, or alloy flanges when mating with flat-faced cast or ductile iron flanges.

2. Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher pressure rating than required for piping.

C. Threaded Joints: NPT taper pipe threads in accordance with ASME B1.20.1.

D. Mechanical Joint Anchor Gland Follower:
1. Ductile iron anchor type, wedge action, with breakoff tightening bolts. Thrust rated to 250 psi minimum. Rated operating deflection not less than 4 degrees. UL and FMG approved.
2. Use product certified for use with AWWA C900 or ductile iron piping as applicable. Refer to Pipe Schedule on Drawings.
3. Manufacturers and Products:
a. EBAA Iron Inc.; Megalug.
b. Romac Industries, Inc.; RomaGrip.

E. Flexible Mechanical Compression Joint Coupling:
1. Stainless steel, ASTM A276, Type 305 bands.
2. Manufacturers:
a. Pipeline Products Corp.
b. Fernco Joint Sealer Co.

F. Mechanical connections of high-density polyethylene pipe to auxiliary equipment such as valves, pumps, tanks, and other piping systems shall be through flanged connections consisting of the following:
1. A polyethylene stub end thermally butt-fused to end of pipe.
2. ASTM A240/A240M, Type 304 stainless steel backing flange, 125-pound, ASME B16.1 standard. Insulating flanges shall be used where shown.
3. Bolts and nuts of sufficient length to show a minimum of three complete threads when the joint is made and tightened to manufacturer's standard. Retorque nuts after 4 hours.
4. Gaskets as specified on Data Sheet.

2.03 GASKET LUBRICANT

A. Lubricant shall be supplied by pipe manufacturer and no substitute or "or-equal" will be allowed.

2.04 PIPE CORROSION PROTECTION

A. Coatings: See Section 09 90 00, Painting and Coating (as included in Balance of Plant Project), and pipe material Data Sheets for details of coating requirements.

B. Fusion Bonded Epoxy Lining and Coating: In accordance with AWWA C116.

C. Petrolatum Wax Tape: In accordance with AWWA C217.

D. Polyethylene Encasement:
   1. Encasement Tube: Black polyethylene encasement tube, 8 mils minimum thickness, conforming to AWWA C105/A21.5, free of gels, streaks, pinholes, foreign matter, undispersed raw materials, and visible defects such as tears, blisters, and thinning at folds.
   2. Securing Tape: Thermoplastic tape, 8 mils minimum thickness, 1 inch wide, pressure sensitive adhesive face capable of bonding to metal, bituminous coating, and polyethylene encasement tube.

E. Insulating Flanges, Couplings, and Unions:
   1. Materials:
      a. In accordance with applicable piping material specified in Pipe Data Sheet. Complete assembly shall have ASME B31.3 working pressure rating equal to or higher than that of joint and pipeline.
      b. Galvanically compatible with piping.
      c. Resistant for intended exposure, operating temperatures, and products in pipeline.
   2. Union Type, 2 Inches and Smaller:
      a. Screwed or solder-joint.
      b. O-ring sealed with molded and bonded insulation to body.
   3. Flange Type, 2-1/2 Inches and Larger: Flanged, complete with bolt insulators, dielectric gasket, bolts, and nuts. Bolt insulating sleeves shall be provided full length between insulating washers. Subcontractor shall be responsible for fit-up of all components of insulated flange assembly to provide a complete functioning installation. AWWA C207 steel flanges may be drilled oversize up to 1/8-inch to accommodate insulating sleeves. No less than minimum thread engagement in accordance with specified bolting standards will be permitted to accommodate thicknesses of all required washers, flanges and gasket.
   4. Flange Insulating Kits:
      a. Gaskets: Full-face, Type E with elastomeric sealing element. Sealing element shall be retained in a groove within retainer portion of gasket.
      b. Insulating Sleeves: Full-length mylar.
      c. Insulating Washers: High strength phenolic.
      d. Steel Washers: Hardened ASTM F436 steel washers, 1/8 inch thick.
         1) Provide two washers per bolt for flange diameters equal to or less than 36 inches.
         2) Provide four washers per bolt for flange diameters larger than 36 inches.
   5. Manufacturers and Products:
      a. Dielectric Flanges and Unions:
         1) GPT Industries, Houston, TX..
         2) Advance Products and Systems, Lafayette, LA.
         3) Lamons, Houston, TX

b. Insulating Couplings:
   1) Dresser; STAB-39.
   2) Baker Coupling Company, Inc.; Series 216.

2.05 THRUST TIES

A. Steel Pipe: Joint harness as specified in Section 40 27 01, Process Piping Specialties.

B. Buried Ductile Iron Pipe and Fittings: Unless restraint is otherwise specified or shown, conform to NFPA 24. Mechanical joint anchor gland followers should be used. Tie-rod attachments relying on clamp friction with pipe barrel to restrain thrust are unacceptable.

2.06 VENT AND DRAIN VALVES

A. Pipeline 2-Inch Diameter and Smaller: 1/2-inch vent, 1-inch drain, unless shown otherwise.

B. Pipelines 2-1/2-Inch Diameter and Larger: 3/4-inch vent, 1-inch drain, unless shown otherwise.

2.07 FABRICATION

A. Mark each pipe length on outside with the following:
   1. Size or diameter and class.
   2. Manufacturer's identification and pipe serial number.
   3. Location number on laying drawing.
   4. Date of manufacture.

B. Comply with ASME B31.3 Normal Fluid Service Category, unless otherwise specified.

C. Code markings according to approved Shop Drawings.

D. Flanged pipe shall be fabricated in the shop, not in the field, and delivered to the Site with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by the manufacturer.

2.08 FINISHES

A. Factory prepare, prime, and finish coat in accordance with Pipe Data Sheet(s) and Piping Schedule on Drawings.

B. Galvanizing:
   1. Hot-dip applied, meeting requirements of ASTM A153/A153M.
   2. Electroplated zinc or cadmium plating is unacceptable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.

B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

C. Welding Electrodes: Verify proper grade and type, free of moisture and dampness, and coating is undamaged.

3.02 PREPARATION

A. See Piping Schedule on Drawings and Section 09 90 00, Painting and Coating (as included in Balance of Plant Project), for additional requirements.

B. Notify Design-Builder at least 2 weeks prior to field fabrication of pipe or fittings.

C. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.

D. Damaged Coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions.

3.03 WELDING

A. Perform in accordance with Section IX, ASME Boiler and Pressure Vessel Code and ASME B31.3, Normal Fluid Service Category, as may be specified on Piping Data Sheets.

B. Weld Identification: Mark each weld with symbol identifying welder.

C. Pipe End Preparation:
   1. Machine Shaping: Preferred.
   2. Oxygen or Arc Cutting: Smooth to touch, true, and slag removal by chipping or grinding.
   3. Beveled Ends for Butt Welding: ASME B16.25.

D. Surfaces:
   1. Clean and free of paint, oil, rust, scale, slag, or other material detrimental to welding.
   2. Clean stainless steel joints with stainless steel wire brushes or stainless steel wool prior to welding.
   3. Thoroughly clean each layer of deposited weld metal, including final pass, prior to deposition of each additional layer of weld metal with a power-driven wire brush.

E. Alignment and Spacing:
   1. Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness.
   2. Root Opening of Joint: As stated in qualified welding procedure.
   3. Minimum Spacing of Circumferential Butt Welds: Minimum four times pipe wall thickness or 1 inch, whichever is greater.

F. Climatic Conditions:
   1. Provide temporary structure as required to prevent impingement of any rain, snow, sleet, or wind exceeding 5 mph on the weld area.
   2. If the ambient temperature is less than weld procedure preheat requirement, local preheating is required.

G. Tack Welds: Performed by qualified welder using same procedure as for completed weld, made with electrode similar or equivalent to electrode to be used for first weld pass, and not defective. Remove those not meeting requirements prior to commencing welding procedures.

H. Surface Defects: Chip or grind out those affecting soundness of weld.

I. Weld Passes: As required in welding procedure.

J. Weld Quality: Free of cracks, incomplete penetration, weld undercutting, excessive weld reinforcement, porosity slag inclusions, and other defects in excess of limits shown in applicable piping code.

3.04 INSTALLATION—GENERAL

A. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.

B. Remove foreign objects prior to assembly and installation.

C. Flanged Joints:
   1. Install perpendicular to pipe centerline.
   2. Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.
   3. Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.
   4. Plastic Flanges: Install annular ring filler gasket at joints of raised-face flange.
   5. Grooved Joint Flange Adapters: Include stainless steel washer plates as required for mating to serrated faces and lined valves and equipment.
   6. Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast iron flange.
   7. Verify compatibility of mating flange to adapter flange gasket prior to selecting grooved adapter flanging.

8. Flange fillers are to be avoided, but if necessary, may be used to make up for small angles up to 6 degrees and for filling gaps up to 2 inches between flanges. Stacked flange fillers shall not be used.
9. Threaded flanged joints shall be shop fabricated and delivered to Site with flanges in-place and properly faced.
10. Manufacturer: Same as pipe manufacturer or grooved joint flange adapter manufacturer.

D. Threaded and Coupled Joints:
1. Conform to ASME B1.20.1.
2. Produce sufficient thread length to ensure full engagement when screwed home in fittings.
3. Countersink pipe ends, ream and clean chips and burrs after threading.
4. Make connections with not more than three threads exposed.
5. Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.

E. Grooved-End Joints:
1. Piping shall be grooved in accordance with the manufacturer's latest published instructions and shall be accurately cut with tools conforming to coupling manufacturer's standards and to AWWA C606.
2. Install grooved joint couplings and gaskets in accordance with manufacturer's latest published installation instructions.
3. Grooved-end joints should only be used for repair.

F. Soldered Joints:
1. Use only solder specified for particular service.
2. Cut pipe ends square and remove fins and burrs.
3. After thoroughly cleaning pipe and fitting of oil and grease using solvent and emery cloth, apply noncorrosive flux to the male end only.
4. Wipe excess solder from exterior of joint before hardened.
5. Before soldering, remove stems and washers from solder joint valves.

G. Brazed Joints for Refrigerant Piping:
1. Braze copper piping with silver solder complying with AWS A5.8/A5.8M.
2. Construct joints according to AWS Brazing Handbook, Chapter Pipe and Tube.
3. Inside of tubing and fittings shall be free of flux.
4. Clean parts to be joined with emery cloth and keep hot until solder has penetrated the full depth of the fitting and extra flux has been expelled.
5. Cool joints in air and remove flame marks and traces of flux.
6. During brazing operation, prevent an oxide film from forming on inside of tubing by slowly flowing dry nitrogen to expel the air.

7. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion valve bulb.

H. Pipe Connections at Concrete Structures: As specified in Article Piping Flexibility Provisions in Section 40 27 01, Process Piping Specialties (as included in Balance of Plant Project).

I. PVC and CPVC Piping:
   1. Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.
   2. Use strap wrench for tightening threaded plastic joints. Do not overtighten fittings.
   3. Do not thread Schedule 40 pipe.

J. Ductile Iron Piping:
   1. Cutting Pipe: Cut pipe with milling type cutter, rolling pipe cutter, or abrasive blade cutter. Do not flame cut.
   2. Dressing Cut Ends:
      a. General: As required for the type of joint to be made.
      b. Rubber Gasketed Joints: Remove sharp edges or projections.
      c. Push-On Joints: Bevel, as recommended by pipe manufacturer.
      d. Flexible Couplings, Flanged Coupling Adapters, and Grooved End Pipe Couplings: As recommended by the coupling or adapter manufacturer.

K. High-Density Polyethylene Piping:
   1. Join pipes, fittings, and flange connections by means of thermal butt-fusion.
   2. Butt-fusion shall be performed in accordance with pipe manufacturer's recommendations as to equipment and technique.
   3. Special Precautions at Flanges: Polyethylene pipe connected to heavy fittings, manholes, and rigid structures shall be supported in such a manner that no subsequent relative movement between polyethylene pipe at flanged joint and rigid structures is possible.

3.05 INSTALLATION—EXPOSED PIPING

A. Piping Runs:
   1. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
   2. Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.

B. Supports: As specified in Section 40 05 15, Piping Support Systems (as included in Balance of Plant Project).

C. Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.

D. Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.

E. Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.

F. Piping clearance, unless otherwise shown:
   1. Over Walkway and Stairs: Minimum of 7 feet 6 inches, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
   2. Between Equipment or Equipment Piping and Adjacent Piping: Minimum 3 feet, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
   3. From Adjacent Work: Minimum 1 inch(es) from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
   4. Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.
   5. Headroom in front of openings, doors, and windows shall not be less than the top of the opening.
   6. Do not install piping containing liquids or liquid vapors in transformer vaults or electrical equipment rooms.
   7. Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

3.06 INSTALLATION—BURIED PIPE

A. Joints:
   1. Dissimilar Buried Pipes:
      a. Provide flexible mechanical compression joints for pressure pipe.
      b. Provide concrete closure collar for gravity and low pressure (maximum 10 psi) piping or as shown.
   2. Concrete Encased or Embedded Pipe: Do not encase joints in concrete, unless specifically shown.

B. Placement:
   1. Keep trench dry until pipe laying and joining are completed.
   2. Pipe Base and Pipe Zone: As specified in Section 31 23 23.15, Trench Backfill.
   3. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.

4. Measure for grade at pipe invert, not at top of pipe.
5. Excavate trench bottom and sides of ample dimensions to permit visual inspection and testing of entire flange, valve, or connection.
6. Prevent foreign material from entering pipe during placement.
7. Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.
8. Lay pipe upgrade with bell ends pointing in direction of laying.
9. Install closure sections and adapters for gravity piping at locations where pipe laying changes direction.
10. Deflect pipe at joints for pipelines laid on a curve using unsymmetrical closure of spigot into bell. If joint deflection of standard pipe lengths will not accommodate horizontal or vertical curves in alignment, provide:
    a. Shorter pipe lengths.
    b. Special mitered joints.
    c. Standard or special fabricated bends.
11. After joint has been made, check pipe alignment and grade.
12. Place sufficient pipe zone material to secure pipe from movement before next joint is installed.
13. Prevent uplift and floating of pipe prior to backfilling.

C. PVC Pipe Placement:
1. Lay pipe snaking from one side of trench to other.
2. Offset: As recommended by manufacturer for maximum temperature variation between time of solvent welding and during operation.
3. Do not lay pipe when temperature is below 40 degrees F, or above 90 degrees F when exposed to direct sunlight.
4. Shield ends to be joined from direct sunlight prior to and during the laying operation.

D. Tolerances:
1. Deflection From Horizontal Line, Except PVC: Maximum 2 inches.
2. Deflection From Vertical Grade: Maximum 1/4 inch(es).
3. Joint Deflection: Maximum of 75 percent of manufacturer's recommendation.
4. Horizontal position of pipe centerline on alignment around curves maximum variation of 1.75 feet from position shown.
5. Pipe Cover: Minimum 3 feet, unless otherwise shown.

3.07 INSTALLATION—CONCRETE ENCASED

A. Provide reinforced concrete pipe encasement where shown on Drawings and where otherwise required. Some piping may be required to be concrete encased for pipe strength requirements that are included in the Specifications. Piping under and within the influence of buildings, utility trenches, vaults, slabs and other structures shall be concrete encased. See details on Drawings for encasement requirements.

B. Where concrete encased piping crosses structure construction and expansion joints, provide flexible piping joints to coincide with structure joints to prevent excessive pipe stress and breakage.

3.08 PIPE CORROSION PROTECTION

A. Ductile Iron Pipe and Fittings:
   1. Exposed: Coat exterior as specified in Section 09 90 00, Painting and Coating (as included in Balance of Plant Project), and as shown in Piping Schedule on Drawings.
   2. Buried: Wrap all metallic buried pipe, pipe sections, specials, fasteners, and fittings, valves, and all metallic appurtenances associated with buried non-metallic pipe with a petrolatum wax tape coating in accordance with AWWA C217.
   3. Submerged or Embedded: Coat exterior with epoxy as specified in Section 09 90 00, Painting and Coating (as included in Balance of Plant Package). If in potable water service, use NSF 61 approved epoxy.

B. Carbon Steel Pipe and Fittings:
   1. Exposed: As specified in Section 09 90 00, Painting and Coating (as included in Balance of Plant Project).
   2. Embedded: Shop coat with epoxy as specified in Section 09 90 00, Painting and Coating (as included in Balance of Plant Project). If in potable water service, use NSF 61 approved epoxy.

C. Copper Pipe:
   1. Exposed: As specified in Section 09 90 00, Painting and Coating (as included in Balance of Plant Project).

D. PVC and CPVC Pipe, Exposed: As specified in Section 09 90 00, Painting and Coating (as included in Balance of Plant Project).

E. Piping Accessories:
   1. Exposed:
      a. Field paint black and galvanized steel, brass, copper, and bronze piping components as specified in Section 09 90 00, Painting and Coating (as included in Balance of Plant Package), as applicable to base metal material.
      b. Accessories include, but are not limited to, pipe hangers, supports, expansion joints, pipe guides, flexible couplings, vent and drain valves, and fasteners.
   2. Buried:
      a. Wrap all metallic buried pipe, pipe sections, specials, fasteners, and fittings, valves, and all metallic appurtenances associated with buried non-metallic pipe with a petrolatum wax tape coating in accordance with AWWA C217.

F. Polyethylene Encasement: Install in accordance with AWWA C600 and ANSI/AWWA C105/A21.5 and in accordance with all recommendations and practices of the AWWA M41, Manual of Water Supply Practices – Ductile Iron Pipe and Fittings. Specifically, the wrap shall be overlapped 1 foot in each direction at joints and secured in place around the pipe, and any wrap at tap locations shall be taped tightly prior to tapping and inspected for any needed repairs following the tap. In addition, installation shall be in accordance with the manufacturer's instructions.

G. Tape Coating System: As specified in Section 09 90 00, Painting and Coating (as included in Balance of Plant Project).

H. Heat Shrink Wrap: Apply in accordance with manufacturer's instructions to surfaces that are cleaned, prepared, and primed.

I. Insulating Flanges, Couplings, and Unions:
   1. Applications:
      a. Dissimilar metal piping connections.
      b. Cathodically protected piping penetration to buildings and watertight structures.
      c. Connections to existing metallic pipe.
      d. Where required for electrically insulated connection.
   2. Pipe Installation:
      a. Insulating joints connecting immersed piping to nonimmersed piping shall be installed above maximum water surface elevation.
      b. Submerged carbon steel, ductile iron, or galvanized piping in reinforced concrete shall be isolated from the concrete reinforcement steel.
      c. Align and install insulating joints as shown on Drawings and according to manufacturer's recommendations. Bolt lubricants that contain graphite or other metallic or electrically conductive components that can interfere with the insulating capabilities of the completed flange shall not be used.

J. Thrust Ties:
   1. Steel Pipe: Attach with joint harness specified in Section 40 27 01, Process Piping Specialties (as included in Balance of Plant Project).
   2. Ductile Iron Pipe: Attach with socket clamps anchored against a grooved joint coupling or flange.
   3. Flanged Coupling Adapters: For exposed installations, install manufacturer's anchor studs through the coupling sleeve or use dismantling joints.

K. Mechanical Joint Valve Restraint in Proprietary Restrained Joint Piping: Install pipe joint manufacturer's adapter gland follower and pipe end retainer, or mechanical joint anchor gland follower.

3.09 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

A. Application and Installation: As specified in Section 40 27 01, Process Piping Specialties (as included in Balance of Plant Project).

3.10 BRANCH CONNECTIONS

A. Do not install branch connections smaller than 1/2-inch nominal pipe size, including instrument connections, unless shown otherwise.

B. When line of lower pressure connects to a line of higher pressure, requirements of Piping Data Sheet for higher pressure rating prevails up to and including the first block valve in the line carrying the lower pressure, unless otherwise shown.

C. Threaded Pipe Tap Connections:
   1. Ductile Iron Piping: Connect only with service saddle or at a tapping boss of a fitting, valve body, or equipment casting.
   2. Welded Steel or Alloy Piping: Connect only with welded threadolet or half-coupling as specified on Piping Data Sheet.
   3. Limitations: Threaded taps in pipe barrel are unacceptable.

3.11 VENTS AND DRAINS

A. Vents and drains at high and low points in piping required for completed system may or may not be shown. Install vents on high points and drains on low points of pipelines at all low and high point locations.

3.12 DISINFECTION

A. See Section 33 13 00, Disinfecting of Water Utility Distribution.

3.13 FIELD FINISHING

A. Notify Design-Builder at least 3 days prior to start of any surface preparation or coating application work.

B. As specified in Section 09 90 00, Painting and Coating (as included in Balance of Plant Project).

3.14 PIPE IDENTIFICATION

A. As specified in Section 09 90 00, Painting and Coating (as included in Balance of Plant Project).

3.15 FIELD QUALITY CONTROL

A. Pressure Leakage Testing: As specified in Section 40 80 01, Process Piping Leakage Testing.

B. Minimum Duties of Welding Inspector:
   1. Job material verification and storage.
   2. Qualification of welders.
   3. Certify conformance with approved welding procedures.

4. Maintenance of records and preparation of reports in a timely manner.
5. Notification to Design-Builder of unsatisfactory weld performance within 24 hours of weld test failure.

C. Required Weld Examinations:
1. Perform examinations in accordance with ASME B31.3, except that 50 percent of the circumferential butt welds shall be random radiographed.
2. Perform examinations for every pipe thickness and for each welding procedure, progressively, for all piping covered by this section.
3. Examine at least one of each type and position of weld made by each welder or welding operator.
4. For each weld found to be defective under the acceptance standards or limitations on imperfections contained in the applicable Piping Code, examine two additional welds made by the same welder that produced the defective weld. Such additional examinations are in addition to the minimum required above. Examine, progressively, two additional welds for each tracer examination found to be unsatisfactory.

D. Test containment piping leak detection system in accordance with system manufacturer's instructions and recommendations to verify proper operation.

3.16 MANUFACTURER'S SERVICES

A. Provide manufacturer's representative at Site in accordance with Section 01 91 14, Equipment Testing and Facility Startup (as included in Balance of Plant Project), to assist with unloading of the double wall containment piping system, system tests, containment pipe joint closure, installation and testing of leak detection system, and training of City's personnel in operation and maintenance of leak detection system. Manufacturer's representative shall complete a Manufacturer's Certificate of Proper Installation. Inspection and examination practices shall be according to ASME B31.3 for normal fluid service.

3.17 CLEANING

A. Following assembly and testing, and prior to disinfection and final acceptance, flush pipelines (except as stated below) with water at 2.5 fps minimum flushing velocity until foreign matter is removed.

B. Blow clean of loose debris plant process air and instrument air-lines with compressed air at 4,000 fpm; do not flush with water.

C. Insert cone strainers in flushing connections to attached equipment and leave in-place until cleaning is complete.

D. Remove accumulated debris through drains 2 inches and larger or by removing spools and valves from piping.

3.18 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification:

1. Data Sheets.

Number	Title
40 27 00.01	Cement-Mortar, Glass, and Ceramic-Epoxy-Lined Ductile Iron Pipe and Fittings
40 27 00.08	Stainless Steel Pipe and Fittings—General Service
40 27 00.10	Polyvinyl Chloride (PVC) Pipe and Fittings
40 27 00.13	Copper and Copper Alloy Pipe, Tubing, and Fittings
40 27 00.14	Polyethylene (PE) Piping for Compressed Air Service
40 27 00.21	High Density Polyethylene (HDPE) Pressure Pipe and Fittings
40 27 00.22	Profile Wall Polyethylene (PWPE)

END OF SECTION

SECTION 40 27 00.01 CEMENT-MORTAR, GLASS, AND CERAMIC-EPOXY-LINED DUCTILE IRON PIPE AND FITTINGS	
Item	**Description**
General	Materials in contact with potable water shall conform to NSF 61 acceptance. Pipe manufacturer shall submit certification that source manufacturing facility has been producing ductile iron pipe of specified diameters, dimensions, and standards for a period of not less than 10 years. Testing of pipe required by AWWA C151/A21.51 shall be conducted in testing and laboratory facilities located in the USA and operating under USA laws and regulations. Pipe shall be handled during manufacture and shipped without nesting (without insertion of one pipe inside another).
Pipe	Buried Liquid Service Using Mechanical or Proprietary Restrained Joints: AWWA C111/A21.11, and AWWA C151/A21.51, pressure class conforming to Table 5 and Table 7 for Type 4 trench, 250 psi minimum working pressure. Follower glands shall be ductile iron. Exposed Pipe Using Grooved End and Flange Joints: AWWA C115/A21.15, thickness Class 53 minimum, 250 psi minimum working pressure.
Lining	Cement-mortar: AWWA C104/A21.4. Glass: ASTM B1000. Ceramic Epoxy: Pipe and fittings to be ceramic-epoxy lined shall not have been previously lined. Surface preparation shall be made to surfaces free of grease, oil, or other substance with abrasive blasting using clean sand or grit abrasive. Lining shall be done within 8 hours of surface preparation and surfaces shall be reblasted if rusting appears before lining. Line with a total dry film thickness of 40 mils of ceramic epoxy. Ceramic epoxy shall be amine-cured Novolac epoxy with 20 percent minimum volume ceramic quartz pigment, Protecto 401 by Induron Coating, “or-equal”, for sewer service. Ceramapure by Induron Coating, “or-equal”, for NSF 61 and potable water service. Lining shall be applied above 40 degrees F ambient temperature and shall not be applied to flange faces. Lining thickness shall be tested using a magnetic film thickness gauge. Lining integrity shall be tested on surfaces with a nondestructive, 2,500-volt dielectric resistance test.
Fittings	Lined and coated same as pipe. Mechanical: AWWA C110/A21.10, AWWA C111/A21.11, and AWWA C153/A21.53 ductile iron, 250 psi minimum working pressure.

SECTION 40 27 00.01 CEMENT-MORTAR, GLASS, AND CERAMIC-EPOXY-LINED DUCTILE IRON PIPE AND FITTINGS	
Item	**Description**
	Follower glands shall be ductile iron. Proprietary Restrained: AWWA C110/A21.10, AWWA C111/A21.11, and AWWA C153/A21.53, ductile iron, 250 psi minimum working pressure. Restraint shall be achieved with removable metal elements fitted between a welded bar on the pipe barrel and the inside of the joint bell or fitting sizes smaller than 16 inches may be mechanical joint, restrained by anchor gland followers, ductile iron anchor type, wedge action, with break-off tightening bolts. Assembled joints shall be rated for deflection in operation at rated pressure. Rated deflection shall be not less than 1-1/2 degrees for 36-inch and smaller pipe. Rated deflection shall be not less than 1/2 degree for 42-inch and larger pipe. Clow Corp., American Cast Iron Pipe Co., U.S. Pipe. Restrained joints relying on metal teeth molded into the gasket to prevent joint separation under pressure will not be accepted. Grooved End: AWWA C606 and AWWA C110/A21.10, ductile iron, 250 psi minimum working pressure; Victaulic. Flange: AWWA C110/A21.10 ductile iron, faced and drilled, Class 125 flat face. Gray cast iron will not be allowed.
Joints	Mechanical: 250 psi minimum working pressure. Proprietary Restrained: 150 psi minimum working pressure. Clow Corp., Super-Lock; American Cast Iron Pipe Co., Flex-Ring or Lok-Ring; U.S. Pipe, TR Flex. Grooved End: Rigid type radius cut conforming to AWWA C606, 250 psi minimum working pressure; Victaulic. Flange: Dimensions per AWWA C110/A21.10 flat face, ductile iron, threaded conforming to AWWA C115/A21.15. Gray cast iron will not be allowed. Branch connections 3 inches and smaller, except from glass-lined pipe, shall be made with service saddles as specified in Section 40 27 01, Process Piping Specialties. Branch connections, 3 inches and smaller from glass-lined pipe shall be made with glass-lined tee with a flanged branch for adapting to branch piping.

SECTION 40 27 00.01 CEMENT-MORTAR, GLASS, AND CERAMIC-EPOXY-LINED DUCTILE IRON PIPE AND FITTINGS	
Item	**Description**
Couplings	Grooved End: 250 psi minimum working pressure, malleable iron per ASTM A47/A47M or ductile iron per ASTM A536; Victaulic. Grooved End Adapter Flanges: 250 psi minimum working pressure, malleable iron per ASTM A47/A47M or ductile iron per ASTM A536; Victaulic.
Bolting	Mechanical, Proprietary Restrained, and Grooved End Joints: Manufacturer's standard. Flanged: ASTM A307, Grade B carbon steel heavy hex head or stud bolts, ASTM A563, Grade A carbon steel heavy hex head nuts and ASTM F436 hardened steel washers at nuts and bolt heads. Stud bolts are not allowed when bolting to tapped flanges. Torque bolts per gasket manufacturer recommendations. Flanged Joints in Sumps, Wet Wells, and Submerged and Wetted Installations: Type 316 stainless steel, ASTM A320/A320M, Grade B8M heavy hex head or stud bolts; ASTM A194/A194M, Grade 8M heavy hex nuts and ASTM F436 Type 3 alloy washers at nuts and bolt heads. Stud bolts are not allowed when bolting to tapped flanges. Torque bolts per gasket manufacturer recommendations.
Gaskets	General: Gaskets in contact with potable water shall be NSF ANSI 61 certified. Mechanical and Proprietary Restrained Joints; Water and Sewage Service: Halogenated butyl or EPDM, Shore A hardness durometer 60, conforming to AWWA C111/A21.11. Grooved End Joints: Halogenated butyl conforming to ASTM D2000 and AWWA C606. Flanged, Water, Sewage and Hot Air Services: 1/8-inch-thick, homogeneous black rubber (EPDM), hardness 60-80 (Shore A), rated to 275 degrees F, conforming to ASME B16.21 and ASTM D2000. Full face for flat-faced flanges, flat-ring type for raised-face flanges. Blind flanges shall be epoxy-lined in accordance with the system specified above. Gasket pressure rating to equal or exceed the system hydrostatic test pressure.

SECTION 40 27 00.01 CEMENT-MORTAR, GLASS, AND CERAMIC-EPOXY-LINED DUCTILE IRON PIPE AND FITTINGS	
Item	**Description**
Joint Lubricant	Manufacturer's standard.

END OF SECTION

SECTION 40 27 00.08 STAINLESS STEEL PIPE AND FITTINGS—GENERAL SERVICE		
Item	**Size**	**Description**
Pipe	2-1/2" & smaller	Schedule 80S: ASTM A312/A312M, Type 316L seamless, pickled and passivated.
	3" thru 6"	Schedule 40S: ASTM A312/A312M EFW, Type 316L, pickled and passivated.
	8" & larger	Schedule 10S: ASTM A312/A312M EFW, Type 316L, pickled and passivated.
Tubing	All	ASTM A269, Type 316 stainless steel, seamless, fully annealed hydraulic tubing, 0.065-inch wall thickness minimum.
Joints	1-1/2" & smaller	Threaded or flanged at equipment as required or shown.
	2" & larger	Butt-welded or flanged at valves and equipment.
Tubing Joints	All	Flareless compression fitting.
Fittings	1-1/2" & smaller	Threaded: Forged 1,000 CWP minimum, ASTM A182/A182M, Grade F316 or cast Class 150, ASTM A351/A351M, Grade CF8M/316 conforming to MSS SP-114.
	2" & 2-1/2"	Butt Welded: ASTM A403/A403M, Grade WP316L conforming to ASME B16.9, annealed, pickled and passivated; fitting wall thickness to match adjoining pipe; long radius elbows, unless shown otherwise.
	3" & larger	Butt-Welded: ASTM A403/A403M Grade WP316L-W conforming to ASME B16.9 annealed, pickled and passivated; fitting wall thickness to match adjoining pipe; long radius elbows, unless shown otherwise.
Tubing Fittings	All	Flareless Compression Type Forged: ASTM A182/A182M, Grade F316, Parker-Hannifin Ferulok, Flodar BA Series.

SECTION 40 27 00.08
STAINLESS STEEL PIPE AND FITTINGS—GENERAL SERVICE

Item	Size	Description
Branch Connections	1-1/2" & smaller	Tee or reducing tee in conformance with fittings above.
	2" & larger	Butt-welding tee or reducing tee in accordance with fittings above.
Tubing Branch Connections	All	Compression type tees or reducing tees in accordance with Tubing Fittings above.
Flanges	All	Forged Stainless Steel: ASTM A182/A182M, Grade F316L, ASME B16.5 Class 150 or Class 300, slip-on or weld neck, raised face. Weld slip-on flanges inside and outside. Weld neck bore to match internal pipe diameter. Provide flat face flange when mating to piping system or equipment with flat face flanges. Blind Flanges, exposed to the atmosphere and not buried nor immersed in liquid, may be either stainless steel or Class 125 ductile iron or Class 150 carbon steel with gaskets as specified herein. Refer to Piping Schedule for carbon steel and ductile iron coatings.
Unions	2" & smaller	Threaded Forged: ASTM A182/A182M, Grade F316, Class 3000, integral ground seats, AAR design meeting the requirements of MSS SP-83, bore to match pipe.
Bolting	All	Forged Flanges, All Other Services: Type 316 stainless steel, ASTM A320/A320M Class 1, Grade B8M heavy hex head or stud bolts and ASTM A194/A194M Grade 8M heavy hex head nuts. Anywhere mating flange on equipment is cast iron or plastic: Carbon steel ASTM A307 Grade B hex head or stud bolts, ASTM A563 Grade A hex head nuts and ASTM F436 hardened steel washers at nuts and bolt heads. Torque Bolts per gasket manufacturer recommendations.

SECTION 40 27 00.08 STAINLESS STEEL PIPE AND FITTINGS—GENERAL SERVICE		
Item	**Size**	**Description**
Gaskets	All Flanges	Flanged, All Services: 1/8-inch thick, unless otherwise specified, homogeneous black rubber (EPDM), hardness 60 (Shore A), rated to 300 degrees F, conforming to ASME B16.21 and ASTM D1330 Steam Grade.
Thread Lubricant	2" & smaller	General Service: 100% virgin PTFE Teflon tape.

END OF SECTION

SECTION 40 27 00.10 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS		
Item	**Size**	**Description**
General	All	Materials in contact with potable water shall conform to NSF 61 acceptance.
Pipe	All	Schedule 80 PVC: Type I, Grade I or Class 12454-B conforming to ASTM D1784 and ASTM D1785. Pipe shall be manufactured with titanium dioxide for ultraviolet protection. Threaded Nipples: Schedule 80 PVC.
Fittings	All	Schedule to Match Pipe Above: ASTM D2466 and ASTM D2467 for socket weld type and Schedule 80 ASTM D2464 for threaded type. Fittings shall be manufactured with titanium dioxide for ultraviolet protection.
Joints	All	Solvent socket weld except where connection to threaded valves and equipment may require future disassembly.
Flanges	All	One-piece, molded hub type PVC flat face flange in accordance with Fittings above, ASME B16.1, Class 125 drilling.
Bolting	All	Flat Face Mating Flange and In Corrosive Areas: ASTM A193/A193M, Type 316 stainless steel Grade B8M hex head bolts, ASTM A194/A194M Grade 8M hex head nuts and ASTM F436 Type 3 alloy washers at nuts and bolt heads. Torque bolts per gasket manufacturer recommendations. With Raised Face Mating Flange: Carbon steel ASTM A307 Grade B square head bolts, ASTM A563 Grade A heavy hex head nuts and ASTM F436 hardened steel washers at nuts and bolt heads. Torque bolts per gasket manufacturer recommendations.
Gaskets	All	Flat Face Mating Flange: Full faced 1/8-inch-thick ethylene propylene (EPR) rubber. Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EPR) rubber, with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment.

SECTION 40 27 00.10 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS		
Item	**Size**	**Description**
Solvent Cement	All	Socket type joints shall be made employing solvent cement that meets or exceeds the requirements of ASTM D2564 and primer that meets or exceeds requirements of ASTM F656, chemically resistant to the fluid service, and as recommended by pipe and fitting manufacturer Solvent cement and primer shall be listed by NSF 61 for contact with potable water.
Thread Lubricant	All	Teflon Tape.

END OF SECTION

SECTION 40 27 00.13 COPPER AND COPPER ALLOY PIPE, TUBING, AND FITTINGS	
Item	**Description**
General	Materials in contact with potable water shall conform to NSF 61 acceptance.
Tubing	Seamless, conforming to ASTM B88 as follows: Compressed Air ..... Type L, hard drawn Water (embedded) ..... Type K, soft or hard temper Water (exposed)..... Type L, hard drawn Domestic hot water ..... Type L, hard drawn Refrigerant service ..... Type L, hard drawn P-Trap priming service..... Type L, soft temper
Fittings	Commercially pure wrought copper, socket joint, conforming to ASTM B75, dimensions conforming to ASME B16.22.
Flanges	Commercially pure wrought copper, socket joint, conforming to ASTM B75, faced and drilled 150-pound ASME B16.24 standard.
Bolting	ASTM A307, carbon steel, Grade A hex head bolts, and ASTM A563 Grade A hex head nuts. Torque bolts per gasket manufacturer recommendations.
Gaskets	1/16-inch thick nonasbestos compression type, full face, Cranite, John Manville.
Solder	Compressed Air Service: Silver brazing alloy, 15 percent silver content, 1,185 degrees F to 1,300 degrees F melting range, conforming to AWS A5.8M/A5.8. Other Services: Joints 2-1/2 Inch and Smaller: Wire solder (95 percent tin), conforming to ASTM B32 Alloy Grade Sn95. Do not use cored solder. Joints Larger Than 2-1/2 Inch: Wire solder, melt range approximately 440 degrees F to 660 degrees F, conforming to ASTM B32 Alloy Grade HB or HN. Do not use cored solder.

END OF SECTION

SECTION 40 27 00.14 POLYETHYLENE (PE) PIPING FOR COMPRESSED AIR SERVICE		
Item	**Size**	**Description**
General	All	Piping shall be specifically listed for compressed air service by piping manufacturer and meet CAL-OSHA requirements for compressed air piping. Pipe lengths and fitting connections to be joined by socket fusion; shall be of the same type, grade, and class of polyethylene compound and supplied from same raw material supplier. Pipe tubing and fittings manufactured in accordance with ASTM D2239.
Pipe	1/2" to 4"	The resin shall be PE100, Solvay Eltex TUB 124 blue high density polyethylene material according to ASTM D3350. Piping shall be based on an SDR* system and calculated utilizing a Hydrostatic Design Basis according to ASTM D2837. Design Stress Rating: 1,600 psi hydrostatic. Pipe shall have a pressure rating of 230 psi at 68 degrees F in all sizes. Identification: Material must be colored coded blue for identification. *SDR: standard dimension ratio = OD/thickness
Fittings	4" & smaller	Injected molded fittings, socket fusion joined, conforming to ASTM D2657. Transition to metallic piping shall be a nickel-plated male pipe adapter from same manufacturer as piping.
Manufacturer		Asahi/America; Air Pro.

END OF SECTION

SECTION 40 27 00.21 HIGH DENSITY POLYETHYLENE (HDPE) PRESSURE PIPE AND FITTINGS		
Item	**Size**	**Description**
Pipe	All	HDPE: Conforming to Iron Pipe Size (IPS) dimensions.. Shall meet or exceed requirements of ASTM D3350 for PE 4710 material with cell classification of 445474C, or better. Pressure rating shall be based on hydrostatic design stress of 1,000 psi at 73.4 degrees F. Pressure Rating: 250 psig and nominal SDR of 9.0.
Fittings	All	HDPE as specified under Pipe above. All pressure fittings shall be injection molded below 8 inches. For sizes above 8 inches, use thermal butt fusion. Fittings shall have same or higher pressure rating as pipe. Grit Piping 90 degree elbows shall be “sweep bends”. Radius/O.D. = 3 minimum for 6-inch pipe.
Joints	All	Butt Fusion: Temperatures, times, and pressures of fusion shall be according to the manufacturer. Pipe joining equipment shall be provided by the pipe and fitting manufacturer. Joining Couplings: Use on 90 degree elbow fittings. Buna-N (Nitrile) gasket. Manufacturers and Products: Victaulic Style 905; Anvil/Gruvlock 7305. Transition to Threaded Stainless Steel: 2-inch and smaller transition between HDPE and stainless steel pipe, utilize a male threaded transition fitting with male NPT threaded Type 316 stainless steel and HDPE butt fusion end connections.
Flanges	All	Stub end and polyethylene coated steel backing ring with ASME B16.5 Class 150 bolt pattern. Follow manufacturer’s torque and tightening procedures.
Bolting	All	ASTM A193/A193M Type 316 stainless steel Grade B8M heavy hex head or stud bolts and ASTM A194/A194M Grade 8M heavy hex head nuts. Stud bolts are not allowed when bolting to tapped flanges. Torque bolts per gasket and flange manufacturer recommendations.
Gaskets	All	Shall be low torque, full face to ASME B16.5 Class 150 dimensions and shall have two concentric, convex, molded rings between center hole and bolt hole circle in flange.

END OF SECTION

SECTION 40 27 00.22 PROFILE WALL POLYETHYLENE (PWPE)	
Item	**Description**
Pipe	AASHTO MP6 (1050- to 1200-mm diameter), as manufactured by ADS, or equal. ASTM F894, PE3408 profile wall type pipe (Spirolite, or equal), class 63, unless otherwise specified. Provide magnetic tracer tape.
Profile	Type S and D. Extruded ribs for gaining structural rigidity and strength.
Joints	Bell and spigot, gasketed type. Gaskets per ASTM F477. Flanges: Flange dimensions and bolt pattern as called out on Drawings. Flanged adapters butt-fused to pipe for dampers or valves or where called out on Drawings, AWWA C207. Stainless steel backup ring epoxy coated. Flange gasket to be 1/4-inch compressed Kevlar with neoprene binder flange gasket. Flanged adapter may be butt-fusion welded to solid wall pipe for attaching to profile wall pipe. Interior of pipe to remain smooth (no step down) at any transitions.
Fittings	Manufacturer's standard; same stiffness and class as adjacent pipe. Where mitered elbows are provided, interior of fitting shall remain smooth. Trim any residual material as necessary. Provide double mitered as a minimum, unless otherwise noted.
Source Quality Control	In accordance with specified AASHTO Specification.
Flexible Connections	Neoprene with coated stainless steel clamps, 1/2-inch thick.

Remarks:

1. Connections to stainless steel or FRP ductwork shall be made with flanged connections. Flange dimensions and bolt pattern shall match.
2. Manufacture from materials that meet or exceed the requirements of ASTM D3350-04 for a minimum cell classification of PE 345434C.
3. Place bells facing upstream. Locate bell and spigot joints, pushed home, at each structural joint indicated on Drawings.

SECTION 40 27 00.22 PROFILE WALL POLYETHYLENE (PWPE)	
Item	**Description**
4. Moe miter, minimum, per 45 degrees of deflection.	
5. For bell and spigot connections, provide a minimum of two bell and spigot joints pulled 1-5/8 inches out from the home position for each 40 feet of pipe length.	
6. Where joining of profile wall pipe by extrusion welding, all joints shall be performed by factory trained technicians.	

END OF SECTION

SECTION 40 27 01
PROCESS PIPING SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. This section covers process piping specialties and accessories for process piping systems.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings.
      b. B16.5, Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24.
   2. American Water Works Association (AWWA):
      a. C153/A21.53, Ductile-Iron Compact Fittings for Water Service.
      b. C210, Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
      c. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
      d. C219, Bolted, Sleeve-Type Couplings for Plain-End Pipe.
      e. Manual M11, Steel Pipe—A Guide for Design and Installation.
   3. ASTM International (ASTM):
      a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      b. A276, Standard Specification for Stainless Steel Bars and Shapes.
   4. National Fire Protection Association (NFPA): 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
   5. NSF International (NSF): NSF 61, Drinking Water System Components—Health Effects.

1.03 SUBMITTALS

A. Action Submittals: Manufacturer's data on materials, construction, end connections, ratings, overall lengths, and live lengths (as applicable).

B. Informational Submittals:

1. Coupling Harness:
   a. Details, ratings, calculations and test reports for thrust restraints relying on welded bars or rings.
   b. Weld procedure qualifications.
   c. Load proof-testing report of prototype restraint for any size coupling.
2. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide required piping specialty items, whether shown or not shown on Drawings, as required by applicable codes and standard industry practice.

B. Rubber ring joints, mechanical joints, flexible couplings, and proprietary restrained ductile iron pipe joints are considered flexible joints; welded, screwed, and flanged pipe joints are not considered flexible.

2.02 CONNECTORS

A. Teflon Bellows Connector:
1. Type: Two convolutions, unless otherwise shown, with metal reinforcing bands.
2. Flanges: Ductile iron, drilled 150 psi ASME B16.5 standard.
3. Working Pressure Rating: 140 psi, minimum, at 120 degrees F.
4. Thrust Restraint: Limit bolts to restrain force developed by specified test pressure.
5. Manufacturers and Products:
   a. Garlock; Style 214.
   b. Resistoflex; No. R6904.
   c. Unisource Manufacturing, Inc.; Style 112.
   d. Proco Products, Inc.; Series 442.
   e. “Or-equal.”

B. Elastomer Bellows Connector:
1. Type: Fabricated spool, with single filled arch.
2. Materials: Nitrile tube and wrap-applied neoprene cover.

3. End Connections: Flanged, drilled 125-pound ASME B16.1 standard, with full elastomer face and steel retaining rings.
4. Working Pressure Rating: 140 psig, minimum, at 180 degrees F for sizes 12 inches and smaller.
5. Thrust Restraint: Control rods to limit travel of elongation and compression.
6. Manufacturers and Products:
    a. Goodall Rubber Co.; Specification E-1462.
    b. Garlock; Style 204.
    c. Unisource Manufacturing, Inc.; Style 1501.
    d. Proco Products, Inc.; Series 220.
    e. "Or-equal."

C. Metal Bellows Connector:
1. Type: Single-ply, annular corrugated metal bellows with limit rods. Circumferential convolution welds not permitted.
2. Material: Type 316 stainless steel.
3. End Connections: ANSI 150-pound carbon steel flanges.
4. Minimum Design Working Pressure: 150 psig at 750 degrees F.
5. Length: Minimum of four convolutions and minimum manufacturer recommendation for vibration isolation.
6. Manufacturers and Products:
    a. Victaulic Depend-O-Lok, Omniflex with short metal bellows.
    b. Metraflex, Model MN.
    c. "Or-equal."

D. Flexible Metal Hose Connector:
1. Type: Close pitch, annular corrugated with single braided jacket.
2. Material: Bronze.
3. End Connections: Female copper solder joint.
4. Minimum Burst Pressure: 500 psig at 70 degrees F.
5. Length: Minimum manufacturer recommendation for vibration isolation.
6. Manufacturers:
    a. Senior Flexonics.
    b. Anamet Industrial, Inc.
    c. Unisource Manufacturing, Inc.
    d. Proco Products, Inc.
    e. "Or-equal."

E. Quick Connect Couplings for Urea and Lube Oil and Waste Oil Services:

1. Type: Twin cam arm actuated, male and female, locking, for fluidloading and transfer.
2. Materials: Type 316 stainless steel, Viton-A or Teflon gaskets as recommended for the service by manufacturer.
3. End Connections: NPT threaded or flanged to match piping connections.
4. Plugs and Caps: Female dust cap for each male end; male dust plug for each female end.
5. Pressure Rating: 150 psi, minimum, at 100 degrees F.
6. Manufacturers and Products:
   a. OPW; Kamlock.
   b. ProFlow Dynamics, Camlock.
   c. "Or-equal."

2.03 COUPLINGS

A. General:

1. Coupling linings for use in potable water systems shall be in conformance with NSF 61.
2. Couplings shall be rated for working pressure not less than indicated in Piping Schedule for the service and not less than 150 psi.
3. Couplings shall be lined and coated with fusion-bonded epoxy in accordance with AWWA C213.
4. Unless thrust restraint is provided by other means, couplings shall be harnessed in accordance with requirements of AWWA Manual M11, and restrained with retainer bar or ring welded to pipe end, or as shown on Drawings.
5. Sleeve type couplings shall conform to AWWA C219 and shall be hydraulically expanded beyond minimum yield for accurate sizing and proofing of tensile strength.

B. Flexible Sleeve Type Coupling:

1. Manufacturers and Products:
   a. Steel Pipe:
      1) Dresser; Style 38.
      2) Smith-Blair, Inc.; Style 411.
   b. Ductile Iron Pipe:
      1) Dresser; Style 38/139.
      2) Smith-Blair, Inc.; Style 411.

C. Restrained Flange Adapter:
   1. Pressure Rating:
      a. Minimum Working Pressure Rating: Not less than 150 psi.
      b. Safety Factor: Not less than two times working pressure and shall be supported by manufacturer's proof testing.
   2. Thrust Restraint:
      a. Provide hardened steel wedges that bear against and engage outer pipe surface, and allow articulation of pipe joint after assembly while wedges remain in their original setting position on pipe surface.
      b. Products employing set screws that bear directly on pipe will not be acceptable.
   3. Manufacturer and Product:
      a. EBAA Iron Sales Co.; Mega-Flange.
      b. "Or-equal."

D. Dismantling Joints:
   1. Pressure Rating:
      a. Minimum working pressure rating shall not be less than rating of the connecting flange.
      b. Proof testing shall conform to requirements of AWWA C219 for bolted couplings.
   2. Manufacturers and Products:
      a. Dresser Piping Specialties; Style 131.
      b. Viking Johnson.
      c. "Or-equal."

2.04 EXPANSION JOINTS AND CONNECTORS

A. Elastomer Bellows:
   1. Type: Reinforced molded wide arch.
   2. End Connections: Flanged, drilled 125-pound ASME B16.1 standard, with split galvanized steel retaining rings.
   3. Washers: Over retaining rings to help provide leak-proof joint under test pressure.
   4. Thrust Protection: Control rods to protect the bellows from overextension.
   5. Bellows Arch Lining: Buna-N, nitrile, or butyl.
   6. Rated Temperature: 250 degrees F.

7. Rated Deflection and Pressure:
   a. Lateral Deflection: 3/4 inch, minimum.
   b. Burst Pressure: Four times the working pressure.
   c. Compression deflection and minimum working pressure as follows:

Size (inch)	Deflection (inch)	Pressure (psig)
2-1/2 to 12	1.06	150
14	1.65	130
16 to 20	1.65	110

8. Manufacturers and Products:
   a. General Rubber Corp.; Style 1015 Maxijoint.
   b. Mercer; Flexmore Style 450.
   c. Goodall Rubber Co.; Specification E-711.
   d. Unisource Manufacturing, Inc.; Series 1500.
   e. Proco Products, Inc.; Series 251.
   f. "Or-equal."

B. Teflon Bellows:
   1. Type: Three convolutions, with metal reinforcing bands.
   2. Flanges: Ductile iron, drilled 150 psi ASME B16.5 standard.
   3. Working Pressure Rating: 100 psig, minimum, at 120 degrees F.
   4. Thrust Restraint: Limit bolts to restrain force developed by specified test pressure.
   5. Manufacturers and Products:
      a. Garlock; Style 215.
      b. Resistoflex; No. R6905.
      c. Unisource Manufacturing, Inc.; Style 113,
      d. Proco Products, Inc.; Series 443.
      e. "Or-equal."

C. Metal Bellows:
   1. Type: Single-ply, annular corrugated metal bellows with limit rods. Circumferential convolution welds not permitted.
   2. Material: Type 316 stainless steel.
   3. End Connections: ASME 150-pound carbon steel flanges.

4. Minimum Design Working Pressure: 150 psig at 750 degrees F.
5. Length: Minimum of four convolutions and minimum axial compression of 3 inches.
6. Manufacturers and Products:
    a. Victaulic; Depend-O-Lok, Omniflex with long metal bellows.
    b. Metraflex; Model MN.
    c. Senior Flexonics; Free Flexing Expansion Joints.
    d. "Or-equal."

D. Copper Pipe Expansion Compensator:
1. Material: Stainless steel bellows with female copper solder joint ends.
2. Working Pressure Rating: 175 psig, minimum.
3. Accessories: Anti-torque device to protect bellows.
4. Manufacturers and Products:
    a. Senior Flexonics; Model HB.
    b. Hyspan; Model 8510.
    c. Unisource Manufacturing, Inc.; Style EC-FFS.
    d. "Or-equal."

E. Steel Pipe Expansion Compensator:
1. Material: All stainless steel.
2. Working Pressure Rating: 175 psig, minimum.
3. Accessories: Anti-torque device to protect bellows.
4. Manufacturers and Products:
    a. Senior Flexonics; Model H.
    b. Hyspan; Model 8503.
    c. Unisource Manufacturing, Inc.; Style EC-MMT.
    d. "Or-equal."

F. Flexible Metal Hose:
1. Type: Close pitch, annular corrugated with single braided jacket.
2. Material: Stainless steel, ASTM A276, Type 321.
3. End Connections:
    a. 3 Inches and Larger: Shop fabricated flanged ends to match mating flanges.
    b. 2-1/2 Inches and Smaller: Screwed ends with one union end.
4. Minimum Burst Pressure: 600 psig at 70 degrees F for 12 inches and smaller.

5. Length: Provide hose live-length equal to lengths shown on Drawings.
6. Manufacturers and Products:
    a. Senior Flexonics; Series 401M.
    b. Anamet Industrial, Inc.; BWC21-1.
    c. "Or-equal."

2.05 SERVICE SADDLES

A. Double-Strap Iron:
    1. Pressure Rating: Capable of withstanding 150 psi internal pressure without leakage or over stressing.
    2. Run Diameter: Compatible with outside diameter of pipe on which saddle is installed.
    3. Taps: Iron pipe threads.
    4. Materials:
        a. Body: Malleable or ductile iron.
        b. Straps: Galvanized steel.
        c. Hex Nuts and Washers: Steel.
        d. Seal: Rubber.
    5. Manufacturers and Products:
        a. Smith-Blair; Series 313 or Series 366.
        b. Dresser; Style 91.
        c. "Or-equal."

B. Nylon-Coated Iron:
    1. Pressure Rating: Capable of withstanding 150 psi internal pressure without leakage or over stressing.
    2. Run Diameter: Compatible with outside diameter of pipe on which saddle is installed.
    3. Materials:
        a. Body: Nylon-coated iron.
        b. Seal: Buna-N.
        c. Clamps and Nuts: Stainless steel.
    4. Manufacturer and Product:
        a. Smith-Blair; Style 315 or Style 317.
        b. "Or-equal."

2.06 PIPE SLEEVES

A. Carbon Steel and Stainless Steel Pipe Sleeve:
   1. Minimum Thickness: 3/16 inch.
   2. Seep Ring:
      a. Center steel flange for water stoppage on sleeves in exterior or water-bearing walls, 3/16-inch minimum thickness.
      b. Outside Diameter: Unless otherwise shown, 3 inches greater than pipe sleeve outside diameter.
      c. Continuously fillet weld on each side all around.
   3. Carbon Steel Factory Finish:
      a. Galvanizing:
         1) Hot-dip applied, meeting requirements of ASTM A153/A153M.
         2) Electroplated zinc or cadmium plating is unacceptable.
      b. Shop Lining and Coating: Factory prepare, prime, and finish coat in accordance with Section 09 90 00, Painting and Coating.

B. Modular Mechanical Seal:
   1. Type: Interconnected synthetic rubber links shaped and sized to continuously fill annular space between pipe and wall sleeve opening.
   2. Fabrication:
      a. Assemble interconnected rubber links with ASTM A276, Type 316 stainless steel bolts and nuts.
      b. Pressure plates shall be reinforced nylon polymer.
   3. Size: According to manufacturer's instructions for size of pipes shown to provide a watertight seal between pipe and wall sleeve opening and to withstand a hydrostatic head of 40 feet of water.
   4. Manufacturer:
      a. Thunderline Corp., Link-Seal Division.
      b. "Or-equal."

2.07 SLAB, FLOOR, WALL AND ROOF PENETRATIONS

A. Ductile Iron Wall Pipe:
   1. Diameter and Ends: Same as connecting ductile iron pipe.
   2. Thickness: Equal to or greater than remainder of pipe in line.
   3. Fittings: In accordance with applicable Pipe Data Sheet.

4. Thrust Collars:
    a. Rated for thrust load developed at 250 psi.
    b. Safety Factor: 2, minimum.
    c. Material and Construction: Ductile iron or cast iron, cast integral with wall pipe wherever possible, or thrust rated, welded attachment to wall pipe.
5. Manufacturers:
    a. American Cast Iron Pipe Co.
    b. U.S. Pipe and Foundry Co.
    c. "Or-equal."

B. Steel or Stainless Steel Wall Pipe:
1. Same material and thickness as connecting pipe, except 1/4-inch minimum thickness.
2. Lining: Same as connecting pipe.
3. Thrust Collar:
    a. Outside Diameter: Unless otherwise shown, 3 inches greater than outside diameter of wall pipe.
    b. Continuously fillet welded on each side all around.

2.08 MISCELLANEOUS SPECIALTIES

A. Strainers, Water Service, 2 Inches and Smaller:
1. Type: Bronze body, Y-pattern, 200 psi nonshock rated, with screwed gasketed bronze cap.
2. Screen: Heavy-gauge Type 304 stainless steel or monel, 20-mesh.
3. Manufacturers and Products:
    a. Armstrong International; Inc.; Model F.
    b. Mueller Steam Specialty; Model 351M.
    c. "Or-equal."

B. Strainers, Water Service, 2-1/2 Inches and Larger:
1. Type: Cast iron or ductile iron body, Y-pattern, 175 psi nonshock rated, with flanged gasketed iron cap.
2. Screen: Heavy-gauge Type 316 stainless steel, 0.045-inch perforations.
3. Manufacturers and Products:
    a. Armstrong International, Inc.; Model A7FL 125.
    b. Mueller Steam Specialty; Model 751.
    c. "Or-equal."

C. Strainers, Plastic Piping Systems, 4 Inches and Smaller:

1. Type: Y-pattern PVC body, 150 psi nonshock rated, with screwed PVC cap and Viton seals.
2. End Connections: Screwed or solvent weld, 2 inches and smaller. Class 150 ANSI flanged, 2-1/2 inches and larger.
3. Screen: Heavy-gauge PVC, 1/32-inch mesh, minimum 2 to 1 screen area to pipe size ratio.
4. Manufacturer:
    a. Hayward.
    a. "Or-equal."

PART 3 EXECUTION

3.01 GENERAL

A. Provide accessibility to piping specialties for control and maintenance.

3.02 PIPING FLEXIBILITY PROVISIONS

A. General:

1. Thrust restraint shall be provided as specified in Section 40 27 00, Process Piping—General.
2. Install flexible couplings to facilitate piping installation, in accordance with approved shop drawings.

B. Flexible Joints at Concrete Backfill or Encasement: Install within 18 inches or one-half pipe diameter, whichever is less, from the termination of any concrete backfill or concrete encasement.

C. Flexible Joints at Concrete Structures:

1. Install 18 inches or less from face of structures; joint may be flush with face.
2. Install a second flexible joint, whether or not shown.
    a. Pipe Diameter 18 Inches and Smaller: Within 18 inches of first joint.
    b. Pipe Diameter Larger than 18 Inches: Within one pipe diameter of first joint.

3.03 PIPING TRANSITION

A. Applications:

1. Provide complete closure assembly where pipes meet other pipes or structures.

2. Pressure Pipeline Closures: Plain end pieces with double flexible couplings, unless otherwise shown.
3. Restrained Joint Pipe Closures: Install with thrust tie-rod assemblies as shown or in accordance with NFPA 24.
4. Elastomer sleeves bonded to pipe ends are not acceptable.

3.04 PIPING EXPANSION

A. Piping Installation: Allow for thermal expansion due to differences between installation and operating temperatures.

B. Expansion Joints:
1. Grooved Joint and Flanged Piping Systems: Elastomer bellows expansion joint.
2. Nonmetallic Pipe: Teflon bellows expansion joint.
3. Screwed and Soldered Piping Systems: Copper or galvanized and black steel pipe expansion compensator, as applicable.
4. Air and Water Service above 120 Degrees F: Metal bellows expansion joint.
5. Pipe Run Offset: Flexible metal hose.

C. Anchors: Install as specified in Section 40 05 15, Piping Support Systems, to withstand expansion joint thrust loads and to direct and control thermal expansion.

3.05 SERVICE SADDLES

A. Ferrous Metal Piping (except stainless steel): Double-strap iron.

B. Plastic Piping: Nylon-coated iron.

3.06 COUPLINGS

A. General:
1. Install in accordance with manufacturer's written instructions.
2. Before coupling, clean pipe holdback area of oil, scale, rust, and dirt.
3. Do not remove pipe coating. If damaged, repair before joint is made.
4. Application:
a. Metallic Piping Systems: Flexible couplings, transition couplings, and flanged coupling adapters.
b. Concrete Encased Couplings: Flexible coupling.

3.07 FLEXIBLE PIPE CONNECTIONS TO EQUIPMENT

A. Install to prevent piping from being supported by equipment, for vibration isolation, and where shown.

B. Product Applications Unless Shown Otherwise:
   1. Nonmetallic Piping: Teflon bellows connector.
   2. Copper Piping: Flexible metal hose connector.
   3. Compressor and Blower Discharge: Metal bellows connector.
   4. All Other Piping: Elastomer bellows connector.

C. Limit Bolts and Control Rods: Tighten snug prior to applying pressure to system.

3.08 PIPE SLEEVES

A. Application:
   1. As specified in Section 40 27 00, Process Piping—General.
   2. Above Grade in Nonsubmerged Areas: Hot-dip galvanized after fabrication.
   3. Below Grade or in Submerged or Damp Environments: Shop-lined and coated.

B. Installation:
   1. Support noninsulating type securely in formwork to prevent contact with reinforcing steel and tie-wires.
   2. Caulk joint with specified sealant in non-submerged applications and seal below grade and submerged applications with wall penetration seal.

3.09 SLAB, FLOOR, WALL AND ROOF PENETRATIONS

A. Applications:
   1. Watertight and Below Ground Penetrations:
      a. Wall pipes with thrust collars.
      b. Provide taps for stud bolts in flanges to be set flush with wall face.
   2. Nonwatertight Penetrations: Pipe sleeves with seep ring.
   3. Existing Walls: Rotary drilled holes.
   4. Fire-Rated or Smoke-Rated Walls, Floors or Ceilings: Insulated and encased pipe sleeves.

B. Wall Pipe Installation:

1. Isolate embedded metallic piping from concrete reinforcement using coated pipe penetrations as specified in Section 09 90 00, Painting and Coating.
2. Support wall pipes securely by formwork to prevent contact with reinforcing steel and tie-wires.

END OF SECTION

SECTION 40 27 02
PROCESS VALVES AND OPERATORS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Gas Association (AGA): 3-88, Orifice Metering of Natural Gas.
   2. American National Standards Institute (ANSI): Z21.15, Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.
   3. American Society of Mechanical Engineers (ASME):
      a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250).
      b. B16.44, Manually Operated Metallic Gas Valves for Use in Aboveground Piping Systems up to 5 PSI.
   4. American Society of Sanitary Engineers (ASSE): 1011, Performance Requirements for Hose Connection Vacuum Breakers.
   5. American Water Works Association (AWWA):
      a. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
      b. C500, Metal-Seated Gate Valves for Water Supply Service.
      c. C504, Rubber-Seated Butterfly Valves.
      d. C507, Ball Valves, 6 in. Through 48 in. (150 mm Through 1200 mm).
      e. C508, Swing-Check Valves for Waterworks Service, 2-in. through 24-in. (50 mm Through 600 mm) NPS.
      f. C509, Resilient-Seated Gate Valves for Water Supply Service.
      g. C510, Double Check Valve, Backflow Prevention Assembly.
      h. C511, Reduced-Pressure Principle Backflow Prevention Assembly.
      i. C540, Power-Actuating Devices for Valves and Slide Gates.
      j. C550, Protective Interior Coatings for Valves and Hydrants.
      k. C606, Grooved and Shouldered Joints.
      l. C800, Underground Service Line Valves and Fittings.
   6. ASTM International (ASTM):
      a. A276, Standard Specification for Stainless Steel Bars and Shapes.
      b. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
      c. A564/A564M, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
      d. B61, Standard Specification for Steam or Valve Bronze Castings.
      e. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
      f. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.

g. B127, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
h. B139, Standard Specification for Phosphor Bronze Rod, Bar and Shapes.
i. B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
j. B194, Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar.
k. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
l. D429, Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.
m. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

7. Canadian Gas Association, Inc. (CGA): 9.1, Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.
8. FM Global (FM).
9. Food and Drug Administration (FDA).
10. International Association of Plumbing and Mechanical Officials (IAPMO).
11. Manufacturers Standardization Society (MSS):
    a. SP-80, Bronze Gate, Globe, Angle and Check Valves.
    b. SP-81, Stainless Steel, Bonnetless, Flanged Knife Gate Valves.
    c. SP-85, Gray Iron Globe & Angle Valves, Flanged and Threaded Ends.
    d. SP-88, Diaphragm Valves.
    e. SP-110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
12. NSF International (NSF): 61, Drinking Water System Components—Health Effects.
13. UL.
14. USC Foundation for Cross-Connection Control and Hydraulic Research.

1.02 SUBMITTALS

A. Action Submittals:
1. Shop Drawings:
    a. Product data sheets for each make and model. Indicate valve Type Number, applicable Tag Number, and facility name/number or service where used.
    b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
    c. For each power actuator provided, manufacturer's standard data sheet, with application specific features and options clearly identified.
    d. Sizing calculations for open-close/throttle and modulating valves.
    e. Submit anchorage and bracing drawings and cut sheets as required by Section 01 88 15, Anchorage and Bracing.
    f. Power and control diagrams with terminal numbers and labels and indication of customer interfaces.

g. Recommended cable for between remote control stations and actuator. Power and control wiring diagrams for connections between actuator and control station with terminal numbers.

B. Informational Submittals:

1. Submit anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's Certificate of Compliance, in accordance with Section 01 91 14, Equipment Testing and Facility Startup, for:
   a. Electric actuators; full compliance with AWWA C540.
   b. Butterfly valves; full compliance with AWWA C504.
3. Tests and inspection data.
4. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
5. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 91 14, Equipment Testing and Facility Startup.

PART 2 PRODUCTS

2.01 GENERAL

A. Valves to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, operating nut, chain, wrench, and accessories to allow a complete operation from the intended operating level.

B. Valve to be suitable for intended service. Renewable parts not to be of a lower quality than specified.

C. Valve same size as adjoining pipe, unless otherwise called out on Drawings.

D. Valve ends to suit adjacent piping.

E. Resilient seated valves shall have no leakage (drip-tight) in either direction at valve rated design pressure. All other valves shall have no leakage (drip-tight) in either direction at valve rated design pressure, unless otherwise allowed for in this section or in stated valve standard.

F. Size operators and actuators to operate valve for the full range of pressures and velocities.

G. Valve to open by turning counterclockwise.

H. Factory mount operator, actuator, and accessories.

2.02 SCHEDULE

A. Additional requirements relative to this section are shown on the Power Actuated Valve Schedule, Manual Valve Schedule and Self-Regulated Valve Schedule located at the end of this section as supplements.

2.03 MATERIALS

A. Bronze and brass valve components and accessories that have surfaces in contact with water to be alloys containing less than 16 percent zinc and 2 percent aluminum.
   1. Approved alloys are of the following ASTM designations: B61, B62, B98/B98M (Alloy UNS No. C65100, C65500, or C66100), B139 (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.
   2. Stainless steel Alloy 18-8 may be substituted for bronze.

2.04 FACTORY FINISHING

A. Epoxy Lining and Coating:
   1. Use where specified for individual valves described herein.
   2. In accordance with AWWA C550 unless otherwise specified.
   3. Either two-part liquid material or heat-activated (fusion) material except only heat-activated material if specified as “fusion” or “fusion bonded” epoxy.
   4. Minimum 7-mil dry film thickness except where limited by valve operating tolerances.

B. Exposed Valves:
   1. In accordance with Section 09 90 00, Painting and Coating.
   2. Safety isolation valves and lockout valves with handles, handwheels, or chain wheels “safety yellow.”

2.05 VALVES

A. Gate Valves:
   1. General:
      a. AWWA gate valves to be in full compliance with stated AWWA standard and the following requirements:
         1) Provide 2-inch operating nut and handwheel for AWWA gate valves 12 inches and smaller.
         2) Provide totally enclosed spur or bevel gear operator with indicator for AWWA gate valves 14 inches and larger.
         3) Provide Affidavit of Compliance per the applicable AWWA standard for AWWA gate valves.
         4) Mark AWWA gate valves with manufacturer’s name or mark, year of valve casting, valve size, and working water pressure.
         5) Repaired AWWA gate valves shall not be submitted or supplied.
         6) Supply AWWA gate valves with stainless steel bolting.
   2. Type V100 Gate Valve 3 Inches and Smaller:
      a. All-bronze, screwed bonnet, packed gland, single solid wedge gate, nonrising stem, Class 125 rated 200 psi CWP, complies with MSS SP-80 Type 1.

b. Manufacturers and Products:
   1) Crane; Figure 438, NPT threaded ends.
   2) Stockham; Figure B-103, NPT threaded ends.
   3) Crane; Figure 1324, soldered ends.
   4) Stockham; Figure B-104, soldered ends.
   5) "Or-equal."

3. Type V108 Gate Valve 2 Inches to 24 Inches:
   a. Iron body, bronze mounted, flanged ends, solid wedge gate, nonrising bronze stem, Class 125 rated 125 psi SWP, 200 psi CWP for 2 inches through 12 inches and 100 psi SWP, 150 psi CWP for 14 inches through 24 inches.
   b. Manufacturers and Products:
      1) Crane; Figure 461.
      2) Stockham; Figure G-612.
      3) "Or-equal."
4. Type V137 Resilient Seated Gate Valve 4 Inches to 12 Inches:
   a. UL Listed and FM Approved for fire protection, iron body, resilient seat, bronze mounted, mechanical joint ends, nonrising stem, 2-inch operating nut, in accordance with AWWA C509, design working water pressure 200 psig, full port, fusion-epoxy coated inside and outside per AWWA C550, NSF 61 certified.
   b. Manufacturers and Products:
      1) Kennedy Valve; Ken-Seal II.
      2) M&H Valve; Style 4067.
      3) Mueller; A-2362.
      4) "Or-equal."
5. Type V150 Knife Gate Valve 4 Inches to 24 Inches:
   a. Bonnetless lugged body type, outside stem and yoke, rated for 150 psi cold water, ASME 16.1 flanged ends, self-cleaning, nonclogging, round port, resilient neoprene seat, drip-tight shutoff.
   b. Type 316 stainless steel wetted metal parts and stem, bronze yoke sleeve, sharp knife edge with gate finish ground both sides.
   c. Packing system leak-tight seal around the gate, valve superstructure and yoke designed for full peripheral access to gland bolts when valve is equipped with power actuator.
   d. Complies with MSS SP-81.
   e. Manufacturers and Products:
      1) DeZurik; Series KGL.
      2) ITT; Fabri-Valve.
6. Type V155 Bonneted Knife Gate Valve 36 Inches and Larger:
   a. Bonneted wafer style carbon steel body type, per, outside stem and yoke, rated 50 psi CWP minimum, handwheel or floor stand operator as required, self-cleaning, nonclogging, with round port, resilient neoprene seat, drip-tight bi-directional shutoff.

b. Wetted metal parts and stem Type 316 stainless steel, yoke sleeve bronze. Carbon steel body. External coating per Section 09 90 00, Painting and Coating, System No. 7.

c. Packing system to provide a leak-tight seal against the valve stem comprised of a top mounted packing gland. Packing set shall be PTFE/synthetic fiber with stainless steel packing gland. A back-seat ring shall be provided on the stem that seal against the packing gland with the gate in the full up position to allow the stem packing to be replaced with the valve in the line and under pressure without bonnet disassembly.

d. Manufacturers and Products:

1) DeZurik/Hilton; H-200.

2) Pratt/Mueller; LVC Figure F193.

B. Globe Valves:

1. Type V200 Globe Valve 3 Inches and Smaller:

a. All-bronze, union bonnet, packed gland, inside screw, rising stem, TFE disc, Class 150 rated 150 psi SWP/300 psi CWP, complies with MSS SP-80 Type 2.

b. Manufacturers and Products:

1) Stockham; Figure B-22T, NPT threaded end.

2) Crane Co.; Figure 7TF, NPT threaded end.

3) Milwaukee; Model 1590T, soldered ends.

4) NIBCO; Figure S-235-Y, soldered ends.

2. Type V203 Stainless Steel Globe Valve 2 Inches and Smaller:

a. ASTM A351/A351M GR CF8M stainless steel body with NPT threaded ends, ASTM A351/A351M GR CF8M threaded bonnet, packed gland with PTFE packing, inside screw, rising stem, ASTM A276 Type 316 stainless steel disc, rated 200 psi CWP, complies with MSS SP-42.

b. Manufacturers and Products:

1) Aloyco; Figure 40, NPT threaded end.

2) Powell; Figure 1861, NPT threaded end.

3) “Or-equal.”

3. Type V210 Globe Valve 2 Inches to 10 Inches:

a. Iron body, bronze mounted, flanged ends, bronze seat, outside screw and yoke, bolted bonnet, Class 125 rated 125 psi SWP/200 psi CWP, complies with MSS SP-85 Type 1.

b. Manufacturers and Products:

1) Stockham; G-512.

2) Crane; Figure 351.

3) “Or-equal.”

4. Type V235 Angle Type Hose Valve 3/4 Inch:
    a. 3/4-inch NPT female inlet, 3/4-inch male hose thread outlet, heavy rough brass body rated 125 psi, lockshield bonnet, removable handle, atmospheric vacuum breaker conforming to ASSE 1011 and IAPMO code.
    b. Manufacturers and Products:
        1) Acorn; 8126, surface pipe mount valve, bent nose without flange.
        2) Acorn; 8121, surface mount through wall valve, bent nose with flange.
        3) Acorn; 8131, pipe and pedestal mounted valve located above 6 inches, straightnose.
        4) Acorn; 8136, pedestal mounted valve located lower than 6 inches, inverted nose.
        5) "Or-equal."
5. Type V236 Globe Style Hose Valve 1 Inch to 3 Inches:
    a. All-bronze, NPT threaded ends, inside screw-type rising stem, PTFE disc, cast brass male NPT by male NHT adapter with hexagonal center wrench nut, brass cap with chain, complies with MSS SP 80, rated 300 WOG.
    b. Manufacturers and Products:
        1) Stockham; Figure B-22T.
        2) Crane Co.; Cat. No. 7TF.
        3) Nibco; Figure T 235 Y.
        4) "Or-equal."
6. Type V237 Angle Pattern Hose Valve 1 Inch to 2 Inches:
    a. All-bronze, NPT threaded ends, inside screw-type rising stem, TFE disc, cast brass male NPT by male NHT adapter with hexagonal center wrench nut, brass cap with chain, complies with MSS SP 80, rated 300 WOG.
    b. Manufacturers and Products:
        1) Stockham; Figure B-222T.
        2) Crane Co.; Cat. No. 17TF.
        3) Nibco; Figure T 335 Y.
        4) "Or-equal."

C. Ball Valves:
1. Type V300 Ball Valve 3 Inches and Smaller for General Water and Air Service:
    a. Two-piece, standard port, NPT threaded ends, bronze body and end piece, hard chrome-plated solid bronze or brass ball, RTFE seats and packing, blowout-proof stem, adjustable packing gland, zinc-coated steel hand lever operator with vinyl grip, rated 600-pound WOG, 150-pound SWP, complies with MSS SP-110. For steam service, provide stainless steel ball and stem.
    b. Manufacturers and Products:
        1) Threaded:
            a) Conbraco Apollo; 70-100.
            b) Nibco; T-580-70.

c) "Or-equal."

2) Soldered:
a) Conbraco Apollo; 70-200.
b) Nibco; S-580-70.
c) "Or-equal."

2. Type V301 Ball Valve 2 Inches and Smaller for General Water and Air Service:
a. Two-piece, full port, NPT threaded ends, bronze body and end piece, hard chrome-plated solid bronze or brass ball, RTFE seats and packing, blowout-proof stem, adjustable packing gland, zinc-coated steel hand lever operator with vinyl grip, rated 600-pound WOG, 150-pound SWP, complies with MSS SP-110. For steam service, provide stainless steel ball and stem.
b. Manufacturers and Products:
1) Threaded:
a) Conbraco Apollo; 77-100.
b) Nibco; T-585-70.
c) "Or-equal."
2) Soldered:
a) Conbraco Apollo; 77-200.
b) Nibco; S-585-70.
c) "Or-equal."

3. Type V302 Actuator Ready Ball Valve 2 Inches and Smaller for General Water and Air Service:
a. Two-piece, standard port, NPT threaded ends, bronze body and end piece, actuator mounting pad, Type 316 stainless steel ball and stem, vented ball, reinforced PTFE seats and seals, adjustable packing nut, blowout-proof stem, rated 600-pound WOG, 150-pound SWP, complies with MSS SP-110.
b. Manufacturers and Products:
1) Conbraco Apollo; 71-140.
2) Milwaukee; 20BSOR-02.
3) "Or-equal."

4. Type V305 Ball Valve 3 Inches and Smaller for Oil and Natural Gas Service:
a. Two-piece bronze or forged brass body and end piece, NPT threaded ends, hard chrome plated solid brass ball, RTFE seats and seal, blowout-proof stem, zinc-plated hand lever operator with vinyl grip, UL Listed Guide YRPV for natural gas, 600 WOG.
b. Manufacturers and Products:
1) Conbraco Apollo; 80-100.
2) Nibco; T-585-70-UL/T-580-70-UL.
3) "Or-equal."

5. Type V306 Stainless Steel Ball Valve 3 Inches and Smaller:
   a. Two-piece, full port, ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel body and end piece, NPT threaded ends, ASTM A276 Type 316 stainless steel ball, reinforced PTFE seats, seals, and packing, adjustable packing gland, blowout proof stainless steel stem, stainless steel lever operator with vinyl grip, rated 1,000 psig CWP, complies with MSS SP-110.
   b. Manufacturers and Products:
      1) Conbraco Apollo; 76F-100 Series.
      2) Nibco; T-585-S6-R-66-LL.
      3) "Or-equal."
6. Type V307 Stainless Steel Ball Valve 2 Inches and Smaller:
   a. Three-piece, full port, ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel body and end pieces, Type 316 stainless steel ball, NPT threaded ends, reinforced PTFE seats, seals, and packing, adjustable packing gland, blowout-proof stainless steel stem, stainless steel lever operator with vinyl grip, rated 800 psig to 1,000 psig CWP, complies with MSS SP-110.
   b. Manufacturers and Products:
      1) Conbraco Apollo; 86R-100 Series.
      2) Nibco; T-595-S6-R-66-LL.
      3) "Or-equal."
7. Type V308 Stainless Steel Ball Valve 2 Inches and Smaller:
   a. Two-piece, standard port, NPT threaded ends, ASTM A351/A351M GR CF8M stainless steel body and end pieces, actuator mounting pad, Type 316 stainless steel ball and stem, vented ball, reinforced PTFE seats and seals, adjustable packing nut, blowout-proof stem, rated 1,500 psig WOG minimum, 150 psi SWP, complies with MSS SP-110.
   b. Manufacturers and Products:
      1) Conbraco Apollo; 76-100.
      2) Nibco; T-580-S6-R-66-LL.
      3) Milwaukee; 20SS0R-02.
      4) "Or-equal."
8. Type V330 PVC Ball Valve 2 Inches and Smaller:
   a. Rated 150 psi at 73 degrees F, with ASTM D1784, Type I, Grade 1 polyvinyl chloride body, ball, and stem, end entry, double union design, solvent-weld socket ends, elastomer seat, Viton or Teflon O-ring stem seals, to block flow in both directions.
   b. Manufacturers and Products:
      1) Nibco; Chemtrol Tru-Bloc.
      2) ASAHI/America; Type 21.
      3) Spears; True Union.

D. Plug Valves:

1. Type V400 Eccentric Plug Valve 2 Inches and Smaller:
    a. Nonlubricated type rated 175 psig CWP, drip-tight shutoff with pressure from either direction, cast-iron body, threaded ends, lever operator, cast-iron plug with round or rectangular port, plug coated with Buna-N, stem bearing lubricated stainless steel or bronze, stem seal multiple V-rings, or U-cups with O-rings of nitrile rubber.
    b. Manufacturers and Products:
        1) Pratt; Ballcentric.
        2) DeZurik; Style PEC.
        3) Milliken; Millcentric Series 603.
2. Type V405 Eccentric Plug Valve 3 Inches to 12 Inches:
    a. Nonlubricated type rated 175 psig CWP, drip-tight shutoff with pressure from either direction, cast-iron body, exposed service flanged ends per ASME B16.1 or grooved ends in accordance with AWWA C606 for rigid joints, buried service mechanical joint ends, unless otherwise shown.
    b. Plug cast iron with round or rectangular port of no less than 80 percent of connecting pipe area and coated with Buna-N, seats welded nickel, stem bearings lubricated stainless steel or bronze, stem seal multiple V-rings, or U-cups with O-rings of nitrile rubber, grit seals on both upper and lower bearings.
    c. For buried service, provide external epoxy coating.
    d. Operators:
        1) 3-Inch to 4-Inch Valves: Wrench lever manual.
        2) 6-Inch to 12-Inch Valves: Totally enclosed, geared, manual operator with handwheel, 2-inch nut or chain wheel. Size operator for 1.5 times maximum operating shutoff pressure differential for direct and reverse pressure, whichever is higher. For buried service, provide completely sealed operator filled with heavy lubricant and 2-inch nut.
    e. Manufacturers and Products:
        1) Pratt; Ballcentric.
        2) DeZurik; Style PEC.
        3) Milliken; Millcentric Series 600.
        4) “Or-equal.”
3. Type V406 Eccentric Plug Valve 14 Inches to 20 Inches:
    a. Nonlubricated type rated 150 psig CWP, drip-tight shutoff with pressure from either direction, cast-iron body, exposed service flanged ends per ASME B16.1 or grooved ends in accordance with AWWA C606 for rigid joints, buried service mechanical joints ends, unless otherwise shown, plug cast iron with round or rectangular port of no less than 80 percent of connecting pipe area and coated with Buna-N, seats welded nickel, stem bearings lubricated stainless steel or bronze, stem seal multiple V-rings or U-cups with O-rings of nitrile rubber, grit seals on both upper and lower bearings.

b. Totally enclosed, geared, manual operator with handwheel, 2-inch nut or chain wheel. Size operator for 1.5 times maximum operating shutoff pressure differential for direct and reverse pressure, whichever is higher. For buried service, provide completely sealed operator filled with heavy lubricant and 2-inch nut.

c. For buried service, provide external epoxy coating.

d. Manufacturers and Products:

1) Pratt; Ballcentric.

2) DeZurik; Style PEC.

3) Milliken; Millcentric Series 600.

4. Type V407 Eccentric Plug Valve 24 Inches to 48 Inches:

a. Nonlubricated type rated 150 psig CWP, drip-tight shutoff with pressure from either direction, cast-iron body, exposed service flanged ends per ASME B16.1, buried service mechanical joints ends unless otherwise shown, plug cast iron port opening of no less than 70 percent of connecting pipe area and coated with Buna-N, seats welded nickel, stem bearings lubricated stainless steel or bronze, stem seal multiple V-rings or U-cups with O-rings of nitrile rubber, grit seals on both upper and lower bearings.

b. Totally enclosed, geared, manual operator with handwheel, 2-inch nut, or chain wheel. Size operator for 1.5 times maximum operating shutoff pressure differential for direct and reverse pressure, whichever is higher. For buried service, provide completely sealed operator filled with heavy lubricant.

c. For buried service, provide external epoxy coating.

d. Manufacturers and Products:

1) Pratt; Ballcentric.

2) DeZurik; Style PEC.

3) Milliken; Millcentric Series 600.

E. Butterfly Valves:

1. General:

a. In full compliance with AWWA C504 or AWWA C516, as indicated in the individual valve specification, and following requirements:

1) Suitable for throttling operations and infrequent operation after periods of inactivity.

2) Elastomer seats which are bonded or vulcanized to the body shall have adhesive integrity of bond between seat and body assured by testing, with minimum 75-pound pull in accordance with ASTM D429, Method B.

3) Bubble-tight with rated pressure applied from either side. Test valves with pressure applied in both directions.

4) No travel stops for disc on interior of body.

5) Self-adjusting V-type or O-ring shaft seals.

6) Isolate metal-to-metal thrust bearing surfaces from flowstream.

7) Provide traveling nut or worm gear actuator with handwheel. Valve actuators to meet the requirements of AWWA C504.

8) Provide linings and coatings per AWWA, unless otherwise indicated on Drawings or specified herein.

9) Valves to be in full compliance with NSF 61.

b. Non-AWWA butterfly valves to meet the following actuator requirements:

1) For above ground installations, provide handle and notch plate for valves 6 inches and smaller and heavy-duty, totally enclosed gearbox type operators with handwheel, position indicator and travel stops for valves 8 inches and larger, unless otherwise indicated on Drawings or specified herein.

2. Type V500 Butterfly Valve Water Works Service 3 Inches to 72 Inches:

a. AWWA C504, Class 150B.

b. Short body type, flanged ends.

c. Ductile iron body and disc, Type 304 stainless steel shafts, Buna-N rubber seat, bonded or retained in the body with Type 316 stainless steel rings and hardware,

d. Provide epoxy lining in compliance with AWWA C550.

e. Manufacturers and Products:

1) Pratt; Model 2FII or Triton XR-70.

2) DeZurik; BAW.

3. Type V501 Butterfly Valve Water Works Service 54 Inches to 78 Inches:

a. AWWA C504 or AWWA C516, Class 75B.

b. Short body type, flanged ends.

c. Cast-iron body, ductile iron disc with Type 316 stainless steel seating edge, Type 316 stainless steel shafts, Buna-N rubber seat bonded or molded in body only.

d. Provide epoxy lining and coating in compliance with AWWA C550.

e. Manufacturers and Products:

1) Pratt; Model Triton XR-70.

2) DeZurik; BAW.

F. Check and Flap Valves:

1. Type V600 Check Valve 2 Inches and Smaller:

a. All bronze, threaded cap, threaded or soldered ends, swing type replaceable bronze disc, rated 125-pound SWP, 200-pound WOG.

b. Manufacturers and Products:

1) Stockham; Figure B-319, threaded ends.

2) Milwaukee; Figure 509, threaded ends.

3) Stockham; Figure B-309, soldered ends.

4) Milwaukee; Figure 1509, soldered ends.

5) “Or-equal.”

2. Type V601 Check Valve 2-1/2 inch to 12 Inches:
   a. All 316-stainless steel, flanged, swing type replaceable Type 316 stainless steel disc, class 150, PTFE gasket, integral seat,
   b. Manufacturer and Product:
      1) Velan Cast Stainless Steel Swing Check Valve.
      2) "Or-equal."
3. Type V604 Check Valve 2-1/2 Inches to 24 Inches:
   a. Flanged end, cast-iron body, bronze mounted swing type, solid bronze hinges, stainless steel hinge shaft, rated 125-pound SWG, 200-pound WOG.
   b. Manufacturers and Products:
      1) Stockham; G-931.
      2) Crane; No. 373.
      3) Milliken.
      4) "Or-equal."
4. Type V608 Swing Check Valve 2 Inches to 24 Inches:
   a. AWWA C508, 125 pound flanged ends, cast-iron body, bronze body seat, bronze mounted cast-iron clapper with rubber facing, stainless steel hinge shaft.
   b. Valves, 2 inches through 12 inches rated 175 pound WWP and 14 inches through 24 inches rated 150 pound WWP. Valves to be fitted with adjustable outside lever and weight. Increasing-pattern body valve may be used where increased outlet piping size is shown.
   c. For valves to be fitted with limit switches.
      1) Switch activation at valve NOT CLOSED position.
      2) Factory installed NEMA 4X limit switch.
      3) Single-pole, double-throw (SPdT) type, field adjustable, with contacts rated for 2 amps at 24V dc.
   d. Manufacturers and Products:
      1) M&H Valve; Style 59, 159, or 259.
      2) Mueller Co.; No. A-2600/8001 Series.
      3) "Or-equal."
5. Type V630 PVC Ball Check Valve 4 Inches and Smaller:
   a. ASTM D1784, Type I, Grade 1 polyvinyl chloride body, dual union socket weld ends, rated 150 psi at 73 degrees F, and Viton seat and seal.
   b. Manufacturers and Products:
      1) Nibco; Chemtrol Tru-Bloc True Union.
      2) ASAHI/America.
      3) Spears; True Union.
      4) "Or-equal."
6. Type V632 Ball Check Valve 3 Inches and Larger:
   a. Flanged end, iron body valve with cleanout and sinking type hollow steel ball, vulcanized nitrile rubber exterior, flanges ASME B16.1, Class 125, rated 150 pound working pressure, suitable for vertical up or horizontal flow.

b. Manufacturers and Products:
   1) FLYGT Corp; Type 5087.
   2) Flomatic Corp.; Model 408.

7. Type V642 Reduced-Pressure Principle Backflow Prevention Assembly 3/4 Inch to 10 Inches:
   a. Two resilient seated check valves with an independent relief valve between the valves, two outside screw and yoke resilient-seated isolation valves, test cocks, in accordance with AWWA C511, rated 175 psi maximum working pressure, meets requirements of USC Foundation for Cross-Connection Control and Hydraulic Research.
   b. Manufacturers and Products:
      1) FEBCO; Series 860.
      2) Watts; Series 009/909.
8. Type V690 Flap Gate 6 Inches to 96 Inches:
   a. Cast-iron body and cover, bronze-mounted, flanged frame type, dual pivot-point hinge arms, hinge arms bronze, hinge pins Type 304 stainless steel, seat bronze and impacted into grooves in body and cover flap, lubrication fittings for each pivot, upper and lower pivot adjustment.
   b. Manufacturers and Products:
      1) Rodney Hunt Co.; Series FV-AC or FV-AR.
      2) Hydro Gate; Model 50C or 50.

G. Self-Regulated Automatic Valves:
1. Type V710 Pressure-Reducing Valve 2-1/2 Inches and Smaller:
   a. Direct diaphragm operated, spring controlled, bronze body, NPT threaded ends, 200-psig rated minimum.
   b. Size/Rating: As shown in the Self-Regulated Valve Schedule.
   c. Manufacturers and Products:
      1) Fisher; Type 75A.
      2) Watts; Series 223.
      1) “Or-equal.”
2. Type V711 Pressure-Reducing Valve 2 Inches and Smaller:
   a. Direct diaphragm, spring controlled, cast-iron body, spring case, composition seat and diaphragm, stainless steel valve stem, NPT threaded ends, 250-psig rated.
   b. Size/Rating: As shown on the Self-Regulated Automatic Valve Schedule.
   c. Manufacturer and Product:
      1) Fisher; MR95 Series.
      2) “Or-equal.”
3. Type V712 Pressure-Reducing Valve 1-1/2 Inches to 2 Inches:
   a. Direct diaphragm, spring controlled, cast-iron body, aluminum diaphragm and spring case, nitrile disc/diaphragm/O-rings, internal relief, NPT threaded ends, 125-psig rated.
   b. Size/Rating: As shown in the Self-Regulated Automatic Valve Schedule.

c. Manufacturer and Product:
   1) Fisher; S200 Series.
   2) "Or-equal."

4. Type V714 Pressure-Reducing Valve 3 Inches and Larger:
   a. Hydraulically operated, diaphragm actuated, pilot controlled globe valve, ductile iron body, ASME B16.1 Class 150 flanged ends, rated 250 psi, bronze or stainless steel trim, stainless steel stem, externally mounted strainers with cocks, maintains a constant downstream pressure regardless of fluctuations in flow or upstream pressure.
   b. FDA approved fusion bonded epoxy lining and coating installed in accordance with AWWA C550.
   c. Size/Rating: As shown in Self-Regulated Automatic Valve Schedule.
   d. Manufacturers and Products:
      1) Cla-Val; 90-01Series.
      2) Singer; Model 106PR.
5. Type V744 Air Release Valve 1/2 Inch to 2 Inches:
   a. Suitable for water service, automatically exhaust small amounts of entrained air that accumulates in a system. In CLOSED position, seat against resilient seat to prevent water leakage.
   b. Rated 150 psi working pressure, cast-iron or ductile iron body and cover, stainless steel float and trim, NPT threaded inlet and outlet, built and tested to AWWA C512. Operating pressure per Self-Regulated Automatic Valve Schedule.
   c. Manufacturers and Products:
      1) APCO Valve and Primer Corp.; Series 50, 200, and 200A.
      2) Val-Matic Valve; Series 15A to 45.6.
      3) "Or-equal."
6. Type V754 Sewage Combination Air Valve 2 Inches to 6 Inches:
   a. Suitable for sewage service; combines operating functions of air and vacuum valve and an air release valve. Air and vacuum portion shall automatically exhaust air during filling of a system and allow air to re-enter during draining or when a vacuum occurs. Air release portion to automatically exhaust entrained air that accumulates in system. Single body unit with air and vacuum valve and an air release valve in a single housing.
   b. Rated working pressure of 150 psi; built and tested to AWWA C512.
   c. Materials: Cast-iron or ductile iron body and covers, NTP threaded inlet and outlet, with concave or skirted stainless steel float and trim.
   d. Sewage air release valve fitted with blowoff valve, flushing valve with quick disconnect couplings, and a minimum 5 feet of hose with quick disconnect couplings to permit backflushing after installation without dismantling valve.

e. Manufacturers and Products:
   1) APCO Valve and Primer Corp.; Series 440 SCAV.
   2) Val-Matic Valve; Series 800.
   3) "Or-equal."

H. Miscellaneous Valves:
   1. Type V905 Pinch Valve 1 Inch to 12 Inches:
      a. Cast-iron fully enclosed body, epoxy lined and coated, ASME B16.1 Class 125 flanged ends, one-piece molded Buna-N elastomer tube, full-port design, 90 psi minimum working pressure, double-acting upper and lower pinch bars that close on centerline, stainless steel stem, handwheel operator, position indicator, geared operator for valves 6 inches and larger.
      b. Manufacturers and Products:
         1) Red Valve Co.; Series 75.
         2) RF Technologies, Inc.; RF Valve.
   2. Type V940 Solenoid Valve 1/2 Inch:
      a. Two-way internal pilot operated diaphragm type, brass body, resilient seat suitable for air or water, solenoid coil molded epoxy, NEMA insulation Class F, 24V dc, unless otherwise indicated. Solenoid enclosure NEMA 250, Type 4 unless otherwise indicated. Size and normal position as indicated in Power Actuated Valve Schedule.
      b. Minimum operating pressure differential no greater than 5 psig, maximum operating pressure differential not less than 100 psig.
      c. Manufacturer and Product: ASCO; 8210G002 24/DC.

2.06 OPERATORS AND ACTUATORS

A. Manual Operators:
   1. General:
      a. For AWWA valves, operator force not to exceed the requirements of the applicable valve standard. For non-AWWA valves, operator force not to exceed applicable industry standard or 80 pounds, whichever is less, under any operating condition, including initial breakaway. Provide gear reduction operator when force exceeds requirements.
      b. Operator self-locking type or equipped with self-locking device.
      c. Position indicator on quarter-turn valves.
      d. Worm and gear operators one-piece design worm-gears of gear bronze material. Worm hardened alloy steel with thread ground and polished. Traveling nut type operator's threaded steel reach rod with internally threaded bronze or ductile iron nut.
   2. Exposed Operator:
      a. Galvanized and painted handwheel.
      b. Cranks on gear type operator.
      c. Chain wheel operator with tieback, extension stem, floor stand, and other accessories to permit operation from normal operation level.

d. Valve handles to take a padlock, and wheels a chain and padlock.

3. Buried Operator:
   a. Buried service operators on valves larger than 2-1/2 inches shall have a 2-inch AWWA operating nut. Buried operators on valves 2 inches and smaller shall have cross handle for operation by forked key. Enclose moving parts of valve and operator in housing to prevent contact with the soil.
   b. Design buried service operators for quarter-turn valves to withstand 450 foot-pounds of input torque at the FULLY OPEN or FULLY CLOSED positions, grease packed and gasketed to withstand a submersion in water to 10 psi.
   c. Buried valves shall have extension stems, bonnets, and valve boxes.

B. Electric Motor Actuators, 120 Volts:
   1. General:
      a. Unit shall be low profile to reduce amount of required space and weigh 15 pounds or less.
      b. Size to 1-1/2 times required operating torque. Motor stall torque not to exceed torque capacity of the valve.
      c. Provide operator mounting bracket to mount operator to valve providing minimal torque to piping system when operating.
   2. Operator Operation, General:
      a. Suitable for full 90-degree rotation of quarter-turn valves.
      b. Manually override handwheel.
      c. Mechanical valve position indication.
      d. Capable of displaying valve position regardless of actuator power.
      e. OPENED and CLOSED indicating lights.
   3. Electronic Control:
      a. Torque Limiting Switches: Two single pole, double throw mechanical switches. Switches operate at any point in valve travel.
      b. Jammed-valve detection and protection.
      c. Motor over-temperature detection and protection.
      d. Travel limit switches, single pole double throw.
   4. Open-Close (O/C) Service:
      a. Duty cycle for intermittent ON-OFF operation shall be 25 percent.
      b. Operator shall power to OPEN and power to CLOSE.
      c. LOCAL-REMOTE Selector Switch, padlockable in each position:
         1) Integral OPEN-STOP-CLOSE momentary pushbuttons with seal-in circuits to control valve in LOCAL position.
         2) Integral reversing motor starter with built-in overload protection.
         3) Valve shall remain in last position on loss of operator power.
   5. Modulating (M) Service:
      a. Operator rated for continuous duty with servo shall be rated for 100 percent modulating operation.

b. Operator shall modulate based on an externally applied 4 mA to 20 mA dc signal.

c. Operator shall be equipped with an electronic servo module for valve modulation.

1) Module shall provide serial communications with provided cable for setup of valve operation.

d. LOCAL-REMOTE Selector Switch, padlockable in each position:

1) Integral OPEN-STOP-CLOSE momentary pushbuttons with seal-in circuits to control valve in LOCAL position.

2) 4 mA dc to 20 mA dc input signal to control valve in REMOTE position

6. Control Features: Electric motor actuators with features as noted, and as modified/supplemented in Power Actuated Valve Schedule.

a. Control Signals: 24V dc rated.

b. Auxiliary Contacts:

1) POWER ON: Open contact on loss of power status to actuator.

2) FAULT: Open contact on actuator fault status.

3) REMOTE: Open contact on actuator being in remote mode.

4) LOCAL: Open contact on actuator being in local mode.

5) OPENED: Closed contact on valve being fully opened.

6) CLOSED: Closed contact on valve being fully closed.

c. Open-Close Service Control:

1) OPEN: Closed momentary dry contact to open valve fully in REMOTE. Integral seal in circuit.

d. Modulating Service:

1) 4 mA to 20 mA input signal to command valve position in REMOTE.

2) 4 mA to 20 mA output valve position feedback signal.

7. Limit Switch:

a. Single-pole, double-throw (SPDT) type, field adjustable, with contacts rated for 3 amps at 24V dc.

b. Each valve actuator to have a minimum of two auxiliary transfer contacts at end position, one for valve FULL OPEN and one for valve FULL CLOSED.

c. Housed in actuator control enclosure.

8. Manufacturer: Rotork.

C. Electric Motor Actuators; 480 Volts:

1. General:

a. Comply with latest version of AWWA C540.

b. Size to 1-1/2 times required operating torque. Motor stall torque not to exceed torque capacity of valve.

c. Controls integral with the actuator and fully equipped as specified in AWWA C540.

d. Stem protection for rising stem valves.

2. Actuator Operation—General:
   a. Suitable for full 90-degree rotation of quarter-turn valves or for use on multiturn valves, as applicable.
   b. Manual override handwheel.
   c. Valve position indication.
   d. Operate from FULL CLOSED to FULL OPEN positions or the reverse in the number of seconds given in the Power Actuated Valve Schedule.
   e. Nonintrusive Electronics: Local controls, diagnostics, and calibration, including limit and torque switch settings, shall be accomplished nonintrusively. Electronic valve position display with capability to show continuous torque output. If applicable, provide two hand-held configuration units for every 10 actuators provided, two minimum.
   f. Capable of displaying valve position regardless of actuator power.
   g. OPENED and CLOSED indicating lights.
3. Open-Close(O/C)/Throttling(T) Service:
   a. Size motors for one complete OPEN-CLOSE-OPEN cycle no less than once every 10 minutes.
   b. Actuator suitable for throttling operation of valve at intermediate positions.
   c. LOCAL-REMOTE Selector Switch, padlockable in each position:
      1) Integral OPEN-STOP-CLOSE momentary pushbuttons with seal-in circuits to control valve in LOCAL position.
   d. Power ON auxiliary contact when there is power to the valve actuator.
   e. Integral reversing motor starter with built-in overload protection.
   f. Valve shall remain in last position on loss of operator power.
4. Modulating (M) Service:
   a. Size motors for continuous duty.
   b. Feedback potentiometer, or equivalent, and integral electronic positioner/comparator circuit to maintain valve position.
   c. LOCAL-REMOTE Selector Switch, padlockable in each position:
      1) Integral OPEN-STOP-CLOSE momentary pushbuttons with seal-in circuits to control valve in LOCAL position.
      2) 4 mA dc to 20 mA dc input signal to control valve in REMOTE position.
   d. Valve shall fail last position, unless otherwise indicated.
   e. Ac motor with solid state reversing starter or dc motor with solid state reversing controller, and built-in overload protection. Controller capable of 1,200 starts per hour.
   f. Duty cycle limit timer and adjustable band width, or equivalent, to prevent actuator hunting.
   g. Valve position output converter that generates an isolated 4 mA dc to 20 mA dc signal in proportion to valve position, and is capable of driving into loads of up to 500 ohms at 24V dc.

5. Control Features: Electric motor actuators with features as noted, and as modified/supplemented in Power Actuated Valve Schedule.
    a. Control Signals: 24V dc rated.
    b. Auxiliary Contacts:
        1) POWER ON: Open contact on loss of power status to actuator.
        2) FAULT: Open contact on actuator fault status.
        3) REMOTE: Open contact on actuator being in remote mode.
        4) LOCAL: Open contact on actuator being in local mode.
        5) OPENED: Closed contact on valve being fully opened.
        6) CLOSED: Closed contact on valve being fully closed.
    c. Open-Close Service Control:
        1) OPEN: Closed momentary dry contact to open valve fully in REMOTE. Integral seal in circuit.
    d. Modulating Service:
        1) 4 mA to 20 mA input signal to command valve position in REMOTE.
        2) 4 mA to 20 mA output valve position feedback signal.
6. Actuator Power Supply:
    a. 480 volts, three-phase, unless otherwise indicated.
    b. Control power transformer, 120-volt secondary.
    c. 24V dc power supply.
    d. Externally operable power disconnect switch.
7. Enclosure: As defined in NEMA 250, Type 6, unless otherwise indicated.
8. Limit Switch:
    a. Single-pole, double-throw (SPDT) type, field adjustable, with contacts rated for 3 amps at 24V dc.
    b. Each valve actuator to have a minimum of two auxiliary transfer contacts at end position, one for valve FULL OPEN and one for valve FULL CLOSED.
    c. Housed in actuator control enclosure.
9. Manufacturers:
    a. Rotork Controls.
    b. Flowserve Limitorque.
    c. “Or-equal.”

D. Pneumatic Actuators:
1. General:
    a. Actuator complete with air sets, exhaust mufflers, speed controls, pilot solenoids, safety vented isolation valves, and accessories.
    b. Suitable for full operation range of valve at air supply pressure indicated.
    c. Position indication and stop limiting devices on all actuators.

2. Cylinder Actuator:
   a. In compliance with AWWA C541.
   b. Air supply pressure of 80 psig.
   c. Nonswivel type totally enclosed:
      1) Travel stops and position indicator.
      2) Factory lubricated and sealed requiring no additional lubrication.
   d. Double Acting:
      1) Nonmetallic for operation on nonlubricated air.
      2) Handwheel override independent of cylinder.
   e. Actuators used on quarter-turn valves to include a totally enclosed valve actuating mechanism. Actuating mechanism to be factory lubricated and sealed.
   f. Manufacturers:
      1) Rotork.
      2) DeZurik.
3. Accessories:
   a. Air Set: Pressure regulator with internal relief, filter, outlet pressure gauge, and adjustable reduced pressure range as required by valve actuator.
      1) Aluminum body and handwheel.
      2) Safety vented lockout isolation valve.
      3) Gauge range 1-1/3 to 2 times maximum operating pressure.
      4) Manufacturers and Products:
         a) Fisher Controls; Type 67 AFR.
         b) Masoneilan; No. 77-4.
   b. Air Exhaust Muffler:
      1) In the exhaust port of actuator pilot solenoid valves.
      2) Manufacturers and Products:
         a) Barry Wright Corp.
         b) Allied Witan Co.
   c. Limit Switch:
      1) Single-pole, double-throw (SPDT) type, rated 2 amps at 24V dc.
      2) Housed in NEMA 4X enclosure.
      3) Adjustable for OPEN and CLOSED valve positions.
   d. Modulating Service Positioner:
      1) For modulating actuators, shall be pneumatic force balance instruments to control valve position as a function of input signal. Accomplish positive positioning of valve by a mechanical feedback connection from valve actuating mechanism. Position feedback through a characterized linear cam to allow adjustment of valve positioning and input signal. Positioner suitable for double acting or spring return actuator.
      2) Positioner to have zero and span adjustment and be field reversible for direct or reverse action.

3) Gauges for supply and output pressure and for input signal pressure.
4) Positioner for or 4 mA to 20 mA dc input signal as indicated.
5) Positioner for dc input signal with transducers shall convert electrical signal to appropriate pneumatic signal. Transducer integral with positioner or separate component. If separate, factory mount transducer on pneumatic operator. Line electric power not required for transducer.
6) Corrosion-resistant enclosures for positioners and transducers to be splash-proof and moisture-proof with gasketed covers.

e. Pilot Solenoid Valve:
1) Solenoid valve shall pilot control actuator in appropriate configuration for type of open-close actuator being controlled. Double acting actuator shall have four-way solenoid valve, and spring return actuator shall have three-way solenoid valve. Dual coil valve shall not change position unless one coil is energized while the other is de-energized.
2) Pilot operated diaphragm type solenoid valve with brass body and resilient seat. Valve with minimum operating pressure differential no greater than 10 psig and maximum operating pressure differential no less than 150 psig. Internal parts corrosion-resistant. Solenoid valve to have Class F molded coils for operation on 24V dc, unless otherwise indicated. Solenoid enclosure as defined in NEMA 250, Type 4X.
3) Manufacturers:
a) Asco.
b) C. A. Norgren Co.

4. Open-Close Service:
a. Double Acting Cylinders: Four-way solenoid with dual coils.
5. Control Features: Pneumatic actuators with features noted in the Power Actuated Valve Schedule.

2.07 ACCESSORIES

A. Tagging: 1-1/2-inch diameter heavy brass or stainless steel tag attached with No. 16 solid brass or stainless steel jack chain for each valve operator or self-regulated valve bearing valve tag number shown on Power Actuated Valve Schedule, Manual Valve Schedule, and Self-Regulated Automatic Valve Schedule at end of section.

B. Chain Wheel and Guide:
1. Handwheel direct-mount type.
2. Complete with chain.
3. Galvanized or cadmium-plated.
4. Manufacturers and Products:
a. Clow Corp.; Figure F 5680.
b. “Or-equal.”

C. Limit Switch: Factory installed NEMA 4X limit switch by actuator manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Flange Ends:
   1. Flanged valve bolt holes shall straddle vertical centerline of pipe.
   2. Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.

B. Screwed Ends:
   1. Clean threads by wire brushing or swabbing.
   2. Apply joint compound.

C. PVC Valves: Install using solvents approved for valve service conditions.

D. Valve Installation and Orientation:
   1. General:
      a. Install valves so handles operate from fully open to fully closed without encountering obstructions.
      b. Install valves in location for easy access for routine operation and maintenance.
      c. Install valves per manufacturer's recommendations.
      d. Valves and associated suspended equipment up to 14 inches or 1,000 pounds are to be installed to 12-gauge strut concrete inserts and have, at minimum, 18 inches of overhead space.
      e. Valves and associated suspended equipment 16 inches to 20 inches or 2,000 pounds are to be installed using internally threaded concrete inserts and have, at minimum, 18 inches of overhead space.
      f. Valves and associated suspended equipment 20 inches and over are to have an overhead trolley system installed with adequate clearance for maintenance.
   2. Gate, Globe, and Ball Valves:
      a. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.
      b. Install operating stem horizontal in horizontal runs of pipe having centerline elevations greater than 4 feet 6 inches above finish floor, unless otherwise shown.
   3. Butterfly Valves:
      a. Unless otherwise restricted or shown on Drawings, install valve a minimum of 8 diameters downstream of an elbow or branch tee and with shaft in horizontal position.
      b. For vertical elbow or branch tee immediately upstream of valve, install valve with shaft in vertical position.

c. For horizontal elbow or branch tee immediately upstream of valve, install valve with shaft in horizontal position.

d. When installed immediately downstream of a swing check, install valve with shaft perpendicular to swing check shaft.

e. For free inlet or discharge into basins and tanks, install valve with shaft in vertical position.

4. Check Valves:

a. Install valve in horizontal or vertical flow (up) flow piping only for liquid services.

b. Install valve in vertical flow (up) piping only for gas services.

c. Install swing check valve with shaft in horizontal position.

E. Install a line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.

F. Install safety isolation valves on compressed air.

G. Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls and plaster ceilings for valve access.

H. Torque Tube: Where operator for quarter-turn valve is located on floor stand, furnish extension stem torque tube of a type properly sized for maximum torque capacity of valve.

I. Chain Wheel and Guide: Install chain wheel and guide assemblies or chain lever assemblies on manually operated valves over 6 feet 9 inches above finish floor. Install chain to within 3 feet of finish floor. Where chains hang in normally traveled areas, use appropriate “L” type tie-back anchors. Install chains to within operator horizontal reach of 2 feet 6 inches maximum, measured from normal operator standing location or station.

J. Buried Valves: Wrap all metallic buried pipe, pipe sections, specials, fasteners, and fittings, valves, and all metallic appurtenances associated with buried non-metallic pipe with a petrolatum wax tape coating in accordance with AWWA C217.

3.02 TESTS AND INSPECTION

A. Valve may be either tested while testing pipelines, or as a separate step.

B. Test that valves open and close smoothly under operating pressure conditions. Test that two-way valves open and close smoothly under operating pressure conditions from both directions.

C. Inspect air and vacuum valves as pipe is being filled to verify venting and seating is fully functional.

D. Count and record number of turns to open and close valve; account for any discrepancies with manufacturer’s data.

E. Set, verify, and record set pressures for relief and regulating valves.

F. Automatic valves to be tested in conjunction with control system testing. Set opening and closing speeds, limit switches, as required or recommended by Design-Builder.

3.03 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are part of this Specification.
   1. Power Actuated Valve Schedule.
   2. Manual Valve Schedule.
   3. Self-Regulated Automatic Valve Schedule.

END OF SECTION

TAG NUMBER	P+ID NO	VALVE TYPE	SERVICE	VALVE SIZE	OPERATOR TYPE	ACTUATOR POWER SUPPLY	MAX OPERATING FLOW	MAX DP (PSI)	CONTROL FUNCTION	FAIL POSITION	TRAVEL TIME (SEC)	SUPPLY BY	REMARKS
12VLV9721-00	N-003-09	V155	RS	48"	Motor				Electric; Open/Close	None			
12VLV9720-00	N-003-09	V155	RS	48"	Motor				Electric; Open/Close	None			
14VLV9510-01	N-006-09	V500	WTR3/RW	4"	Motor				Electric; Open/Close	None			
14VLV9520-02	N-008-09		SCR	18"	Motor				Electric; Open/Close	None		Package	Provide with Remote Control Station
14VLV9520-01	N-008-09		SCR	18"	Motor				Electric; Open/Close	None		Package	Provide with Remote Control Station
14VLV9522-01	N-008-09	V302	WTR3	1"	Motor				Electric; Open/Close	None			
14VLV9522-02	N-008-09	V302	WTR3	1"	Motor				Electric; Open/Close	None			
14VLV9520-04	N-009-09		SCR	18"	Motor				Electric; Open/Close	None		Package	Provide with Remote Control Station
14VLV9520-03	N-009-09		SCR	18"	Motor				Electric; Open/Close	None		Package	Provide with Remote Control Station
14VLV9522-03	N-009-09	V302	WTR3	1"	Motor				Electric; Open/Close	None			
14VLV9522-04	N-009-09	V302	WTR3	1"	Motor				Electric; Open/Close	None			
14VLV9677-01	N-012-09	V302	WTR3	1 1/2"	Motor				Electric; Open/Close	None			
14VLV9670-01	N-012-09	V405	V	6"	Motor				Electric; Open/Close	None			
14VLV9677-02	N-013-09	V302	WTR3	1 1/2"	Motor				Electric; Open/Close	None			
14VLV9670-02	N-013-09	V405	V	6"	Motor				Electric; Open/Close	None			
14VLV9677-03	N-014-09	V302	WTR3	1 1/2"	Motor				Electric; Open/Close	None			
14VLV9670-03	N-014-09	V405	V	6"	Motor				Electric; Open/Close	None			
14VLV9677-04	N-015-09	V302	WTR3	1 1/2"	Motor				Electric; Open/Close	None			
14VLV9670-04	N-015-09	V405	V	6"	Motor				Electric; Open/Close	None			
14VLV9677-05	N-016-09	V302	WTR3	1 1/2"	Motor				Electric; Open/Close	None			
14VLV9670-05	N-016-09	V405	V	6"	Motor				Electric; Open/Close	None			
14VLV9926-02	N-019-09	V302	WTR3	1 1/2"	Motor				Electric; Open/Close	None			
14VLV9926-01	N-019-09	V302	WTR3	1 1/2"	Motor				Electric; Open/Close	None			
14VLV9926-04	N-020-09	V302	WTR3	1 1/2"	Motor				Electric; Open/Close	None			
14VLV9926-03	N-020-09	V302	WTR3	1 1/2"	Motor				Electric; Open/Close	None			
14VLV9926-06	N-021-09	V302	WTR3	1 1/2"	Motor				Electric; Open/Close	None			
14VLV9926-05	N-021-09	V302	WTR3	1 1/2"	Motor				Electric; Open/Close	None			
14VLV9604-01	N-022-09		GR/OF	4"	Motor				Electric; Open/Close	None		Package	
14VLV9607-01	N-022-09		WTR3	1"	Single Solenoid				Electric; Open/Close	None		Package	
14VLV9604-02	N-023-09		GR/OF	4"	Motor				Electric; Open/Close	None		Package	
14VLV9607-02	N-023-09		WTR3	1"	Single Solenoid				Electric; Open/Close	None		Package	
14VLV9604-03	N-024-09		GR/OF	4"	Motor				Electric; Open/Close	None		Package	
14VLV9607-03	N-024-09		WTR3	1"	Single Solenoid				Electric; Open/Close	None		Package	
14VLV9604-04	N-025-09		GR/OF	4"	Motor				Electric; Open/Close	None		Package	

TAG NUMBER	P+ID NO	VALVE TYPE	SERVICE	VALVE SIZE	OPERATOR TYPE	ACTUATOR POWER SUPPLY	MAX OPERATING FLOW	MAX DP (PSI)	CONTROL FUNCTION	FAIL POSITION	TRAVEL TIME (SEC)	SUPPLY BY	REMARKS
14VLV9607-04	N-025-09		WTR3	1"	Single Solenoid				Electric; Open/Close	None		Package	
14VLV9604-05	N-026-09		GR/OF	4"	Motor				Electric; Open/Close	None		Package	
14VLV9607-05	N-026-09		WTR3	1"	Single Solenoid				Electric; Open/Close	None		Package	
14VLV9604-06	N-027-09		GR/OF	4"	Motor				Electric; Open/Close	None		Package	
14VLV9607-06	N-027-09		WTR3	1"	Single Solenoid				Electric; Open/Close	None		Package	
23VLV2378-01	N-031-09	V501	RS	78"	Cylinder				Pneumatic; Modulating	None			
23VLV2577-01	N-031-09	V501	RS	54"	Cylinder				Pneumatic; Modulating	None			
23VLV2354-01	N-031-09	V501	RS	54"	Cylinder				Pneumatic; Modulating	None			
23VLV2578-01	N-031-09	V501	RS	72"	Cylinder				Pneumatic; Modulating	None			
12VLV9712-01	N-034-09		WTR3	1"	Single Solenoid				Electric; Open/Close	None		Package	
14VLV9710-16	N-034-09		WTR3	1"	Regulator External Tap				Electric; Open/Close	None		Package	

TAG NUMBER	P+ID NO	SERVICE	VALVE SIZE	VALVE TYPE	SUPPLY BY
14VLV0100-11	N-001-09	RS	12"	V690	
14VLV0100-12	N-001-09	WTR3	4"	V405	
14VLV0300-13	N-001-09	WTR3	4"	V405	
14VLV9910-01	N-006-09	WTR3	8"	V500	
14VLV9910-02	N-006-09	RW	8"	V500	
14VLV9911-01	N-006-09	WTR3/RW	1"	V330	
14VLV9912-01	N-006-09	WTR3/RW	4"	V500	
14VLV9912-02	N-006-09	WTR3/RW	4"	V500	
14VLV9507-01	N-007-09	SA	1"	V330	
14VLV9507-02	N-007-09	SA	1"	V330	
14VLV9855-07	N-008-09	WTR3	1"	V330	
14VLV9915-01	N-008-09	RW	4"	V500	
14VLV9916-01	N-008-09	WTR3	4"	V500	
14VLV9920-01	N-008-09	PRW	1"	V330	
14VLV9920-02	N-008-09	PRW	1"	V330	
14VLV9921-01	N-008-09	WTR3	1"	V330	
14VLV9921-02	N-008-09	WTR3	1"	V330	
14VLV9922-01	N-008-09	WTR3	1"	V330	
14VLV9922-02	N-008-09	WTR3	1"	V330	
14VLV9920-03	N-009-09	PRW	1"	V330	
14VLV9920-04	N-009-09	WTR3	1"	V330	
14VLV9921-03	N-009-09	WTR3	1"	V330	
14VLV9921-04	N-009-09	WTR3	1"	V330	
14VLV9922-03	N-009-09	WTR3	1"	V330	
14VLV9922-04	N-009-09	WTR3	1"	V330	
14VLV9938-01	N-012-09	WTR3	1 1/2"	V330	
14VLV9939-01	N-012-09	WTR1	1"	V330	
14VLV9941-01	N-012-09	WTR3	3/4"	V200	
14VLV9938-02	N-013-09	WTR3	1 1/2"	V330	
14VLV9941-02	N-013-09	WTR3	3/4"	V200	
23VLV9939-02	N-013-09	WTR3	1 1/2"	V330	
14VLV9938-03	N-014-09	WTR3	1 1/2"	V330	
14VLV9939-03	N-014-09	WTR1	1"	V330	
14VLV9941-03	N-014-09	WTR3	3/4"	V200	
14VLV9938-04	N-015-09	WTR3	1 1/2"	V330	
14VLV9939-04	N-015-09	WTR1	1"	V300	
14VLV9941-04	N-015-09	WTR3	3/4"	V200	
14VLV9938-05	N-016-09	WTR3	1 1/2"	V330	
14VLV9939-05	N-016-09	WTR1	1"	V330	
14VLV9941-05	N-016-09	WTR3	3/4"	V200	
14VLV9927-01	N-019-09	WTR3	1 1/2"	V330	
14VLV9927-02	N-019-09	WTR3	1 1/2"	V330	
23VLV9930-01	N-019-09	GR/D	6"	V405	

TAG NUMBER	P+ID NO	SERVICE	VALVE SIZE	VALVE TYPE	SUPPLY BY
23VLV9930-02	N-019-09	GR/D	6"	V405	
14VLV9927-03	N-020-09	WTR3	1 1/2"	V330	
14VLV9927-04	N-020-09	WTR3	1 1/2"	V330	
14VLV9930-03	N-020-09	GR/D	6"	V405	
14VLV9930-04	N-020-09	GR/D	6"	V405	
14VLV9927-05	N-021-09	WTR3	1 1/2"	V330	
14VLV9927-06	N-021-09	WTR3	1 1/2"	V330	
14VLV9930-05	N-021-09	GR/D	6"	V405	
14VLV9930-06	N-021-09	GR/D	6"	V405	
14VLV9901-01	N-022-09	GR	6"	V405	
14VLV9906-01	N-022-09	WTR3	1"	V330	
14VLV9907-01	N-022-09	GR/OF	3"	V306	
14VLV9901-02	N-023-09	GR	6"	V405	
14VLV9906-02	N-023-09	WTR3	1"	V330	
14VLV9907-02	N-023-09	GR/OF	3"	V306	
14VLV9901-03	N-024-09	GR	6"	V405	
14VLV9906-03	N-024-09	WTR3	1"	V330	
14VLV9907-03	N-024-09	GR/OF	3"	V306	
14VLV9901-04	N-025-09	GR	6"	V405	
14VLV9906-04	N-025-09	WTR3	1"	V330	
14VLV9907-04	N-025-09	GR/OF	3"	V306	
14VLV9901-05	N-026-09	GR	6"	V405	
14VLV9906-05	N-026-09	WTR3	1"	V330	
14VLV9907-05	N-026-09	GR/OF	3"	V306	
14VLV9901-06	N-027-09	GR	6"	V405	
14VLV9906-06	N-027-09	WTR3	1"	V330	
14VLV9907-06	N-027-09	GR/OF	3"	V306	
11VPL0300-01	N-030-09	PD	6"	V405	
14VPL0300-02	N-030-09	PD	6"	V405	
14VPL0300-03	N-030-09	PD	6"	V405	
14VPL0300-04	N-030-09	PD	6"	V405	
14VLV9961-01	N-033-09	D	1"	V330	
14VLV9961-02	N-033-09	D	1"	V330	
14VLV9962-01	N-033-09	D	1"	V330	
14VLV9962-02	N-033-09	D	1"	V330	
14VLV9963-01	N-033-09	FA	1"	V330	
14VLV9963-02	N-033-09	FA	1"	V330	
14VLV9964-01	N-033-09	FA	1"	V330	
14VLV9964-02	N-033-09	FA	1"	V330	
14VLV9965-00	N-033-09	FA	1"	V330	
14VLV9710-08	N-034-09	BR/D	1"	V330	
14VLV9710-09	N-034-09	BR/D	1"	V330	
14VLV9710-10	N-034-09	BR/D	1"	V330	

TAG NUMBER	P+ID NO	SERVICE	VALVE SIZE	VALVE TYPE	SUPPLY BY
14VLV9710-11	N-034-09	WTR3	1"	V330	
14VLV9710-12	N-034-09	WTR3	1"		Package
14VLV9710-13	N-034-09	WTR3	1"		Package
14VLV9710-14	N-034-09	WTR3	1"		Package
14VLV9710-15	N-034-09	WTR3	1"		Package
14VLV9710-17	N-034-09	WTR3	1"	V330	
14VLV9710-18	N-034-09	NUT	1"		Package
14VLV9710-19	N-034-09	WTR3	1"		Package
14VLV9710-20	N-034-09	WTR3	1"		Package
14VLV9710-21	N-034-09	NUT/D	1"	V330	
14VLV9710-22	N-034-09	BR	1"	V330	
14VLV9710-23	N-034-09	BR	1"	V330	
14VLV9710-24	N-034-09	CD	1"	V330	
14VLV9710-26	N-034-09	BR	1"	V330	
14VLV9710-27	N-034-09	BR	1"	V330	
14VLV9710-28	N-034-09	BR	1"	V330	
14VLV9710-29	N-034-09	WTR1 (NON-POTABLE)	1"	V300	
14VLV9710-30	N-034-09	BR	1"	V330	
12VLV9707-01	N-037-09	PD	14"	V406	
12VLV9707-02	N-037-09	PD	14"	V406	
12VLV9707-03	N-037-09	PD	14"	V406	
12VLV9707-04	N-037-09	PD	14"	V406	
12VLV9950-01	N-037-09	PD	14"	V608	
12VLV9950-02	N-037-09	PD	14"	V608	
12VLV9950-03	N-037-09	PD	14"	V608	
12VLV9950-04	N-037-09	PD	14"	V608	
12VPL0905	N-037-09	PD	3"	V405	
12VPL0906	N-037-09	PD	3"	V405	
12VPL0907	N-037-09	PD	3"	V405	
12VPL0908	N-037-09	PD	3"	V405	
12VLV9727-01	N-038-09	PD	8"	V405	
12VLV9727-02	N-038-09	PD	8"	V405	
12VLV9955-01	N-038-09	PD	8"	V608	
12VLV9955-02	N-038-09	PD	8"	V608	
12VLV9955-03	N-038-09	PD	1 1/2"	V630	
12VPL3809	N-038-09	PD	2"	V400	
12VPL3810	N-038-09	PD	2"	V400	
14VLV9727-03	N-038-09	PD	1 1/2"	V400	
12VLV9739-01	N-039-09	PD	2"	V330	
14VLV2739-04	N-039-09	PD	2"	V630	
14VLV2739-3	N-039-09	PD	2"	V330	
14VLV9739-02	N-039-09	PD	2"	V630	

TAG NUMBER	P+ID NO	VALVE TYPE	SERVICE	VALVE SIZE
14VLV9854-01	N-008-09	V714	WTR3	4"
14VLV9947-01	N-012-09	V711	WTR3	1 1/2"
14VLV9947-02	N-013-09	V711	WTR3	1 1/2"
14VLV9947-03	N-014-09	V711	WTR3	1 1/2"
14VLV9947-04	N-015-09	V711	WTR3	1 1/2"
14VLV9947-05	N-016-09	V711	WTR3	1 1/2"
	N-037-09	V754	PD	3"
	N-037-09	V754	PD	3"
	N-037-09	V754	PD	3"
	N-037-09	V754	PD	3"
	N-037-09	V754	PD	2"
	N-037-09	V754	PD	2"

SECTION 40 80 01
PROCESS PIPING LEAKAGE TESTING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. Chlorine Institute (2001 L Street N.W., Washington D.C. 28036): Pamphlet 6, Piping Systems for Dry Chlorine.

1.02 SUBMITTALS

A. Informational Submittals:
   1. Testing Plan: Submit prior to testing and include at least the information that follows.
      a. Testing dates.
      b. Piping systems and section(s) to be tested.
      c. Test type.
      d. Method of isolation.
      e. Calculation of maximum allowable leakage for piping section(s) to be tested.
   2. Certifications of Calibration: Testing equipment.
   3. Certified Test Report.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PREPARATION

A. Notify Jacobs' Engineer in writing 5 days in advance of testing. Perform testing in presence of Jacobs' Engineer.

B. Pressure Piping:
   1. Install temporary thrust blocking or other restraint as necessary to protect adjacent piping or equipment and make taps in piping prior to testing.
   2. Wait 5 days minimum after temporary concrete thrust blocking is installed to perform pressure tests. If high-early strength cement is used for thrust blocking, wait may be reduced to 2 days.
   3. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.
   4. New Piping Connected to Existing Piping:
      a. Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to Jacobs' Engineer.

b. Test joint between new piping and existing piping by methods that do not place entire existing system under test load, as approved by Jacobs' Engineer.

5. Items that do not require testing include: Equipment seal drains, tank overflows to atmospheric vented drains, and tank atmospheric vents.

6. Test Pressure: As indicated on Piping Schedule on Drawings, or as specified by package system equipment manufacturer.

C. Test section may be filled with water and allowed to stand under low pressure prior to testing.

D. Gravity Piping:

1. Perform testing after service connections, manholes, and backfilling have been completed between stations to be tested.

2. Determine groundwater level at time of testing by exploratory holes or other method acceptable to Jacobs' Engineer.

3. Pipe 42 Inches Diameter and Larger: Joint testing device may be used to isolate and test individual joints.

3.02 HYDROSTATIC TEST FOR PRESSURE PIPING

A. Fluid: Clean water of such quality to prevent corrosion of materials in piping system.

B. Exposed Piping:

1. Perform testing on installed piping prior to application of insulation.

2. Maximum Filling Velocity: 0.25 foot per second, applied over full area of pipe.

3. Vent piping during filling. Open vents at high points of piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets.

4. Maintain hydrostatic test pressure continuously for 60 minutes, minimum, and for such additional time as necessary to conduct examinations for leakage.

5. Examine joints and connections for leakage.

6. Correct visible leakage and retest as specified.

7. Empty pipe of water prior to final cleaning or disinfection.

C. Buried Piping:

1. Test after backfilling has been completed.

2. Expel air from piping system during filling.

3. Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.

4. Maintain hydrostatic test pressure continuously for 2 hours minimum, reopening isolation valve only as necessary to restore test pressure.

5. Determine actual leakage by measuring quantity of water necessary to maintain specified test pressure for duration of test.
6. Maximum Allowable Leakage:

$$L = \frac{SD(P)^{1/2}}{133{,}200}$$

where:

L = Allowable leakage, in gallons per hour.
S = Length of pipe tested, in feet.
D = Nominal diameter of pipe, in inches.
P = Test pressure during leakage test, in pounds per square inch.

7. Correct leakage greater than allowable, and retest as specified.

D. After Testing: All hydrocarbon and compressed air services lines shall be dried with instrument-quality air after testing. Purge lube oil lines and urea-service compressed air lines with nitrogen after drying.

3.03 PNEUMATIC TEST FOR PRESSURE PIPING

A. Do not perform on:
   1. PVC pipe.
   2. Piping larger than 18 inches.
   3. Buried and other non-exposed piping.

B. Fluid: Oil-free, dry air.

C. Procedure:
   1. Apply preliminary pneumatic test pressure of 25 psig maximum to piping system prior to final leak testing, to locate visible leaks. Apply soap bubble mixture to joints and connections; examine for leakage.
   2. Correct visible leaks and repeat preliminary test until visible leaks are corrected.
   3. Gradually increase pressure in system to half of specified test pressure. Thereafter, increase pressure in steps of approximately one-tenth of specified test pressure until required test pressure is reached.
   4. Maintain pneumatic test pressure continuously for minimum of 10 minutes and for such additional time as necessary to conduct soap bubble examination for leakage.
   5. Correct visible leakage and retest as specified.

D. Allowable Leakage: Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of leakage.

E. After testing and final cleaning, purge with nitrogen those lines that will carry flammable gases to assure no explosive mixtures will be present in system during filling process.

3.04 HYDROSTATIC TEST FOR GRAVITY PIPING

A. Testing Equipment Accuracy: Plus or minus 1/2-gallon water leakage under specified conditions.

B. Maximum Allowable Leakage: 0.16 gallon per hour per inch diameter per 100 feet. Include service connection footage in test section, subjected to minimum head specified.

C. Gravity Sanitary and Roof Drain Piping: Test with 15 feet of water to include highest horizontal vent in filled piping. Where vertical drain and vent systems exceed 15 feet in height, test systems in 15-foot vertical sections as piping is installed.

D. Raw Sewage Piping: Test pipe between hydraulic holding structures by filling the adjoining structures to the maximum normal operating water surface.

E. Exfiltration Test:
   1. Hydrostatic Head:
      a. At least 6 feet above maximum estimated groundwater level in section being tested.
      b. No less than 6 feet above inside top of highest section of pipe in test section, including service connections.
   2. Length of Pipe Tested: Limit length such that pressure on invert of lower end of section does not exceed 30 feet of water column.

F. Infiltration Test:
   1. Groundwater Level: At least 6 feet above inside top of highest section of pipe in test section, including service connections.

G. Piping with groundwater infiltration rate greater than allowable leakage rate for exfiltration will be considered defective even if pipe previously passed a pressure test.

H. Defective Piping Sections: Test and seal individual joints, and retest as specified.

3.05 FIELD QUALITY CONTROL

A. Test Report Documentation:
   1. Test date.
   2. Description and identification of piping tested.
   3. Test fluid.
   4. Test pressure.

5. Remarks, including:
   a. Leaks (type, location).
   b. Repair/replacement performed to remedy excessive leakage.
6. Signed by Design-Builder to represent that test has been satisfactorily completed.

END OF SECTION

SECTION 40 80 02
PHYSICAL HYDRAULIC MODELING STANDARDS AND REQUIREMENTS

PART 1 GENERAL

1.01 REFERENCES

A. The following references are used in developing this section:
   1. American National Standards Institute (ANSI) Hydraulic Institute (HI) Standards, lastest editions.
   2. Hydraulic Modeling Concepts and Practice, ASCE Manual and Reports on Engineering Practice No. 97

1.02 SUMMARY

A. Physical modeling of hydraulic structures shall include the following:
   1. Initial model proposal and approval
   2. Creation of physical model geometry
   3. A series of tests, observations, data collection and alternatives evaluation.
   4. Comparison to acceptance criteria
   5. Presentation and reporting of relevant information
   6. Witness testing to demonstrate physical model performance and results to appropriate stakeholders

B. Acceptance Criteria for Physical Hydraulic Models for Pump Stations - The physical model of a pump station shall be evaluated based on the following criteria as defined in HI Standards, Section 9.8:
   1. Free surface and sub-surface vortices.
   2. Swirl angle at pump intakes.
   3. Uniform distribution of velocity at pump intakes.

C. General – Each hydraulic structure can have a variety of different operational needs and requirements. Because of this, it is not possible to list specific physical hydraulic model requirements for all hydraulic structures. Therefore, prior approval is required for physical hydraulic model methods as described below in Section 3.1.

1.03 SUBMITTALS

A. The testing laboratory shall produce and submit the following for review by the Engineer:
   1. Technical Report
      a. The technical report shall clearly explain how each of the items listed below in Part 2 – Products and Part 3 – Execution are implemented.
      b. The report shall include dimensioned drawings of the constructed model in model and prototype scale.

c. The report shall describe the general conditions and configurations for the model runs, including flow rate, pressures, water surface levels and any other relevant criteria.

d. The boundary conditions applied at the fluid domain inlet/outlets shall be stated explicitly.

e. Comparative calculations such as 1D engineering correlations will be included to show the general accuracy of the model as well as to provide a check on boundary conditions and assumptions.

f. Results shall be presented to clearly show key flow features using photographs and video of the observations and other suitable means.

g. A section shall be included summarizing conclusions from the analysis.

h. A set of recommendations shall be presented based on the conclusions.

2. Results files

a. CAD geometry files shall be submitted where appropriate.

b. Results data shall be made available in digital format upon request.

PART 2 PRODUCTS

2.01 COMPUTER AIDED DESIGN/ENGINEERING (CAD/CAE) SOFTWARE

A. A variety of CAD/CAE software packages exist and are acceptable for generating geometric models. The CAD program shall be able to export to multiplatform formats such as Parasolid or IGES.

2.02 MATERIALS

A. Materials shall be selected that allow for construction of all model geometries while maintaining the selected model scale throughout the flow domain.

B. Selected materials shall be adequate to provide required structural strength and integrity throughout the duration of the testing.

C. Selected materials and construction methods shall provide visual observation of the flow patterns at critical locations.

PART 3 EXECUTION

3.01 INITIAL MODEL PROPOSAL

A. Prior to construction of the model, a description of the following items shall be submitted in a model proposal.

1. Scope of modeling
2. Model layout and geometry details in both model and prototype scale

3. Construction materials highlighting flow visualization areas and how model modifications can be easily incorporated to address potential flow characteristic problems
4. Boundary controls and approach flow conditioning to ensure the flow boundary does not inappropriately impact the flow patterns.
5. Model scale selection and how modeling scale effects will be addressed
    a. For physical hydraulic models of pump stations, the scale of the model will be selected using appropriate dimensionless analysis of the Froude, Reynolds and Weber numbers. The model will conform to similitude criteria in the HI Standards section 9.8.4.3. The scale will conform such that key dimensions in the model are an exact representation of the prototype. Typically the exact scale will be set by the available model pipe size for the pump intake. Approximations of the intake pipe size to the nearest available size are not acceptable when such approximations do not maintain the selected scale throughout the model.
6. Flow visualization and recording methods with anticipated accuracy
7. Instrumentation and data acquisition
    a. For physical hydraulic models of pump stations, the model instrumentation and measuring techniques will conform to the criteria in the HI Standards section 9.8.
8. Modeling maximum and minimum limits for flow and water level.
9. Model operation and testing program.
    a. For physical hydraulic models of pump stations, the model test plan will conform to the criteria in the HI Standards section 9.8.
10. Acceptance criteria which will be used to determine that the model performs adequately for the desired purpose.

3.02 GEOMETRY

A. The physical hydraulic model shall contain all pertinent structures affecting the flow domain being evaluated, and shall through the entirety of the Raw Sewage Pump Station and upstream to the beginning of the 120 inch pipe leading to the pump station.

3.03 TESTING OF PUMP STATION PHYSICAL HYDRAULIC MODELS

A. Measurements shall be performed as described in HI Standards 9.8. For convenience, some of the required measurements are summarized below. If there are any discrepancies between what is listed below and the HI Standards, the HI Standards take precedence.
    1. The outflow from each pump shall be measured with flow meters. The measurement accuracy shall be within ±2%.
    2. The liquid level shall be measured with an accuracy of ±0.01ft (3mm).
    3. Free surface vortices shall be evaluated with dye, debris or other appropriate visualization technique. The strength of the vortices shall be

identified in accordance with HI standard 9.8.7.5. The vortex testing shall consist of observations at short intervals over a period of at least 15 minutes once steady state conditions are reached.

4. Subsurface vortices shall be identified using dye injection at all locations on the wall and floor around the suction bell. The observations shall be made consistent with the free surface requirements.
5. Visualization of pre-swirl at the pump intake may be useful using appropriate visualization techniques. One useful technique includes small streamers mounted to a circle at a distance one half between the intake and the floor.
6. Swirl at pumps shall be quantitatively measured using a straight impeller mounted in the suction piping 4 diameters downstream from the suction intake. The impeller shall be 0.75 times the diameter from tip to tip and 0.6 times the diameter in length. Swirl angle shall be calculated by counting the number of rotations in 10 to 30 second intervals consecutively over a 10 minute period. The angle is expressed using the equation: $\theta = \tan^{-1}(\pi dn/u)$, where u is the average axial velocity, d is the diameter of the pipe and n is the number of revolutions per second.
7. Velocity distribution shall be measured across the throat of the intake using a pitot-static tube or comparable instrument with an accuracy of ±2%. The instrument shall not introduce interference or damping to the velocity magnitude or fluctuations.
8. Angularity of the velocity distribution shall be evaluated using dye or strings to ensure no large deviations from axial flow.

B. Initial runs shall be used to identify any hydraulic problems. Modifications, if necessary, shall be made to address the problems. Proposed modifications shall be reviewed with the Engineer prior to construction and proceeding with the test plan.

C. For intakes with free surfaces, a final run shall be performed at 1.5 times the maximum Froude scaled flow rate. This is a worst case scenario run to test for scale effects on free surface vortices in the model. The proposed method to manage the number of pumps operating and the total flow for this test shall be reviewed with the Engineer for acceptance.

D. The test plan shall include maximum, average and minimum liquid levels within the pump station being modeled. Selected pump operation scenarios which bracket the flow possibilities of all possible pump operation combinations, shall be included for the final pump configuration. The required measurements shall be made for all tests. Photographic and videographic evidence shall be obtained for critical and typical tests.

3.04 ACCEPTANCE CRITERIA OF PUMP STATION PHYSICAL HYDRAULIC MODELS

A. Acceptance criteria shall be as described in HI Standards 9.8. For convenience, the acceptance criteria are summarized below. If there are any discrepancies

between what is listed below and the HI Standards, the HI Standards take precedence.

1. Free surface vortices shall be less severe than Type 3 based on HI Standards definition. Sub surface vortices shall be less severe than Type 2. Infrequent dye core vortices may be acceptable.
2. Swirl angles shall be less than 5 degrees. Transient swirl peaks of up to 7 degrees may be acceptable if they are infrequent.
3. Time averaged velocity distribution at the throat of the intake shall be less than 10% of the average velocity. The standard deviation of time variation shall be less than 10%.

3.05 TESTING OF GENERAL PHYSICAL HYDRAULIC MODELS

A. Testing shall be performed in accordance with the accepted model proposal.

B. Initial runs shall be used to identify any hydraulic problems. Modifications, if necessary, shall be made to address the problems. Proposed modifications shall be reviewed with the Engineer prior to construction and proceeding with the test plan.

C. The test plan shall include scenarios that bracket the maximum, average and drawdown operating conditions for the pump station, including identifying pump running combinations representing the worst case hydraulic condition. The required measurements shall be made for all tests. Photographic and videographic evidence shall be obtained for critical and typical tests.

3.06 ACCEPTANCE CRITERIA OF GENERAL PHYSICAL HYDRAULIC MODELS

A. Acceptance criteria will be as presented in the approved model proposal described above in Section 3.1. Model modifications will be implemented until the acceptance criteria are met.

PART 4 PHYSICAL MODELING REQUIREMENTS

4.01 RAW SEWAGE PUMP STATION

A. The Raw Sewage Pump Station 3 (RSPS3) will be modeled consistent with the Physical Hydraulic Modeling Standards and Requirements in this document.

B. It is desired that the physical hydraulic model provide insights regarding potential for swirl, vortex formation, uneven flow into each pump bell,.

END OF SECTION

SECTION 40 90 00
INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Process Control Integration (PCI) work is to be performed by Jacobs in conjunction with a PCI subcontractor (PCIS). Major Work items include, but are not limited to, engineering, programming, furnishing, installing, calibrating, adjusting, testing, documenting, starting up, and training.

1. Distributed Control System (DCS) controller cabinet incorporating controllers, media converters, communication modules, redundant power supplies, terminations, protective devices, fiber patch panel and etc. and as described in this section and related subsections.
2. DCS remote I/O cabinets incorporating input-output modules, redundant power supplies, media converters, communication modules, terminations, protective devices, fiber patch panel and etc., and as described in this section and related subsections.
3. Modifications to existing Distributed Control Unit (DCU) cabinets patching fiber-optic cables to complete communication links between DCS remote I/O cabinets, DCS controller cabinets, and DCS.
4. Computer hardware and software and appropriate licensing.
5. Application Software:
    a. Configuration of all DCS components including, but not limited to, workstations, DCS panels, Network panels, and the integration of all Packaged Control Systems into the City of San José (City) Regional Wastewater Facility (RWF) DCS System. Provide all software licenses to support development and runtime operation.
    b. Updating the City DCS Historian and Alarm manager.
    c. Workshops.
    d. Software Testing, startup, and training.
6. Local Area Network (LAN) subsystem linking new DCS components to the City RWF Supervisory Control and Data Acquisition (SCADA) system; including but not limited to, network communication hardware and setup.
7. Drawings, including but not limited to, network drawings, panel drawings, loop wiring diagrams, modifications of existing panel drawings, and other specified hereinafter.
8. Coordination with Package System Suppliers.
9. Complete and thorough testing and documentation of the PCI system. This includes but not limited to all networked and hardwired Input/Output (I/O), interfaces or communication with packaged systems, switch gear, motor control centers, drives, valves, or instrumentation.

B. Field instruments are specified and supplied by Jacobs per Section 40 91 00, Instrumentation Components. Field instruments supplied, certified properly installed, tagged, and calibrated by Jacobs.

C. Reference City RWF Automation Guidelines for additional requirements related to RWF DCS hardware and software programming including: processors, Input/Output (IO) modules, switches, communications, display and data format, display, and pop-up colors and controls, display navigation, tag point numbering and descriptions, and DCS and Programmable Logic Controllers (PLCs) functionality. RWF Automation Guidelines will be provided as part of the Project Bid Process. In the event of a contradiction between items in this Section and the RWF Automation Guidelines, the RWF Automation Guidelines take precedence.

D. Provide separate, bid line deductive item costs for application software programming as listed in Bid Document's Schedule of Quantities.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section and other related sections:
   1. American National Standards Institute (ANSI).
   2. ASTM International (ASTM):
      a. A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
      b. A276, Standard Specification for Stainless Steel Bars and Shapes.
      c. A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
      d. B32, Standard Specification for Solder Metal.
      e. B88, Standard Specification for Seamless Copper Water Tube.
   3. City of San José RWF Automation Guidelines.
   4. City of San José RWF Standard Operating Procedure (SOP) AM100, RWF Asset Tagging Convention.
   5. Deutsche Industrie-Norm (DIN): VDE 0611, Specification for modular terminal blocks for connection of copper conductors up to 1,000V ac and up to 1,200V dc.
   6. Institute of Electrical and Electronics Engineers, Inc. (IEEE): C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
   7. The Instrument, Systems, and Automation Society (ISA):
      a. RP12.06.01, Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation Part 1: Intrinsic Safety.
      b. S5.1, Instrumentation Symbols and Identification.
      c. S5.4, Instrument Loop Diagrams.

d. S50.1, Compatibility of Analog Signals for Electronic Industrial Process Instruments.
e. TR20.00.01, Specification Forms for Process Measurement and Control Instruments, Part 1: General.

8. International Conference on Energy Conversion and Application (ICECA).
9. International Electrotechnical Commission (IEC): 61131-3 International standard for PLC Programming Languages.
10. National Computer Aided Design (CAD) Standards.
11. National Electrical Code (NEC):
    a. Article 250 Grounding.
    b. Article 500 Electrical Area Classifications.
12. National Electrical Manufacturers Association (NEMA):
    a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
    b. ICS 1, Industrial Control and Systems General Requirements.
13. National Institute of Standards and Technology (NIST) Guide to Industrial Control System (ICS) Security 800-82 Rev 2 – May 2015.
14. National Fire Protection Association (NFPA): 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
15. UL:
    a. 486E, Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.
    b. 508A, Standard for Safety, Industrial Control Panels.
    c. 698A Industrial Control Panel Relating to Hazardous (Classified) Locations.
    d. 1059, Standard for Terminal Blocks.

1.03 RELATED SECTIONS

A. The following are subsections to this Specification:
    1. Section 40 91 00, Instrumentation Components.
        a. Instrument List.
        b. Instrument Data Sheets.
    2. Section 40 91 01, Control Strategies.
    3. Section 40 96 00, Applications Software.

1.04 DEFINITIONS

A. Abbreviations:
    1. DCU: Distributed control unit.
    2. DCS: Distributed control system.
    3. FAT: Factory acceptance test.
    4. HMI: Human-machine interface.
    5. HVAC: Heating, ventilating, and air conditioning.

6. I&C: Instrumentation and control.
7. I/O: Input and output.
8. ISA: International Society of Automation.
9. LAN: Local Area Network.
10. LED: Light Emitting Diode.
11. O&M: Operation and maintenance.
12. P&ID: Piping and instrument diagram.
13. PC: Personal computer.
14. PCI: Process Control Integration.
15. PCIS: Process Control Integration Subcontractor.
16. PLC: Programmable logic controller.
17. OIT: Operator interface terminal.
18. OIU: Operator interface unit.
19. SCADA: Supervisory Control And Data Acquisition.
20. RIO: Remote input-output.
21. RWF: San José/Santa Clara Regional Wastewater Facility.
22. UL: Underwriters Laboratories.

B. Enclosure: Control panel, console, cabinet, or instrument housing.

C. Instructor Day: Eight hours of actual instruction time.

D. Software:
   1. Programming of digital devices using all types of programming language.
   2. Configuring of digital devices using all types of configuring process.
   3. Programs or configuration data stored in read only memory, programmable read only memory, read/write memory, disk, tape, or other storage device.
   4. Types of Software:
      a. Standard Software: Software packages that are independent of project on which they are used. Standard software includes system software and process monitoring and control software.
         1) System Software: Application independent software developed by Microsoft. Includes, but is not limited to, Microsoft's NT operating system; file management utilities; text editors; debugging aids; and diagnostics.
         2) Process Monitoring and Control Software (PMCS): Software packages independent of specific process control project on which they are used. Includes, but is not limited to, providing capability for, data acquisition, monitoring, alarming, man-machine interface, data collection, data retrieval, trending, report generation, control, and diagnostics.

b. Application Software:
   1) Software to provide functions unique to this Project and that are not provided by standard software alone.
   2) Configuring databases, tables, displays, reports, parameter lists ladder logic, and control strategies required to implement functions unique to this Project.
   3) DCS Function Block Programming.

E. Rising/Falling: Define action of discrete devices about their setpoint.
   1. Rising: Contacts close when an increasing process variable rises through setpoint.
   2. Falling: Contacts close when a decreasing process variable falls through setpoint.

F. Signal Types:
   1. Analog Signal, Current Type:
      a. 4 mA dc to 20 mA dc signals conforming to ISA S50.1.
      b. HART capable.
      c. Use the following ISA S50.1 options.
         1) Transmitter Type: Number 2, two-wire.
         2) Transmitter Load Resistance Capacity: Class L.
         3) Fully isolated transmitters and receivers.
   2. Analog Signal, Voltage Type: 1V dc to 5V dc within panel where common high precision dropping resistor is used.
   3. Discrete signals, two-state logic signals using dc or 120V ac sources as indicated.
   4. Pulse Frequency Signals:
      a. Direct-current pulses whose repetition rate is linearly proportional to process variable.
      b. Pulses generated by contact closures or solid state switches.
      c. Power source less than 30V dc.
   5. Special Signals: Other types of signals used to transmit analog and digital information between field elements, transmitters, receivers, controllers, and digital devices.
   6. Provide 25 percent spare I/O of each signal type, or a minimum of 2 points, whichever is greater.

1.05 SYSTEM DESCRIPTION

A. Detailed Wiring Design: Panel wiring diagrams, loop wiring diagrams, and interconnecting wiring diagrams will be provided as part of the Submittals and will be designed to completely show control panel wiring, terminations, wire numbers, interfaces with other systems, hardwired functions, interlocks, and wiring of components to be provided, including terminations at DCS I/O.

B. Design Requirements:
   1. Complete detailed design of PCI components and PCI drawings.
   2. Provide consistent hardware and software functions for PCI. For example, provide functions in control logic, sequence controls, and display layouts in same or similar manner.
   3. PCI design as shown and specified includes: Functional requirements, performance requirements, and component specifications.
   4. Typical drawings for installation details, control panel layouts, control panel schedules, DCS I/O module wiring, panel power, and control diagrams.

C. PCI to perform the following:
   1. Completing detail design.
   2. Submittals.
   3. Equipment, enclosures, and ancillaries.
   4. Verify correctness of final power and signal connections (lugging and connecting).
   5. Starting up.
   6. Testing and coordination of testing.
   7. Training.
   8. Assist City with Functional Test Part 2 as defined in Article Field Quality Control.

D. For Non-PCI Equipment Directly Connected to PCI Equipment:
   1. Coordinate with Jacobs to allow required interface and operation with PCI.
   2. For operation and control, verify installations, interfacing signal terminations, and adjustments have been completed in accordance with manufacturer's recommendations.
   3. Test to demonstrate required interface and operation with PCI.
   4. Examples of items in this category, but not limited to the following:
      a. Valve operators, position switches, and controls.
      b. Field Instruments.
      c. Chemical feed pump and feeder speed/stroke controls.
      d. Automatic samplers.
      e. Motor control centers.
      f. Adjustable speed and adjustable frequency drive systems.
      g. Process Instrumentation.
   5. Examples of items not in this category:
      a. Internal portions of equipment provided under Division 26, Electrical, that are not directly connected to PCI equipment.
      b. Internal portions of package system instrumentation and controls that are not directly connected to PCI equipment.

E. Structural Design:
   1. Design connections and related details for structural design criteria as specified in Section 01 88 15, Anchorage and Bracing.
   2. Provide calculations for:
      a. Determination of weight including panel internal components.
      b. Determination of seismic forces and overturning moments.
      c. Determination of shear and tension forces in connections.
      d. Design of connection details based on calculated shear and tension forces.
   3. Equipment Units Weighing 50 pounds or More: Provide with lifting lugs or eyes to allow removal with hoist or other lifting device.

1.06 SUBMITTALS

A. General:
   1. Partial Submittals not in accordance with Project Schedule will not be accepted.
   2. Submit all documents in accordance with Section 01 33 00, Submittal Procedures.
   3. Identify proposed items, options, installed spares, and other provisions for future work (for example, reserved panel space; unused components, wiring, and terminals).
   4. Legends and Abbreviation Lists:
      a. Definition of symbols and abbreviations used; for example, engineering units, flowstreams, instruments, structures, and other process items used in nameplates, legends, data sheets, point descriptions, HMI displays, alarm/status logs, and reports.
      b. Submit updated versions as they occur.
   5. Activity Completion:
      a. Action Submittals: Completed when reviewed and approved.
      b. Informational Submittals: Completed when reviewed and found to meet conditions of the Contract.

B. Action Submittals:
   1. Manufacturer's Instructions:
      a. Handling, Storage, and Installation Instructions:
         1) Submittal Objective(s): Provide basic instruction regarding handling, storage, and installation of provided equipment, accessories, and parts.
         2) Provide for each of the following:
            a) All equipment, accessories, and parts provided.
            b) All spare parts and supplies provided.

3) Special Submittal Instruction(s):
   a) Submit in PDF file format.
   b) Include with Catalog Data.

2. Product Data:
   a. Bill of Materials: List of required equipment.
      1) Submittal Objective: Provide itemized list of all equipment, accessories, and parts provided.
      2) Provide for each of the following:
         a) All equipment, accessories, and parts provided.
         b) All spare parts and supplies provided.
      3) Special Submittal Instructions:
         a) Submit in PDF and Microsoft Excel file format.
         b) Group equipment by Enclosure and Field.
         c) Group equipment within an Enclosure, as follows:
            (1) PCI Components: By component identification code.
            (2) Other Equipment: By equipment type.
            (3) Include the following data:
               (a) Equipment Tag Number.
               (b) Description.
               (c) Manufacturer, complete model number and all options not defined by model number.
               (d) Quantity supplied.
               (e) Component identification code where applicable.
               (f) For panels, include panel reference number and name plate inscription.
   b. Catalog Cuts:
      1) Submittal Objective(s): Provide basic, descriptive literature about supplied I&C components, network components, electrical devices, and mechanical devices.
      2) Provide for each of the following:
         a) Catalog information marked to identify proposed items and options provided.
         b) Descriptive literature.
         c) External power and signal connections.
         d) Scaled drawings showing exterior dimensions and locations of electrical and mechanical interfaces.
         e) All spare parts and supplies provided.
      3) Special Submittal Instruction(s):
         a) Submit in PDF file format.
         b) Indicate all equipment, accessories, and parts provided.

c) Indicate any available options.

d) Notate with corresponding product specification number.

e) Notate any deviations from specifications.

3. Shop Drawings:

a. Preliminary Panel Elevation Drawings:

1) Submittal Objective(s): Provide panel elevation drawings prior to fabrication.

2) Provide for all panels supplied.

3) Special Submittal Instruction(s):

a) Submit in PDF and AutoCAD file format.

b) Submit prior to Panel Construction Drawings.

c) Scale Drawings: Show dimensions and location of front of panel devices.

d) Panel Legend (Bill of Material): List front of panel devices by tag number. Include nameplate inscriptions, service legends, and annunciator inscriptions.

e) Submit electronic copies of Drawings on 11 inch by 17 inch sheet size.

b. Panel Construction Drawings:

1) Submittal Objective(s): Provide final, as-fabricated Panel Drawings.

2) Provide for all panels supplied.

3) Special Submittal Instruction(s):

a) Submit in PDF and AutoCAD file format.

b) Scale Drawings: Show dimensions and locations of panel-mounted devices, doors, louvers, subpanels, internal and external.

c) Include Panel Legend (Bill of Material): List front of panel devices by tag numbers, nameplate inscriptions, service legends, and annunciator inscriptions.

d) Include Bill of Materials: List devices mounted within panel that are not listed in panel legend. Include tag number, description, manufacturer, and model number.

e) Include Construction Details: NEMA rating, materials, material thickness, structural stiffeners and brackets, lifting lugs, mounting brackets and tabs, door hinges and latches, and welding and other connection callouts and details.

f) Include Construction Notes: Finishes, wire color schemes, wire ratings, wire, terminal block numbering, and labeling scheme.

g) Panel Power Requirements and Heat Dissipation: For control panels tabulate and summarize:
   (1) Required voltages, currents, and phases(s).
   (2) Maximum heat dissipations Btu per hour.
   (3) Calculations.
   (4) Steady State Temperature Calculations: For nonventilated panels, provide heat load calculations showing the panel estimated internal steady state temperature for ambient air temperatures of 80 degrees F.

4) Spares, expendables, and test equipment.

5) Submit electronic copies of Drawings on 11 inch by 17 inch sheet size.

c. Detailed Wiring Diagrams:

1) Submittal Objective(s): Provide detailed wiring diagrams of final, as-fabricated, panels.

2) Provide for all panels supplied.

3) Special Submittal Instruction(s): Submit in PDF and AutoCAD file format.

a) Refer to Drawings for Detailed Wiring Diagrams including:
   (1) Panel Wiring Diagrams for discrete control and power circuits.
   (2) Loop Wiring Diagrams showing individual wiring diagram for each analog or pulse frequency loop.
   (3) Interconnecting Wiring (or Communications and Network) Diagrams showing electrical connections between equipment, consoles, panels, terminal junction boxes, and field-mounted components.

b) Prepare as-built redline markup of detailed wiring diagrams. Show terminal numbers on switch blocks, relays, and internal components.

c) Submit electronic copies of Drawings on 11 inch by 17 inch sheet size.

d. Panel Wiring Diagrams:

1) Submittal Objective(s): Provide diagrams for use in wiring panels, making panel connections, and future panel trouble shooting.

2) Provide for each of the following: All Panels supplied.

3) Special Submittal Instruction(s):

a) Submit in PDF and AutoCAD file format.

b) Cover wiring within a panel including, but not limited to, instrumentation, control, power, and communications, and digital networks.

c) Internal interconnecting wiring diagrams showing terminal strips and all external devices connected to the panel shall be shown in the design submittal for loop and schematic diagrams.

d) Complete schematic and diagrams including terminal block and wire identification numbers and device location symbols consistent with the Contract Documents.

e) Diagram Type:

(1) Ladder diagrams where applicable. Include devices that are mounted in or on the panel that require electrical connections. Show unique rung numbers on left side of each rung.

(2) Schematic drawings for wiring of circuits that cannot be well represented by ladder diagrams.

f) Item Identification: Identify each item with attributes listed.

(1) Wires: Wire number and color. Cable number if part of multi-conductor cable.

(2) Terminals: Location (enclosure number, terminal junction box number, or MCC number), terminal strip number, and terminal block number.

(3) Components:

(a) Tag number, terminal numbers, and location (“FIELD”, enclosure number, or MCC number).

(b) Switching action (open or close on rising or falling process variable), setpoint value and units, and process variable description (for example, Sump Level High).

(c) I/O Points: DCS unit number, I/O tag number, I/O address, terminal numbers, and terminal strip numbers.

(4) Relay Coils:

(a) Tag number and its function.

(b) On right side of run where coil is located, list contact location by ladder number and sheet number. Underline normally closed contacts.

(5) Relay Contacts: Coil tag number, function, and coil location (ladder rung number and sheet number).

(6) Communications and Networks: Network type, address or node identification, port or channel number, and type of connector.

g) Show each circuit individually. No “typical” diagrams or “typical” wire lists will be allowed.

h) Ground wires, surge protectors, and connections.

i) Wire and Cable Names: Show names and wire color corresponding to Circuit and Raceway Schedule for circuits entering and leaving a panel. Refer to Division 26, Electrical.

j) Submit electronic copies of Drawings on 11 inch by 17 inch sheet size.

e. Loop Wiring Diagrams:

1) Submittal Objective(s): Provide individual, end-to-end wiring diagram for each analog and discrete or equipment loop.

2) Provide for each of the following:
   a) All panels supplied.

3) Special Submittal Instruction(s):
   a) Submit in PDF and AutoCAD file format.
   b) Drawing Size: Individual 11 inch by 17 inch sheet for each loop.
   c) Conform to the minimum requirements of ISA S5.4.
   d) Under Paragraph 5.3 of ISA S5.4, include the information listed under Subparagraphs 2 and 6.
   e) Show loop components within a panel and identify each component, component terminals, and panel terminals.
   f) If a loop connects to panels or devices not provided under this section and its subsections, such as control valves, motor control centers, package system panels, variable speed drives, include the following information:
      (1) Show the first component connected to within the panel or device that is not provided under this section and its subsections.
      (2) Identify the component by tag and description.
      (3) Identify panel and component terminal numbers.
   g) Drawing Size: Individual 11 inch by 17 inch sheet for each loop. Submit via electronic.
   h) Divide each loop diagram into areas for panel face, back-of-panel, field and DCS.
   i) One Drawing Per Loop: Show each loop individually. No “typical” loop diagrams will be allowed.
   j) Show:
      (1) Terminal numbers, location of dc power supply, and location of common dropping resistors.
      (2) Switching contacts in analog loops and output contacts of analog devices. Reference specific control diagrams where functions of these contacts are shown.
      (3) Tabular summary on each analog loop diagram:
      (4) Transmitting Instruments: Output capability.
      (5) Circuit and raceway schedule names

f. Communications and Digital Networks Diagrams:
   1) Submittal Objective(s): Provide summary of Communications and Digital Network including connections to DCUs, remote I/O, and fieldbus (for example, Modbus, Profibus, Modbus TCP/IP, etc.).
   2) Provide for each of the following:
      a) All panels supplied.
   3) Special Submittal Instruction(s):
      a) Submit in PDF and AutoCAD file format.
      b) Format: Network schematic diagrams for each different type of network.
      c) Show:
         (1) Interconnected devices, both passive and active.
         (2) Device names and numbers.
         (3) Terminal numbers.
         (4) Communication Media: Type of cable.
         (5) Connection Type: Type of connector.
         (6) Node and device address numbers.
         (7) Wire and cable numbers and colors.
      d) Submit electronic copies of Drawings on 11 inch by 17 inch sheet size.

g. Contract Document Changes:
   1) Submittal Objective(s): Provide documentation to any changes to contract documents including but not limited to Loop Descriptions or I/O List.
   2) Provide for each of the following:
      a) Jacobs maintained Contract Documents.
   3) Special Submittal Instruction(s):
      a) Submit changes in PDF format with highlights.
      b) Submit marked up copies, with changes, at 30-day intervals.

C. Informational Submittals:
   1. Experience and Qualifications:
      a. Submittal Objective(s): Provide record of experience and qualifications for PCI Subcontractor and onsite Jacobs Startup and Testing Team.
      b. Submit qualifications and resumes in PDF file format.
   2. Operation and Maintenance Data:
      a. Submittal Objective(s): Provide all Operation and Maintenance information necessary for the City to run and maintain the system in the future.

b. Provide for each of the following:
   1) For all supplied PCI components.
c. Special Submittal Instructions:
   1) Submit in PDF.
   2) In accordance with Section 01 78 23, Operation and Maintenance Manual, and in addition the following:
      a) Provide sufficient detail to allow operation, removal, installation, adjustment, calibration, maintenance and purchasing replacements for PCI components.
      b) Final versions of Legend and Abbreviation Lists.
      c) Provide the following items as defined under heading Action Submittals:
         (1) Bill of materials.
         (2) Catalog cuts.
         (3) Component data sheets.
         (4) Record Drawings to be completed after construction:
            (a) Detailed wiring diagrams.
            (b) Panel wiring diagrams.
            (c) Loop diagrams.
            (d) Interconnecting wiring diagrams.
            (e) Applications software documentation.
         (5) Manufacturer's O&M manuals for components, electrical devices, and mechanical devices:
            (a) Content for Each O&M Manual:
               (a) Table of Contents.
               (b) Operations procedures.
               (c) Installation requirements and procedures.
               (d) Maintenance requirements and procedures.
               (e) Troubleshooting procedures.
               (f) Calibration procedures.
               (g) Internal schematic and wiring diagrams.
               (h) Component and I/O Module Calibration Sheets from field quality control calibrations.
         (6) Provide PDF file will linked index to all manuals.
         (7) List of spares, expendables, test equipment and tools provided.

(8) List of additional recommended spares, expendables, test equipment, and tools. Include quantities, unit prices, and total costs.

3. Testing Related Submittals:
   a. Refer to Section 01 91 14, Equipment Testing and Facility Startup, for any additional information.
   b. Factory Demonstration Plan:
      1) Submittal Objective(s): Provide overview of factory test procedures and results, prior to and after successful factory testing.
      2) Provide for each of the following:
         a) Factory Demonstration Test.
      3) Special Submittal Instructions:
         a) Submit Procedures, Forms, Checklists, and Results in PDF file format.
         b) Submit Preliminary Test Procedures: Provide outline of proposed tests, forms, and checklists.
         c) Submit Final Test Procedures:
            (1) Provide outline of proposed tests, forms, and checklists.
            (2) Describe simulation and monitoring methods used to demonstrate compliance with capacity and timing requirements.
         d) Submit copy of signed-off test results.
   c. Startup Plan:
      1) Submittal Objective(s): Provide overview of functional test procedures and results, prior to and after successful functional testing.
      2) Provide for each of the following:
         a) All Functional Tests including but not limited to Network testing, panel testing, I/O testing, software testing.
         b) Performance Tests including but not limited to Network testing, panel testing, I/O testing, software testing.
      3) Special Submittal Instructions:
         a) Submit Procedures, Forms, Checklists, and Results in PDF file format.
         b) Submit Preliminary Test Procedures: Provide outline of proposed tests, forms, and checklists.
         c) Submit Final Test Procedures
            (1) Provide outline of proposed tests, forms, and checklists.
            (2) Describe simulation and monitoring methods used to demonstrate compliance with capacity and timing requirements.

4) Submit copy of signed-off test results.

1.07 QUALITY ASSURANCE

A. Qualifications:
   1. PCI Subcontractor: Minimum of 5 years' experience providing, integrating, installing, and starting up similar systems as required for this Project.
   2. PCI Subcontractor's Site Representative: Minimum of 5 years' experience installing systems similar to PCI required for this Project.

B. PCI Coordination Meetings:
   1. General: Refer to Section 01 31 19, Project Meetings, for PCI coordination meetings.
   2. PCI Schedule Coordination Meeting:
      a. Timing: Following Jacobs review of PCI Schedule.
      b. Purpose: Discuss Jacobs comments and resolve scheduling issues.
   3. Training Coordination Meeting:
      a. Timing: Following Jacobs review of preliminary training plan.
      b. Purpose:
         1) Resolve required changes to proposed training plan.
         2) Identify specific City personnel to attend training.

1.08 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01 61 00, Common Product Requirements.

B. Prior to shipment, include corrosive inhibitive vapor capsules in shipping containers, and related equipment as recommended by capsule manufacturer.

C. Prior to installation, store items in dry indoor locations. Provide heating in storage areas for items subject to corrosion under damp conditions.

D. Cover panels and other elements that are exposed to dusty construction environments.

1.09 SEQUENCING AND SCHEDULING

A. Refer to Section 01 31 19, Project Meetings, for Jacobs scheduling requirements.

B. Prerequisite Activities and Lead Times: Do not start following key Project activities until prerequisite activities and lead times listed below have been completed and satisfied:
   1. Shop Drawing reviews by Jacobs:
      a. Prerequisite: Jacobs Engineer's acceptance of Schedule of Values and Progress Schedule.

b. Schedule: In accordance with completed schedule of Shop Drawing and Sample submittals specified in Section 01 33 00, Submittal Procedures.

2. Test Prerequisite: Associated test procedures Submittals completed.
3. Training Prerequisite: Associated training plan Submittal completed.
4. Functional Test Part 1 Prerequisite: Associated test procedures submittals completed. DCS and HMI installation complete.
5. Functional Test Part 2 Prerequisite: Associated test procedures submittals completed. Functional Test Part 1 completed.
6. Performance Test Prerequisite: Associated test procedures submittals completed. Functional Test Part 2 completed and facility started up.

1.10 EXTRA MATERIALS

A. In computing spare parts quantities based on specified percentages, round up to nearest whole number.

B. Spare Parts: If any of the below hardware is supplied, provide spare parts not associated with the spare capacity built into the panel.

Description	Percent of Each Type and Size Used	No Less Than
Fuses	10	5
Indicating light bulb	5	3
Relays	10	5
Terminal Blocks	10	10

C. Expendables: For following items provide manufacturer's recommended 2 year supply, unless otherwise noted.

1. Chemical for analyzers.
2. Calibration/test gas for combustible gas detection.
3. Spray pump filter adhesive; Hoffman Model A FLTAD. One pint per panel with air filters.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide PCI functions shown on Drawings and required in Control Strategies for each system and loop. Furnish materials, equipment, and software, whether indicated or not, necessary to effect required system and loop performance.

B. First Named Manufacturer: PCI design is based on first named manufacturers of equipment, materials, and software.
   1. If an item is proposed from other than first named manufacturer, obtain approval from Jacobs' Engineer for such changes in accordance with the Contract Documents.
   2. If proposed item requires, but not limited to, different installation, wiring, raceway, enclosures, intrinsically safe barriers, and accessories, provide such equipment and work.

C. Like Equipment Items:
   1. Use products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services.
   2. Implement same or similar functions in same or similar manner. For example, control logic, sequence controls, and display layouts.

2.02 I&C COMPONENTS

A. Field Instrumentation is provided by Jacobs.

B. Components for Each Loop: Furnish equipment that is necessary to achieve required loop performance.

C. Control Panels: Reference Control Panel Schedule in Article Supplements.

2.03 SERVICE CONDITIONS

A. Standard Service Conditions:
   1. The following defines certain types of environments. Design equipment for continuous operation in these environments:
      a. Inside, Conditioned:
         1) Temperature:
            a) Normal: 60 degrees F to 85 degrees F.
            b) With Up to 4-Hour HVAC System Interruptions: 40 degrees F to 105 degrees F.
         2) Relative Humidity:
            a) Normal: 10 percent to 70 percent.
            b) With Up to 4-Hour HVAC System Interruption: 10 percent to 100 percent.
         3) NEC Classification: Nonhazardous.
      b. Inside:
         1) Temperature: 35 degrees F to 110 degrees F.
         2) Relative Humidity: 10 percent to 70 percent.
         3) NEC Classification: Nonhazardous.
      c. Outside:
         1) Temperature: 30 degrees F to 110 degrees F.

2) Relative Humidity: 10 percent to 95 percent.
3) NEC Classification: Nonhazardous.

B. Standard Service Conditions for Panels and Consoles: Refer to Material and Area Classification Table on Contract Drawings for NEMA rating.

C. Special Environmental Requirements: Design panels for continuous operation in environments listed.

2.04 NAMEPLATES AND TAGS

A. Panel Nameplates: Enclosure identification located on enclosure face.
1. Location and Inscription: As shown on Drawings.
2. Materials: Laminated plastic attached to panel with stainless steel screws.
3. Letters: 1/2-inch-high, black on white background with 1/4-inch minimum size lettering.

B. Component Nameplates, Panel Face: Component identification located on panel face under or near component.
1. Location and Inscription: As shown on Panel Drawing.
2. Materials: Adhesive-backed, laminated plastic.
3. Letters: 3/16-inch-high, black on white background, unless otherwise noted.

C. Component Nameplates, Back of Panel: Component identification located on or near component inside of enclosure.
1. Inscription: Component tag number.
2. Materials: Adhesive-backed, laminated plastic.
3. Letters: 3/16-inch-high, black on white background, unless otherwise noted.

D. Legend Plates for Panel Mounted Pushbuttons, Lights, and Switches:
1. Inscription:
a. Refer to table under Paragraph Standard Pushbutton Colors and Inscriptions.
b. Refer to table under Paragraph Standard Light Colors and Inscriptions.
c. Refer to P&IDs on Drawings.
2. Materials: Stainless steel, keyed legend plates. Secured to panel by mounting nut for pushbutton, light, or switch.
3. Letters: Black on gray or white background.

E. Service Legends: Component identification nameplate located on face of component.
1. Inscription: As shown on Panel Drawing.

2. Materials: Adhesive-backed, laminated plastic.
3. Letters: 3/16-inch-high, white on black background, unless otherwise noted.

F. Nametags: Component identification for field devices.
1. Inscription: Component tag number.
2. Materials: 16 gauge, Type 304 stainless steel.
3. Letters: 3/16-inch-high, imposed.
4. Mounting: Affix to component with 16-gauge or 18-gauge stainless steel wire or stainless-steel screws.

2.05 FUNCTIONAL REQUIREMENTS FOR CONTROL LOOPS

A. Shown on Drawings, and Process and Instrumentation Diagrams (P&ID). P&ID format and symbols are in accordance with ISA S5.1, except as specified or shown on Drawings.

B. Supplemented by Control Strategies that describe requirements not obvious on P&IDs.

C. Standard functional requirements in Application Software specification.

2.06 ELECTRICAL REQUIREMENTS

A. Refer to City RWF Automation Guidelines for wire sizing, type, colors, labeling, and termination block requirements. For any other requirements not listed in the City RWF Automation Guidelines use this Section.

B. Electrical Raceways: As specified in Section 26 05 33, Raceway and Boxes.

C. Wiring External to PCI Equipment:
1. Special Control and Communications Cable: Provided by PCI Subcontractor as noted in Component Specifications and PCI subsections.
2. Other Wiring and Cable: As specified in Section 26 05 05, Conductors.

D. I&C and electrical components, terminals, wires, and enclosures UL recognized or UL listed.

E. Wires within Enclosures:
1. ac Circuits:
a. Type: 600 volt, Type MTW stranded copper.
b. Size: For current to be carried, but not less than No. 18 AWG.
2. Analog Signal Circuits:
a. Type: 600 volt stranded copper, twisted shielded pairs or triad with a 100 percent, aluminum-polyester shield, rated 60 degrees C.
b. Panels with Circuits Less Than 600 volts: Rated at 600 volts. Belden No. 18 AWG Type 9341, Triad Beldon No. 1121A.

c. Size: No. 18 AWG, minimum.

3. Other dc Circuits.
   a. Type: 600 volt, Type MTW stranded copper.
   b. Size: For current carried, but not less than No. 18 AWG.
4. Special Signal Circuits: Use manufacturer's standard cables.
5. Wire Identification: Numbered and tagged at each termination.
   a. Wire Tags: Machine printed, heat shrink.

F. Terminate and identify wires entering or leaving enclosures as follows:
   1. Analog and Discrete Signals: Terminate at numbered terminal blocks.
   2. Special signals terminated using manufacturer's standard connectors.
   3. Identify wiring in accordance with requirements in Section 26 05 05, Conductors.

G. Terminal Blocks for Enclosures:
   1. Quantity:
      a. Accommodate present and spare indicated needs.
      b. Wire spare DCS I/O points to terminal blocks.
      c. One wire per terminal for field wires entering enclosures.
      d. Maximum of two wires per terminal for No. 18 AWG wire for internal enclosure wiring.
      e. Spare Terminals: 20 percent of connected terminals, but not less than 5 per terminal block, unless otherwise shown on Drawings.
   2. General:
      a. Terminal blocks shall be UL 486E and UL 1059 capable of termination of control circuits entering or leaving equipment, panels, or boxes.
      b. Group to keep 120V ac circuits separate from 24V dc circuits.
      c. Group cables, and firmly support wiring to the panel.
      d. Provide minimum 8 inches clearance between terminal strips and the base of vertical panels for conduit and wiring space and 2-1/2 inches between wire-ways and terminals.
      e. Individually fuse each control loop or system, and clearly label and locate fuses or circuit breakers for maintenance.
      f. Triple-stacked terminal blocks shall not be used.
      g. Connection Type: Screw connection clamp. Compression clamp not allowed.
      h. Screws: Hardened steel, captive, and self-locking.
      i. Current Bar: Copper or treated brass.
      j. Insulation:
         1) Thermoplastic rated for minus 55 degrees C to plus 110 degrees C.
         2) Two funnel shaped inputs to facilitate wire entry.

k. Mounting:
   1) Rail.
   2) Terminal block can be extracted from an assembly without displacing adjacent blocks.
   3) End Stops: One at each end of rail, minimum.
l. Wire Preparation: Stripping only.
m. Jumpers: Allow jumper installation without loss of space on terminal or rail.
n. Marking System:
   1) Terminal number shown on both sides of terminal block.
   2) Allow use of preprinted and field marked tags.
   3) Terminal strip numbers shown on end stops.
   4) Mark terminal block and terminal strip numbers as shown.

3. Terminal Block:
   a. Rated Voltage: 600V ac/dc.
   b. Rated Current: 30 amp.
   c. Wire Size: 22 AWG through 10 AWG.
   d. Rated Wire Size: 10 AWG.
   e. Color: Gray body.
   f. Spacing: 0.25 inch, maximum.
   g. Allen-Bradley; 1492-W4, “or-equal.”
4. Terminal Block, Ground:
   a. Wire Size: 22 AWG through 12 AWG.
   b. Rated Wire Size: 12 AWG.
   c. Color: Green and yellow body.
   d. Spacing: 0.25 inch, maximum.
   e. Grounding: Ground terminal blocks electrically grounded to the mounting rail.
   f. Allen-Bradley; 1492-WG4, “or-equal.”
5. Terminal Block, Blade Disconnect Switch:
   a. Use: Provide one for each discrete input and output field interface wire.
   b. Rated Voltage: 600V ac.
   c. Rated Current: 10 amp.
   d. Wire Size: 22 AWG through 12 AWG.
   e. Rated Wire Size: 12 AWG.
   f. Color: Gray body, orange switch.
   g. Spacing: 0.25 inch, maximum.
6. Terminal Block, Fused, 24V dc:
   a. Rated Voltage: 600V dc.
   b. Rated Current: 6.3 amp.

c. Wire Size: 22 AWG through 12 AWG.
d. Rated Wire Size: 12 AWG.
e. Color: Gray body.
f. Fuse: 5 by 20 GMA fuses.
g. Fuse Marking: Fuse amperage rating shown on top of terminal block.
h. Indication: LED diode 24V dc.
i. Leakage Current: 5.2 mA, maximum.
j. Spacing: 0.32 inch, maximum.

7. Terminal Block, Fused, 120V ac:
   a. Rated Voltage: 600V ac.
   b. Rated Current: 6.3 amp.
   c. Wire Size: 22 AWG through 12 AWG.
   d. Rated Wire Size: 12 AWG.
   e. Color: Gray body.
   f. Fuse: 5 by 20 GMA fuses.
   g. Fuse Marking: Fuse amperage rating shown on top of terminal block.
   h. Indication: Neon lamp 110V ac.
   i. Leakage Current: 1.8 mA, maximum.
   j. Spacing: 0.32 inch, maximum.

H. Grounding of Enclosures:
   1. Furnish isolated copper grounding bus for signal and shield ground connections.
   2. Ground this ground bus at a common signal ground point in accordance with National Electrical Code requirements.
   3. Single Point Ground for Each Analog Loop:
      a. Locate signal ground at dc power supply for loop.
      b. Use to ground wire shields for loop.
      c. Group and ground wire shields on local control panel ground bus.
   4. Ground terminal block rails to ground bus.

I. Relays:
   1. General:
      a. Relay Mounting: Plug-in type socket.
      b. Relay Enclosure: Provide dust cover.
      c. Socket Type: Screw terminal interface with wiring.
      d. Socket Mounting: Rail.
      e. Furnish holddown clips.
   2. Control Circuit Switching Relay, Nonlatching:
      a. Type: Compact general purpose plug-in.
      b. Contact Arrangement: Two Form C contacts.

c. Contact Rating: 5A at 28V dc or 240V ac.
d. Indication Type: LED indicator lamp.
e. Push-to-test button.

3. Control Circuit Switching Relay, Latching:
   a. Type: Dual coil mechanical latching relay.
   b. Contact Arrangement: 2 Form C contacts.
   c. Contact Rating: 10A at 28V dc or 120V ac.
   d. Contact Material: Silver cadmium oxide alloy.
   e. Coil Voltage: As noted or shown.
   f. Coil Power: 2.7 watts (dc), 5.3VA (ac).
   g. Expected Mechanical Life: 500,000 operations.
   h. Expected Electrical Life at Rated Load: 50,000 operations.
4. Control Circuit Switching Relay, Time Delay:
   a. Type: Adjustable time delay relay.
   b. Contact Arrangement: 2 Form C contacts.
   c. Contact Rating: 10A at 240V ac.
   d. Contact Material: Silver cadmium oxide alloy.
   e. Coil Voltage: As specified or shown.
   f. Operating Temperature: Minus 10 degrees C to 55 degrees C.
   g. Repeatability: Plus or minus 2 percent.
   h. Delay Time Range: Select range such that time delay setpoint fall between 20 percent to 80 percent or range.
   i. Time Delay Setpoint: As specified or shown.
   j. Mode of Operation: As specified or shown.
   k. Adjustment Type: Integral potentiometer with knob external to dust cover.

J. Analog Signal Isolators: Furnish signal isolation for analog signals that are sent from one enclosure to another.

K. Intrinsic Safety System Installation:
1. Comply with NEC Article 504, Intrinsically Safe Systems.
2. Install intrinsically safe circuits in a separate wire way that:
   a. Is separated from nonintrinsically safe circuits as specified by NEC.
   b. Is colored light blue and has message “Intrinsically Safe Circuits Only” on raceway cover every 6 inches.

L. Wiring Interface: Terminate and identify wiring entering or leaving enclosures.
1. Analog and Discrete Signal Wires: Terminate at numbered terminal blocks as shown on the wiring diagrams.
2. Wiring for Special Signals: Terminate communications, digital data, and multiplexed signals using manufacturer’s standard connectors for the device to which the signals terminate.

M. Electrical Transient Protection:

1. General:
    a. Function: Protect elements of PCI against damage due to electrical transients induced in interconnecting lines by lightning and nearby electrical systems.
    b. Surge suppressors are not shown for external analog transmitters. Determine quantity and location, and show on Shop Drawings.
    c. Provide, install, coordinate, and inspect grounding of surge suppressors at:
        1) Connection of ac power to PCI equipment including panels, consoles assembles, and field-mounted analog transmitters and receivers.
        2) At the field and panel, console, or assembly connection of signal circuits that have portions of the circuit extending outside of a protective building.
2. Installation and Grounding of Suppressors: Grounding equipment, installation of grounding equipment, and terminations for field mounted devices are provided under Division 26, Electrical.
3. Surge Protection Device for Power Entrances: Nominal 120V ac with a nominal clamping voltage of 200 volts; nonfaulting and non-interrupting design with a response time of not more than 5 nanoseconds.

N. Power Supplies:

1. Furnish as required to power instruments requiring external dc power, including two-wire transmitters and dc relays. Provide redundant power supplies.
2. Provide status outputs on either power supply or redundancy manager.
3. Provide a large enough power supply to have a minimum of 50 percent spare capacity at Substantial Completion of Project.
4. Convert 120V ac, 60 Hz power to dc power of appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances.
5. Provide output over voltage and over current protective devices to:
    a. Protect instruments from damage due to power supply failure.
    b. Protect power supply from damage due to external failure.
6. Enclosures: NEMA 1.
7. Mount such that dissipated heat does not adversely affect other components.
8. Fuses: For each dc supply line to each individual two-wire transmitter.
    a. Type: Indicating.
9. Mount so fuses can be easily seen and replaced.

O. Panel Enclosure Internal Wiring:

1. Provide one duplex, 20A, grounded GFI receptacle for service and maintenance tools within the panel at spacing's not greater than 48 inches throughout the length of a panel.
2. Provide lighting, receptacle and air conditioning unit circuit from a separate non-UPS or non-battery-backed power source and fuse separately.
3. Restrain by plastic ties or ducts or metal raceways.
4. Hinge Wiring: Secure at each end so bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve.
5. Arrange wiring neatly, cut to proper length, and remove surplus wire.
6. Provide abrasion protection for wire bundles that pass through holes or across edges of sheet metal.
7. Connections to Screw Type Terminals:
    a. Locking-fork-tongue or ring-tongue lugs.
    b. Use manufacturer's recommended tool with required sized anvil to make crimp lug terminations.
    c. Wires terminated in a crimp lug, maximum of one.
    d. Lugs installed on a screw terminal, maximum of two.
8. Splicing and tapping of wires, allowed only at device terminals or terminal blocks.
9. Terminate 24V dc and analog signal circuits on separate terminal blocks from ac circuit terminal blocks.
10. Separate analog and dc circuits by at least 6 inches from ac power and control wiring, except at unavoidable crossover points and at device terminations.
11. Arrange wiring to allow access for testing, removal, and maintenance of circuits and components.
12. Plastic Wire Duct Fill: Do not exceed manufacturer's recommendations.
13. Conductors Carrying Foreign Voltages within a Panel:
    a. Route foreign voltage conductors into panel and land on a circuit blade disconnect type terminal block.
    b. Use wire with pink insulation to identify foreign voltage circuits within panel from terminal block on. Do not use wires with pink insulation for any other purpose.
14. Interconnecting wiring and wiring to terminals for external connection shall be MTW 16 AWG, stranded copper wire, insulated for not less than 600 volts, with a moisture-resistant and flame-retardant covering rated for not less than 90 degrees C except for electronic circuits and special instrument interconnect wiring which shall be in accordance with manufacturer requirements.

15. Wiring Sizes:

Type	Size (Minimum)
120VAC Control Panels	16 AWG
DC Analog Signal (TSP)	18 AWG
DC Power	16 AWG
Ground	16 AWG
Neutral	16 AWG

16. Wire Colors:

Control Conductor	120V
Power (AC)	Black
Control (AC)	Red
Neutral	White
Neutral (foreign)	White/Yellow Tracer
Power/Switched (AC)	White/Red Tracer
Ground	Green
Foreign Voltage Hot (AC)	Yellow
24V dc Positive	Blue
24V dc Common	White/Blue Tracer

2.07 PANEL MANUFACTURERS

A. For Distributed Control Unit (DCU), use Rittal, "or-equal":

1. Rittal Corporation
   One Rittal Place
   Springfield, OH 45504
   Phone: (937) 399-0500
   Fax: (937) 390-5599
   Toll free: (800) 477-4000
   Website: www.rittal-corp.com.

B. For Local Control Panel (LCP), use one of the following, "or-equal":

1. Rittal Corporation
   One Rittal Place
   Springfield, OH 45504
   Phone: (937) 399-0500
   Fax: (937) 390-5599

Toll free: (800) 477-4000
Website: www.rittal-corp.com

2. Hoffman
2100 Hoffman Way
Anoka, MN 55303
Phone: (763) 421-2240
Fax: (763) 422-2178
Website: www.hoffmanonline.com

2.08 PANEL FABRICATION

A. General:

1. The general fabrication requirements for the instrument and control panels including enclosures and sub-panels shall be as stated in City of San José RWF Automation Guidelines, AG-RWF-005, Equipment and Instrumentation Guidelines.
2. Size panels in accordance with limitations indicated on Drawings. Panel size is the specific requirement of the panel manufacturer.
3. Panel Component Schedule: Refer to Control Panel Schedule in Article Supplements which provides a list by local control panel of major panel-mounted components for each panel. In case of a conflict between this list and Instrument List, Instrument List takes precedence. In case of a conflict between Panel Component Schedule and P&IDs, P&IDs take precedence.
4. Panel Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), state and local codes, and applicable sections of NEMA, ANSI, UL, and ICECA.
5. Refer to Material and Area Classification Table in Contract Drawings for panel construction material and NEMA rating.
6. Fabricate panels, install instruments and wire, and plumb at PCI Subcontractor's facility. No fabrication other than correction of minor defects or minor transit damage permitted onsite.
7. UL Listing Mark shall be provided with all equipment and assemblies. The Listing Mark on a control panel shall cover the enclosure and the components that are installed within the enclosure. The Listing Mark shall provide evidence of third-party certification to the municipal inspection authority and to the City of the panel assemblies and shall show that the equipment and assemblies complies with an acceptable safety standard and fabrication. When a product is not available with a UL agency Listing Mark for the purpose for which it is to serve, the product may be required by the inspection authority, to undergo inspection at the manufacturer's place of assembly.
8. Electrical Work: In accordance with the applicable requirements of Division 26, Electrical.

B. Temperature Control:
   1. Freestanding Panels:
      a. Nonventilated Panels: Size to adequately dissipate heat from equipment mounted inside panel and on panel.
      b. Ventilated Panels:
         1) Furnish with louvers and forced ventilation as required to prevent temperature buildup from equipment mounted inside panel and on panel.
         2) For panels with backs against wall, furnish louvers on top and bottom of panel sides.
         3) For panels without backs against wall, furnish louvers on top and bottom of panel back.
         4) Louver Construction: Stamped sheet metal.
         5) Ventilation Fans:
            a) Furnish where required to provide adequate cooling.
            b) Create positive internal pressure within panel.
            c) Fan Motor Power: 120V ac, 60 Hz, thermostatically controlled.
         6) Air Filters: Washable aluminum, Hoffman Series A FLT.
      c. Refrigerated System: Furnish where heat dissipation cannot be adequately accomplished with natural convection or forced ventilation.
   2. Smaller Panels (that are not freestanding):
      a. Size to adequately dissipate heat from equipment mounted inside panel and on panel face.
      b. Provide fabricated sunshield for panels with fronts in direct sunlight.
   3. Space Heaters:
      a. Thermostatically controlled to maintain internal panel temperatures above dewpoint.
      b. Refer to Control Panel Schedule in Article Supplements.

C. Security:
   1. Use CyberLock® cylinders instead of keyed cylinders in handles for security.
   2. Doors shall have padlock locking provisions.

D. Freestanding Panel Construction:
   1. Minimum Thickness: 10 gauge, unless otherwise noted.
   2. Panel Front:
      a. Fabricated to form a single piece of sheet steel.
      b. No seams or bolt heads visible when viewed from front.
      c. Panel Cutouts: Smoothly finished with rounded edges.

d. Stiffeners: Steel angle or plate stiffeners or both on back of panel face to prevent panel deflection under instrument loading or operation.

3. Internal Framework:
   a. Structural steel for instrument support and panel bracing.
   b. Permit panel lifting without racking or distortion.
   c. Form base of heavy channel iron, with flanges up, and with 1/2-inch holes drilled at 12-inch spacing so that the panel shall be bolted to floor.
4. Lifting rings to allow simple, safe rigging and lifting of panel during installation.
5. Adjacent Panels: Securely bolted together so front faces are parallel.
6. Door:
   a. Full height, fully gasketed access doors.
   b. Latch: Three-point, Southco Type 44.
   c. Handle: “D” ring, foldable type.
   d. Hinges: Full-length, continuous, piano-type, stainless steel hinges with stainless steel pins.
   e. Rear Access: Extend no further than 24 inches beyond panel when opened to 90-degree position.
   f. Panel hardware (door hinges, screw clamps, door handles, latches, hasps, fasteners, etc.) shall be Type 316 stainless steel. Three-point latch hardware shall be provided for doors whenever available, or when the height exceeds 30 inches.

E. Nonfreestanding Panel Construction:
   1. Based on environmental design requirements and referenced in Article Environmental Requirements, provide the following unless otherwise noted in Control Panel Schedule in Article Supplements:
      a. Metal Thickness: 14 gauge, minimum.
      b. Doors:
         1) Rubber-gasketed with continuous hinge.
         2) Stainless steel lockable quick-release clamps.
   2. Manufacturers:
      a. Hoffman Engineering Co.
      b. Rittal.
      c. “Or-equal.”

F. Breather and Drains:
   1. Furnish with NEMA 250, Type 4 and Type 4X Panels:
      a. Manufacturers and Products:
         1) Cooper Crouse-Hinds; ECD Type 4X Drain and Breather; Drain Model ECD1 N4D, Breather Model ECD1 N4B.

2) "Or-equal."

G. Control Panel Electrical:

1. Power Distribution within Panels:

a. Feeder Circuits:

1) Provide one 120V ac, 60 Hz battery backed feeder circuit as the main circuit, and one 120V ac, 60 Hz non-battery backed feeder circuit as a backup circuit.

2) Make provisions for feeder circuit conduit entry.

3) Furnish terminal block for termination of wires.

b. Power Panel: Furnish main circuit breaker and circuit breaker on each individual branch circuit distributed from power panel.

1) Locate to provide clear view of and access to breakers when door is open.

2) Breaker Sizes: Coordinate such that fault in branch circuit will blow only branch breaker, but not trip main breaker.

3) Branch Circuit Breakers: 20 amps at 250V ac.

4) Breaker Manufacturers and Products: Refer to Division 26, Electrical.

c. Circuit Wiring: P&IDs and Control Diagrams on Drawings show function only. Use following rules for actual circuit wiring:

1) Devices on Single Circuit: 20, maximum.

2) Multiple Units Performing Parallel Operations: To prevent failure of any single branch circuit from shutting down entire operation, do not group all units on same branch circuit.

3) Branch Circuit Loading: 12 amperes continuous, maximum.

4) Panel Lighting and Service Outlets: Put on separate 20 amp, 120V ac branch circuit.

5) Provide 120V ac plug mold for panel components with line cords.

2. Signal Distribution:

a. Signal Wiring: Separate analog signal cables from power and control within a panel and cross at right angles where necessary.

b. Within Panels: 4 mA dc to 20 mA dc signals may be distributed as 1V dc to 5V dc.

c. Outside Panels: Isolated 4 mA dc to 20 mA dc only.

d. Signal Wiring: Twisted shielded pairs.

e. RTD and Thermocouple Extension Cable:

1) Continuous field to panel with no intermediate junction boxes or terminations.

2) RTDs in motor windings are considered a 600 volt circuit.

3) Terminate thermocouple extension wire directly to loop instrument.

3. Push-to-Test Circuitry: For each push-to-test indicating light, provide a fused push-to-test circuit.
4. Internal Panel Lights for Freestanding Panels:
   a. Type: Switched LED lights.
   b. Quantity: One light for every 4 feet of panel width.
   c. Mounting: Inside and in the top of back-of-panel area.
   d. Protective metal shield for lights.
5. Service Outlets for Freestanding Panels:
   a. Type: Three-wire, 120 volt, 20 ampere, GFCI duplex receptacles.
   b. Quantity:
      1) Panels 4 Feet Wide and Smaller: One.
      2) Panels Larger than 4 Feet Wide: One for every 4 feet of panel width, two minimum per panel.
   c. Mounting: Evenly spaced along back-of-panel area.
6. Internal Panel Lights and Service Outlets for Smaller Panels:
   a. Internal Panel Light: Switched LED light.
   b. Service Outlet: Breaker protected 120 volt, 20 amp, GFCI duplex receptacle.
   c. Required for panels. Refer to Control Panel Schedule in Article Supplements.
7. Standard Pushbutton Colors and Inscriptions:
   a. Use following unless otherwise noted on Drawings:

Tag Function	Inscription(s)	Color
OO	ON OFF	Black Black
OC	OPEN CLOSE	Black Black
OCA	OPEN CLOSE AUTO	Black Black Black
OOA	ON OFF AUTO	Black Black Black
MA	MANUAL AUTO	Black Black
SS	START STOP	Green Red
RESET	RESET	Black

Tag Function	Inscription(s)	Color
EMERGENCY STOP	EMERGENCY STOP	Red

b. Lettering Color:
   1) Black on white and yellow buttons.
   2) White on black, red, and green buttons.

8. Standard Light Colors and Functions:
   a. Use following color code and functions for lens colors for indicating lights, unless otherwise noted on Drawings:

Color	Typical Function	Example
RED	Running Light	Equipment operating, motor running, valve open, power voltage applied, cycle in automatic
GREEN	Stopped Light	End of cycle; unit or head returned; motors stopped; motion stopped; contactor open, valve closed
WHITE	Ready Light	System ready for operation
AMBER	Fault, Alarm, Fail Light	Equipment failure, trouble, status abnormal

   b. Lettering Color:
      1) Black on white and amber lenses.
      2) White on red and green lenses.

9. Panel Work:
   a. No exposed connections.
   b. Allow adjustments to equipment to be made without exposing these terminals.
   c. For power and control wiring operating above 80V ac or dc use covered channels or EMT raceways separate from low voltage signal circuits.

10. Plastic Wire Ducts Color:
   a. 120V ac: White.
   b. 24V dc: Gray.
   c. Communications Cables and Fiber Optic Jumpers: Orange.

11. Provide a communications plastic wire duct for communications cables and fiber optic cables between the communications devices in control panel and communications raceways. Design plastic wire duct design to take into account the minimum bending radius of the communications cable.

12. Make plastic wire ducts the same depth.
13. Provide a minimum of 1-1/2 inches between plastic wire ducts and terminal blocks.

H. Control Relay Arrangement: Install control relays associated with specific loops in same panel section as corresponding terminal blocks or side panels. Provide 20 percent space for future relays. Locate spare space in same sections as spare terminal blocks.

I. Factory Finishing:
1. Furnish materials and equipment with manufacturer's standard finish system in accordance with Section 09 90 00, Painting and Coating.
2. Use specific color if indicated. Otherwise use manufacturer's standard finish color, or light gray if manufacturer has no standard color.
3. Stainless Steel and Aluminum: Not painted.
4. Nonmetallic Panels: Similar to steel panels.
5. Steel Panels:
a. Sand panel and remove mill scale, rust, grease, and oil.
b. Fill imperfections and sand smooth.
c. Paint panel interior and exterior with one coat of epoxy coating metal primer, two finish coats of two-component type epoxy enamel.
d. Sand surfaces lightly between coats.
e. Dry Film Thickness: 3 mils, minimum.

2.09 AIR CONDITIONING

A. Manufacturers:
1. One of the following, "or-equal:"
a. Rittal.
b. Noren Products.
c. Borg Warner.
d. Hoffman.
e. McLean Midwest.
f. "Or-equal."

B. Provide cabinet coolers or solid-state air conditioning units on panels containing electronic components such as panel instruments, programmable logic controllers remote I/O. Where panel cooling is required to maintain the ratings of the enclosed equipment, forced air fans or air conditioners shall be used. Air-conditioner NEMA rating shall match the enclosure rating it is installed in. Air-conditioners shall be equipped with UL-approved washable filters.

C. Provide internal fans, coolers, or air conditioning units with thermostatic control as necessary for internal air circulation to maintain internal temperature ratings of 90 degrees F or below. Provide filters on intake and exhaust openings.

2.10 INSTRUMENT SUNSHIELDS

A. Sunshield required on outdoor indicating instrument transmitters not facing north and in direct sunlight. Refer to instrument list for required sunshield instruments.

B. Fabricated aluminum shield made of 10 GA aluminum.

C. Fabricated to allow easy removal/reinstallation of transmitter.

2.11 CORROSION PROTECTION

A. Corrosion-Inhibiting Vapor Capsules:
   1. Areas Where Required: Refer to Part 3, Article Protection.
   2. Manufacturers and Products:
      a. Northern Instruments; Model Zerust VC.
      b. Hoffmann Engineering; Model A HCI.
      c. “Or-equal.”

2.12 SOURCE QUALITY CONTROL

A. General:
   1. Jacobs may actively participate in many of the tests.
   2. Jacobs reserves right to test or retest specified functions.
   3. Jacobs decision will be final regarding acceptability and completeness of testing.
   4. Procedures, Forms, and Checklists:
      a. Except for Unwitnessed Factory Test, conduct tests in accordance with, and documented on, Jacobs accepted procedures, forms, and checklists.
      b. Describe each test item to be performed.
      c. Have space after each test item description for sign off by appropriate party after satisfactory completion.
   5. Required Test Documentation: Test procedures, forms, and checklists signed by Jacobs.
   6. Conducting Tests:
      a. Provide special testing materials and equipment.
      b. Wherever possible, perform tests using actual process variables, equipment, and data.
      c. If not practical to test with real process variables, equipment, and data provide suitable means of simulation.
      d. Define simulation techniques in test procedures.
      e. Test Format: Cause and effect.
         1) Person conducting test initiates an input (cause).
         2) Specific test requirement is satisfied if correct result (effect), occurs.

f. For PCI systems for which Jacobs provides applications software, provide sufficient temporary software configuring to allow FAT and SSDT testing of these subsystems.

B. Unwitnessed Factory Test:
1. Scope: Inspect and test PCI to ensure it is operational, ready for FAT.
2. Location: PCI Subcontractor's facility.
3. Integrated Test:
a. Interconnect and test PCI, except for primary elements and smaller panels.
b. Exercise and test functions.
c. Provide stand-alone testing of smaller panels.
d. Simulate inputs and outputs for primary elements, final control elements, and panels excluded from test.

C. Factory Acceptance Tests (FAT):
1. Notify Jacobs of test schedule 4 weeks prior to start of test.
2. Scope:
a. Test entire PCI, with exception of primary elements, final control elements, and certain smaller panels, to demonstrate it is operational.
b. Refer to Control Panel Schedule in Article Supplements for list of panels for which FAT is required.
3. Location: PCI Subcontractor's facility.
4. Correctness of wiring from panel field terminals to DCS system input/output points and to panel components.
a. Simulate each discrete signal at terminal strip.
b. Simulate correctness of each analog signal using current source.
5. Operation of communications between DCS and remote I/O and between DCS and computers.
6. Loop-Specific Functions: Demonstrate functions shown on P&IDs, control diagrams, and loop specifications:
a. One of each type of function; for example, if there are filter backwash sequence control for several identical filters, demonstrate controls for one filter.
b. One of each type of function in each panel; for example, but not limited to annunciator operation, controller operation, and recorder operation.
c. All required and shown functions for 100 percent of loops.
7. Nonloop-Specific Functions:
a. Capacity: Demonstrate that PCI systems have required spare capacity for expansion. Include tests for both storage capacity and processing capacity.
b. Timing: Include tests for timing requirements.

c. Diagnostics: Demonstrate online and offline diagnostic tests and procedures.

8. Correct deficiencies found and complete prior to shipment to Site.
9. Failed Tests:
   a. Repeat and witnessed by Jacobs.
   b. With approval of Jacobs, certain tests may be conducted by PCI Subcontractor and witnessed by Jacobs as part of Functional Test.
10. Make following documentation available to Jacobs at test site both before and during FAT:
    a. Drawings, Specifications, Addenda, and Change Orders.
    b. Master copy of FAT procedures.
    c. List of equipment to be tested including make, model, and serial number.
    d. Approved hardware Shop Drawings for equipment being tested.
    e. Approved preliminary software documentation Submittal.
11. Daily Schedule for FAT:
    a. Begin each day with meeting to review day's test schedule.
    b. End each day with each meeting to review day's test results and to review or revise next day's test schedule.

PART 3 EXECUTION

3.01 EXAMINATION

A. For equipment not provided by PCI Subcontractor, but that directly interfaces with PCI, verify the following conditions:
   1. Proper installation.
   2. Calibration and adjustment of positioners and I/P transducers.
   3. Correct control action.
   4. Switch settings and dead bands.
   5. Opening and closing speeds and travel stops.
   6. Input and output signals.

3.02 INSTALLATION

A. Material and Equipment Installation: Follow manufacturers' installation instructions, unless otherwise indicated or directed by Jacobs.

B. Wiring connected to PCI components and assemblies, including power wiring in accordance with requirements in Section 26 05 05, Conductors.

C. Electrical Raceways: As specified in Section 26 05 33, Raceway and Boxes.

D. Field Finishing: Refer to Section 09 90 00, Painting and Coating.

3.03 FIELD QUALITY CONTROL

A. General:
   1. Coordinate PCI testing with City and affected subcontractors.
   2. Notify Jacobs of Performance Test schedule 4 weeks prior to start of test.
   3. Jacobs may actively participate in tests.
   4. Jacobs reserves right to test or retest specified functions.
   5. Jacobs's decision will be final regarding acceptability and completeness of testing.

B. Onsite Supervision:
   1. Require PCI Subcontractor to observe PCI equipment installation to extent required in order to provide Certificates of Proper Installation.
   2. Require PCI Subcontractor's site representative to supervise and coordinate onsite PCI activities.
   3. Require PCI Subcontractor's site representative to be onsite while onsite work covered by this section and PCI subsystems is in progress.

C. Testing Sequence:
   1. Provide Functional Tests and Performance Tests for facilities as required to support staged construction and startup of plant.
   2. Refer to article Sequence of Work under Section 01 31 19, Project Meetings, for a definition of project milestones.
   3. Refer to Section 01 91 14, Equipment Testing and Facility Startup, for overall testing requirements.
   4. Completion: When tests (except Functional Test) have been completed and required test documentation has been accepted.

D. Testing:
   1. Prior to Facility Startup and Performance Evaluation period for each facility, inspect, test, and document that associated PCI equipment is ready for operation. Divide Functional Test for each facility into two parts.
   2. Loop tests shall comply with the documentation provided in the RWF Automation Guidelines, Section AG-RWF-007 Project Execution Guidelines For Automation, Appendix E – System Loop Validation Test Outline and Appendix F – Sample Forms.
   3. Functional Test Part 1: Performed by Jacobs and PCI Subcontractor to test and document PCI is ready for operation.
      a. Loop/Component Inspections and Tests:
         1) These inspections and tests can be spot checked by City.
         2) Check PCI for proper installation, calibration, and adjustment on loop-by-loop and component-by-component basis.
         3) Provide space on forms for signoff by Jacobs and City.
         4) Use loop test sheets provided in Article Supplements.

5) Component calibration sheet for each active I&C component (except simple hand switches, lights, gauges, and similar items) and each DCS I/O module and include the following:
   a) Project name.
   b) Loop number.
   c) Component tag number or I/O module number.
   d) Component code number for I&C elements.
   e) Manufacturer for I&C elements.
   f) Model number/serial number for I&C elements.
   g) Summary of Functional Requirements; for Example:
      (1) Indicators and recorders, scale and chart ranges.
      (2) Transmitters/converters, input and output ranges.
      (3) Computing elements' function.
      (4) Controllers, action (direct/reverse) and control modes (P, I, D).
      (5) Switching elements, unit range, differential (fixed/adjustable), reset (auto/manual).
      (6) I/O Modules: Input or output.
   h) Calibrations, for example, but not limited to:
      (1) Analog Devices: Actual inputs and outputs at 0, 10, 50, and 100 percent of span, rising and falling.
      (2) Discrete Devices: Actual trip points and reset points.
      (3) Controllers: Mode settings (P&ID).
      (4) I/O Modules: Actual inputs or outputs of 0, 10, 50, and 100 percent of span, rising and falling.
      (5) Space for comments.

b. Maintain loop test sheets, valve adjustment sheets, and component calibration sheets at Site, and make them available to City at all times.

c. City reviews loop test sheets and component calibration sheets and spot-check their entries periodically, and upon completion of Preparation for Testing. Correct deficiencies found.

d. FAT-Repeat:
   1) Repeat FAT onsite with installed PCI equipment and software.
   2) As listed in PCI subsections, certain portions of FAT may not require retesting.
   3) Use FAT test procedures as basis for this test.
   4) In general, this test shall not require witnessing. However, portions of this test, as identified by City during original FAT shall be witnessed.

e. Forms: See Loop Test Sheet, Instrument Calibration Sheet, and I&C Valve Adjustment Sheet referenced in Article Supplements.

4. Functional Test Part 2: Combined effort between Jacobs, PCI Subcontractor, and City to confirm PCI, including applications software, is ready for operation.
   a. Prerequisite: Completion of Functional Test Part 1.
   b. Joint test with City using real field sensors and equipment. Plant interlocking and communications with DCS tested on loop-by-loop basis.
   c. Test procedures provided by Jacobs.
   d. Completed when Functional Test has been conducted and City has spot-checked associated test forms and checklists in field.

E. Performance Test During and After Facility Startup:
   1. Once a facility's Functional Test has been completed and that facility has been started up, perform jointly with City. Performance Test on associated PCI equipment to demonstrate that it is operating as required by Contract Documents. Demonstrate each required function on a paragraph-by-paragraph, loop-by-loop, and site-by-site basis.
   2. Perform local and manual tests for each loop before proceeding to REMOTE and AUTOMATIC modes.
   3. Where possible, verify test results using visual confirmation of process equipment and actual process variable. Unless otherwise directed, exercise and observe devices supplied by others, as needed to verify correct signals to and from such devices and to confirm overall system functionality. Test verification by means of disconnecting wires or measuring signal levels is acceptable only where direct operation of plant equipment is not possible.
   4. Make updated versions of documentation required for Performance Test available to City at Site, both before and during tests.
   5. Make O&M data available to City at Site both before and during testing.
   6. Determination of Ready for Operation: When Functional Test has been completed.
   7. Refer to examples of Performance Test procedures and forms in Article Supplements.

3.04 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: As required by each PCI subsection.

B. Specialty Equipment: For certain components or systems provided under this section, but not manufactured by PCI Subcontractor, provide services of qualified manufacturer's representative during installation, startup, demonstration testing, and training.

C. See Section 01 91 14, Equipment Testing and Facility Startup.

3.05 TRAINING

A. General:
   1. Provide an integrated training program for City's personnel.
   2. Perform training to meet specific needs of City's personnel.
   3. Include training sessions, classroom and field, for managers, engineers, operators, and maintenance personnel.
   4. Provide instruction during dayshift as needed to accommodate the City's personnel schedule.
   5. City reserves the right to reuse videotapes of training sessions.

B. Operations Training:
   1. Operations Training: For City's operations personnel on operation of the Application Software.
      a. Training Session Duration: 1 instructor day.
      b. Number of Training Sessions: Two.
      c. Location: Project Site.
      d. Course Objective: Develop skills needed to control the plant on a day-to-day basis.
      e. Content: Conduct training on loop-by-loop basis.
      f. Loop Functions: Understanding of loop functions, including interlocks for each loop.
   2. Loop Operation: For example, adjusting process variable setpoints, AUTO/MANUAL control transfer, AUTO and MANUAL control, annunciator acknowledgement and resetting.
   3. Interfaces with PCI subsystems.

3.06 CLEANING

A. Upon completion of Work, remove materials, scraps, and debris from interior and exterior of equipment.

B. Use corrosion-inhibiting vapor capsules in enclosures to protect electrical, instrumentation, and control devices, including spare parts, from corrosion.

3.07 PROTECTION

A. Periodically replace capsules based on capsule manufacturer's recommendations.

3.08 SUPPLEMENTS

A. Supplements listed below, following "End of Section," are part of this Specification.
   1. DCS Input/Output List.
   2. Control Panel Schedule.

3. Loop Test Sheet.
4. Performance Test Sheet: Describe Performance Test for a given loop.
    a. List requirements of the loop.
    b. Briefly describe test.
    c. Cite expected results.
    d. Provide space for check-off by witness.

END OF SECTION

PANEL	DCU	TAG NO	IO TAG NUMBER	LOOP TITLE	ZERO STATE	ONE STATE	TYPE	P+ID NO	ADDRESS	SLOT	POINT
	13DCU64	11LI9750-01	11LI9750-01_LEVEL	California Structure Level			AI	7701-09-N-030			
	13DCU64	11HSL9751-01	11HSL9751-01_LOCAL	HW3 Influent Gate - California Structure	OFF	LOCAL	DI	7701-09-N-030			
	13DCU64	11HSR9751-01	11HSR9751-01_REMOTE	HW3 Influent Gate - California Structure	OFF	REMOTE	DI	7701-09-N-030			
	13DCU64	11HX9751-01	11HX9751-01_POWER ON	HW3 Influent Gate - California Structure			DI	7701-09-N-030			
	13DCU64	11XA9751-01	11XA9751-01_FAULT	HW3 Influent Gate - California Structure	FAULT	NORMAL	DI	7701-09-N-030			
	13DCU64	11HL9752-01	11HL9752-01_DSC CLOSED	Plant Influent Sampler DSC	OPENED	CLOSED	DI	7701-09-N-030			
	13DCU64	11XA9752-01	11XA9752-01_FAULT	Plant Influent Sampler	FAULT	NORMAL	DI	7701-09-N-030			
	13DCU64	11XL9751-01	11XL9751-01_DSC CLOSED	HW3 Influent Gate - California Structure DSC	OPENED	CLOSED	DI	7701-09-N-030			
	13DCU64	11ZIH9751-01	11ZIH9751-01_OPENED	HW3 Influent Gate - California Structure	NOT OPENED	OPENED	DI	7701-09-N-030			
	13DCU64	11ZIL9751-01	11ZIL9751-01_CLOSED	HW3 Influent Gate - California Structure	NOT CLOSED	CLOSED	DI	7701-09-N-030			
	13DCU64	11HS9751-01C	11HS9751-01C_OPEN	HW3 Influent Gate - California Structure		OPEN	DO	7701-09-N-030			
	13DCU64	11HS9751-01D	11HS9751-01D_CLOSE	HW3 Influent Gate - California Structure		CLOSE	DO	7701-09-N-030			
	13DCU64	11SC9752-01	11SC9752-01_INITIATE	Plant Influent Sampler		INITIATE	DO	7701-09-N-030			
	13DCU64	12FI9708-00	12FI9708-00_FLOW	Recycle Pump Station 1 Flow			AI	7701-09-N-037			
	13DCU64	12LAH9702-00	12LAH9702-00_HIGH	Recycle Pump Station 1 Level	HIGH	NORMAL	AI	7701-09-N-037			
	13DCU64	12LI9702-00	12LI9702-00_LEVEL	Recycle Pump Station 1 Level			AI	7701-09-N-037			
	13DCU64	12PI9706-01	12PI9706-01_PRESSURE	Recycle Pump Station 1 - Pump 1 Pressure			AI	7701-09-N-037			
	13DCU64	12PI9706-02	12PI9706-02_PRESSURE	Recycle Pump Station 1 - Pump 2 Pressure			AI	7701-09-N-037			
	13DCU64	12PI9706-03	12PI9706-03_PRESSURE	Recycle Pump Station 1 - Pump 3 Pressure			AI	7701-09-N-037			
	13DCU64	12PI9706-04	12PI9706-04_PRESSURE	Recycle Pump Station 1 - Pump 4 Pressure			AI	7701-09-N-037			
	13DCU64	12SC9705-01	12SC9705-01_SPEED CONTROL	Recycle Pump Station 1 - Pump 1			AI	7701-09-N-037			
	13DCU64	12SC9705-02	12SC9705-02_SPEED CONTROL	Recycle Pump Station 1 - Pump 2			AI	7701-09-N-037			
	13DCU64	12SC9705-03	12SC9705-03_SPEED CONTROL	Recycle Pump Station 1 - Pump 3			AI	7701-09-N-037			
	13DCU64	12SC9705-04	12SC9705-04_SPEED CONTROL	Recycle Pump Station 1 - Pump 4			AI	7701-09-N-037			
	13DCU64	12SI9705-01	12SI9705-01_SPEED	Recycle Pump Station 1 - Pump 1			AI	7701-09-N-037			
	13DCU64	12SI9705-02	12SI9705-02_SPEED	Recycle Pump Station 1 - Pump 2			AI	7701-09-N-037			
	13DCU64	12SI9705-03	12SI9705-03_SPEED	Recycle Pump Station 1 - Pump 3			AI	7701-09-N-037			
	13DCU64	12SI9705-04	12SI9705-04_SPEED	Recycle Pump Station 1 - Pump 4			AI	7701-09-N-037			
	13DCU64	12HSL9720-00	12HSL9720-00_LOCAL	Headworks 2 Isolation Gate	OFF	LOCAL	DI	7701-09-N-003			
	13DCU64	12HSL9721-00	12HSL9721-00_LOCAL	Santa Clara Forcemain Isolation Gate	OFF	LOCAL	DI	7701-09-N-003			
	13DCU64	12HSR9720-00	12HSR9720-00_REMOTE	Headworks 2 Isolation Gate	OFF	REMOTE	DI	7701-09-N-003			
	13DCU64	12HSR9721-00	12HSR9721-00_REMOTE	Santa Clara Forcemain Isolation Gate	OFF	REMOTE	DI	7701-09-N-003			
	13DCU64	12UA9705-01	12UA9705-01_ESTOP	Recycle Pump Station 1 - Pump 1	E-STOP	NORMAL	DI	7701-09-N-037			
	13DCU64	12UA9705-02	12UA9705-02_ESTOP	Recycle Pump Station 1 - Pump 2	E-STOP	NORMAL	DI	7701-09-N-037			
	13DCU64	12UA9705-03	12UA9705-03_ESTOP	Recycle Pump Station 1 - Pump 3	E-STOP	NORMAL	DI	7701-09-N-037			
	13DCU64	12UA9705-04	12UA9705-04_ESTOP	Recycle Pump Station 1 - Pump 4	E-STOP	NORMAL	DI	7701-09-N-037			
	13DCU64	12XA9720-00	12XA9720-00_FAULT	Headworks 2 Isolation Gate	FAULT	NORMAL	DI	7701-09-N-003			
	13DCU64	12XA9721-00	12XA9721-00_FAULT	Santa Clara Forcemain Isolation Gate	FAULT	NORMAL	DI	7701-09-N-003			
	13DCU64	12XL9705-01B	12XL9705-01B_DSC CLOSED	Recycle Pump Station 1 - Pump 1 DSC	OPENED	CLOSED	DI	7701-09-N-037			
	13DCU64	12XL9705-02B	12XL9705-02B_DSC CLOSED	Recycle Pump Station 1 - Pump 2 DSC	OPENED	CLOSED	DI	7701-09-N-037			
	13DCU64	12XL9705-03B	12XL9705-03B_DSC CLOSED	Recycle Pump Station 1 - Pump 3 DSC	OPENED	CLOSED	DI	7701-09-N-037			
	13DCU64	12XL9705-04B	12XL9705-04B_DSC CLOSED	Recycle Pump Station 1 - Pump 4 DSC	OPENED	CLOSED	DI	7701-09-N-037			
	13DCU64	12XL9708-00	12XL9708-00_DSC CLOSED	Recycle Pump Station 1 Flow DSC	OPENED	CLOSED	DI	7701-09-N-037			
	13DCU64	12XL9720-00A	12XL9720-00A_DSC CLOSED	Headworks 2 Isolation Gate DSC	OPENED	CLOSED	DI	7701-09-N-003			
	13DCU64	12XL9720-00B	12XL9720-00B_POWER ON	Headworks 2 Isolation Gate	OFF	POWERED	DI	7701-09-N-003			
	13DCU64	12XL9721-00A	12XL9721-00A_DSC CLOSED	Santa Clara Forcemain Isolation Gate DSC	OPENED	CLOSED	DI	7701-09-N-003			
	13DCU64	12XL9721-00B	12XL9721-00B_POWER ON	Santa Clara Forcemain Isolation Gate	OFF	POWERED	DI	7701-09-N-003			
	13DCU64	12ZIH9720-00	12ZIH9720-00_OPENED	Headworks 2 Isolation Gate	NOT OPENED	OPENED	DI	7701-09-N-003			
	13DCU64	12ZIH9721-00	12ZIH9721-00_OPENED	Santa Clara Forcemain Isolation Gate	NOT OPENED	OPENED	DI	7701-09-N-003			

	13DCU64	12ZIL9720-00	12ZIL9720-00_CLOSED	Headworks 2 Isolation Gate	NOT CLOSED	CLOSED	DI	7701-09-N-003			
	13DCU64	12ZIL9721-00	12ZIL9721-00_CLOSED	Santa Clara Forcemain Isolation Gate	NOT CLOSED	CLOSED	DI	7701-09-N-003			
	13DCU64	12HS-C19705-01	12HS-C19705-01_START	Recycle Pump Station 1 - Pump 1		START	DO	7701-09-N-037			
	13DCU64	12HS-C19705-02	12HS-C19705-02_START	Recycle Pump Station 1 - Pump 2		START	DO	7701-09-N-037			
	13DCU64	12HS-C19705-03	12HS-C19705-03_START	Recycle Pump Station 1 - Pump 3		START	DO	7701-09-N-037			
	13DCU64	12HS-C19705-04	12HS-C19705-04_START	Recycle Pump Station 1 - Pump 4		START	DO	7701-09-N-037			
	13DCU64	12HS-C19720-00	12HS-C19720-00_OPEN	Headworks 2 Isolation Gate		OPEN	DO	7701-09-N-003			
	13DCU64	12HS-C19721-00	12HS-C19721-00_OPEN	Santa Clara Forcemain Isolation Gate		OPEN	DO	7701-09-N-003			
	13DCU64	12HS-C29705-01	12HS-C29705-01_STOP	Recycle Pump Station 1 - Pump 1		STOP	DO	7701-09-N-037			
	13DCU64	12HS-C29705-02	12HS-C29705-02_STOP	Recycle Pump Station 1 - Pump 2		STOP	DO	7701-09-N-037			
	13DCU64	12HS-C29705-03	12HS-C29705-03_STOP	Recycle Pump Station 1 - Pump 3		STOP	DO	7701-09-N-037			
	13DCU64	12HS-C29705-04	12HS-C29705-04_STOP	Recycle Pump Station 1 - Pump 4		STOP	DO	7701-09-N-037			
	13DCU64	12HS-C29720-00	12HS-C29720-00_CLOSE	Headworks 2 Isolation Gate		CLOSE	DO	7701-09-N-003			
	13DCU64	12HS-C29721-00	12HS-C29721-00_CLOSE	Santa Clara Forcemain Isolation Gate		CLOSE	DO	7701-09-N-003			
	14DCU64	14AI9507-01	14AI9507-00_LEL	Plant Influent Combustible Gas			AI	7701-09-N-007			
	14DCU64	14AI9507-02	14AI9507-02_LEL	Plant Influent Combustible Gas			AI	7701-09-N-033			
	14DCU64	14AI9706-01	14AI9706-01_PH	Biotower Scrubber Recirculation pH			AI	7701-09-N-034			
	14DCU64	14DPI9702-01	14DPI9702-01_DIFFERENTIAL PRESSURE	Odor Control Exhaust Fan 1 Headloss			AI	7701-09-N-033			
	14DCU64	14DPI9702-02	14DPI9702-02_DIFFERENTIAL PRESSURE	Odor Control Exhaust Fan 2 Headloss			AI	7701-09-N-033			
	14DCU64	14DPI9702-02	14DPI9702-02_DIFFERENTIAL PRESSURE	Odor Control Exhaust Fan 2 Headloss			AI	7701-09-N-033			
	14DCU64	14DPI9717-01	14DPI9717-01_DIFFERENTIAL PRESSURE	Biotower Scrubber Vessel Headloss			AI	7701-09-N-034			
	14DCU64	14FI9510-01	14FI9510-01_FLOW	Screening Trough Flow			AI	7701-09-N-006			
	14DCU64	14FI9561-00	14FI9561-00_FLOW	Emergency Overflow Basin Level			AI	7701-09-N-002			
	14DCU64	14FI9561-00	14FI9561-00_FLOW	Emergency Overflow Basin Level			AI	7701-09-N-002			
	14DCU64	14FI9602-01	14FI9602-01_FLOW	Grit Pump 1 Discharge Flow			AI	7701-09-N-022			
	14DCU64	14FI9602-02	14FI9602-02_FLOW	Grit Pump 2 Discharge Flow			AI	7701-09-N-023			
	14DCU64	14FI9602-03	14FI9602-03_FLOW	Grit Pump 3 Discharge Flow			AI	7701-09-N-024			
	14DCU64	14FI9602-04	14FI9602-04_FLOW	Grit Pump 4 Discharge Flow			AI	7701-09-N-025			
	14DCU64	14FI9602-05	14FI9602-05_FLOW	Grit Pump 5 Discharge Flow			AI	7701-09-N-026			
	14DCU64	14FI9602-06	14FI9602-06_FLOW	Grit Pump 6 Discharge Flow			AI	7701-09-N-027			
	14DCU64	14FI9669-01	14FI9669-01_FLOW	Raw Sewage Pump 1 Discharge Flow			AI	7701-09-N-012			
	14DCU64	14FI9669-02	14FI9669-02_FLOW	Raw Sewage Pump 2 Discharge Flow			AI	7701-09-N-013			
	14DCU64	14FI9669-02	14FI9669-02_FLOW	Raw Sewage Pump 2 Discharge Flow			AI	7701-09-N-013			
	14DCU64	14FI9669-03	14FI9669-03_FLOW	Raw Sewage Pump 3 Discharge Flow			AI	7701-09-N-014			
	14DCU64	14FI9669-04	14FI9669-04_FLOW	Raw Sewage Pump 4 Discharge Flow			AI	7701-09-N-015			
	14DCU64	14FI9669-05	14FI9669-05_FLOW	Raw Sewage Pump 5 Discharge Flow			AI	7701-09-N-016			
	14DCU64	14FI9676-01	14FI9676-01_FLOW	Raw Sewage Pump 1 Seal Water Flow			AI	7701-09-N-012			
	14DCU64	14FI9676-02	14FI9676-02_FLOW	Raw Sewage Pump 2 Water Flow			AI	7701-09-N-013			
	14DCU64	14FI9676-03	14FI9676-03_FLOW	Raw Sewage Pump 3 Water Flow			AI	7701-09-N-014			
	14DCU64	14FI9676-04	14FI9676-04_FLOW	Raw Sewage Pump 4 Water Flow			AI	7701-09-N-015			
	14DCU64	14FI9676-05	14FI9676-05_FLOW	Raw Sewage Pump 5 Water Flow			AI	7701-09-N-016			
	14DCU64	14FI9711-01	14FI9711-01_FLOW	Odor Control Water Panel Makeup H2O Flow			AI	7701-09-N-034			
	14DCU64	14FI9728-00	14FI9728-00_FLOW	HW3 Recycle Pump Station Flow			AI	7701-09-N-001			
	14DCU64	14LAH9511-01	14LAH9511-01_HIGH	Screenings Trough Level	NORMAL	HIGH	AI	7701-09-N-006			
	14DCU64	14LAH9534-01	14LAH9534-01_HIGH	Grit Basins Effluent Channel Level	NORMAL	HIGH	AI	7701-09-N-021			
	14DCU64	14LAH9722-00	14LAH9722-00_HIGH	HW3 Recycle Pump Station Level			AI	7701-09-N-038			
	14DCU64	14LAH9739-00	14LAH9739-00_HIGH	Grit Pump Room Sump Level			AI	7701-09-N-039			
	14DCU64	14LI9500-01	14LI9500-01_LEVEL	Influent Screens Influent Channel Level	0	20 Feet	AI	7701-09-N-005			
	14DCU64	14LI9500-02	14LI9500-02_LEVEL	Influent Screens Influent Channel Level	0	20 Feet	AI	7701-09-N-005			
	14DCU64	14LI9506-01	14LI9506-01_LEVEL	Influent Screens Effluent Channel Level	0	20 Feet	AI	7701-09-N-007			
	14DCU64	14LI9506-02	14LI9506-02_LEVEL	Influent Screens Effluent Channel Level	0	20 Feet	AI	7701-09-N-007			

	14DCU64	14LI9532-01	14LI9532-01_LEVEL	Grit Basin 1 Flow			AI	7701-09-N-019			
	14DCU64	14LI9532-02	14LI9532-02_LEVEL	Grit Basin 2 Flow			AI	7701-09-N-019			
	14DCU64	14LI9532-03	14LI9532-03_LEVEL	Grit Basin 3 Flow			AI	7701-09-N-020			
	14DCU64	14LI9532-04	14LI9532-04_LEVEL	Grit Basin 4 Flow			AI	7701-09-N-020			
	14DCU64	14LI9532-05	14LI9532-05_LEVEL	Grit Basin 5 Flow			AI	7701-09-N-021			
	14DCU64	14LI9532-06	14LI9532-06_LEVEL	Grit Basin 6 Flow			AI	7701-09-N-021			
	14DCU64	14LI9561-00	14LI9561-00_LEVEL	Emergency Overflow Basin Level			AI	7701-09-N-002			
	14DCU64	14LI9561-00	14LI9561-00_LEVEL	Emergency Overflow Basin Level			AI	7701-09-N-002			
	14DCU64	14LI9606-01	14LI9606-01_LEVEL	Grit Washer 1 Level			AI	7701-09-N-022			
	14DCU64	14LI9606-02	14LI9606-02_LEVEL	Grit Washer 2 Level			AI	7701-09-N-023			
	14DCU64	14LI9606-03	14LI9606-03_LEVEL	Grit Washer 3 Level			AI	7701-09-N-024			
	14DCU64	14LI9606-04	14LI9606-04_LEVEL	Grit Washer 4 Level			AI	7701-09-N-025			
	14DCU64	14LI9606-05	14LI9606-05_LEVEL	Grit Washer 5 Level			AI	7701-09-N-026			
	14DCU64	14LI9606-06	14LI9606-06_LEVEL	Grit Washer 6 Level			AI	7701-09-N-027			
	14DCU64	14LI9651-01	14LI9651-01_LEVEL	Raw Sewage Pump 1 Wet Well Level	0	20 Feet	AI	7701-09-N-012			
	14DCU64	14LI9651-02	14LI9651-02_LEVEL	Raw Sewage Pump 2 Wet Well Level	0	20 Feet	AI	7701-09-N-013			
	14DCU64	14LI9651-03	14LI9651-03_LEVEL	Raw Sewage Pump 3 Wet Well Level	0	20 Feet	AI	7701-09-N-014			
	14DCU64	14LI9651-04	14LI9651-04_LEVEL	Raw Sewage Pump 4 Wet Well Level	0	20 Feet	AI	7701-09-N-015			
	14DCU64	14LI9651-05	14LI9651-05_LEVEL	Raw Sewage Pump 5 Wet Well Level	0	20 Feet	AI	7701-09-N-016			
	14DCU64	14LI9707-01	14LI9707-01_LEVEL	Biotower Scrubber Sump Level			AI	7701-09-N-034			
	14DCU64	14LI9721-00	14LI9721-00_LEVEL	HW3 Recycle Pump Station Level			AI	7701-09-N-038			
	14DCU64	14LI9739-00	14LI9739-00_LEVEL	Grit Pump Room Sump Level			AI	7701-09-N-039			
	14DCU64	14PI9709-01	14PI9709-01_PRESSURE	Biotower Scrubber Recirculation Pump Pressure			AI	7701-09-N-034			
	14DCU64	14PI9726-01	14PI9726-01_PRESSURE	HW3 Recycle Pump Station - Pump 1 Pressure			AI	7701-09-N-038			
	14DCU64	14PI9726-01	14PI9726-01_PRESSURE	HW3 Recycle Pump Station - Pump 1 Pressure			AI	7701-09-N-038			
	14DCU64	14PI9726-02	14PI9726-02_PRESSURE	HW3 Recycle Pump Station - Pump 2 Pressure			AI	7701-09-N-038			
	14DCU64	14SC9725-01	14SC9725-01_SPEED CONTROL	HW3 Recycle Pump Station - Pump 1			AI	7701-09-N-038			
	14DCU64	14SC9725-02	14SC9725-02_SPEED CONTROL	HW3 Recycle Pump Station - Pump 2			AI	7701-09-N-038			
	14DCU64	14SI9508-01	14SI9508-01_SPEED	Influent Screen 1	0	100 Percent	AI	7701-09-N-006			
	14DCU64	14SI9508-02	14SI9508-02_SPEED	Influent Screen 2	0	100 Percent	AI	7701-09-N-006			
	14DCU64	14SI9508-03	14SI9508-03_SPEED	Influent Screen 3	0	100 Percent	AI	7701-09-N-006			
	14DCU64	14SI9655-01	14SI9655-01_SPEED	Raw Sewage Pump 1	0	100 Percent	AI	7701-09-N-012			
	14DCU64	14SI9655-02	14SI9655-02_SPEED	Raw Sewage Pump 2	0	100 Percent	AI	7701-09-N-013			
	14DCU64	14SI9655-03	14SI9655-03_SPEED	Raw Sewage Pump 3	0	100 Percent	AI	7701-09-N-014			
	14DCU64	14SI9655-04	14SI9655-04_SPEED	Raw Sewage Pump 4	0	100 Percent	AI	7701-09-N-015			
	14DCU64	14SI9655-05	14SI9655-05_SPEED	Raw Sewage Pump 5	0	100 Percent	AI	7701-09-N-016			
	14DCU64	14SI9701-01	14SI9701-01_SPEED	Odor Control Exhaust Fan 1	0	100 Percent	AI	7701-09-N-033			
	14DCU64	14SI9701-02	14SI9701-02_SPEED	Odor Control Exhaust Fan 2	0	100 Percent	AI	7701-09-N-033			
	14DCU64	14SI9725-01	14SI9725-01_SPEED	HW3 Recycle Pump Station - Pump 1			AI	7701-09-N-038			
	14DCU64	14SI9725-02	14SI9725-02_SPEED	HW3 Recycle Pump Station - Pump 2			AI	7701-09-N-038			
	14DCU64	14ZI9530-01	14ZI9530-01_POSITION	Grit Basin 1 Inlet Gate	0	100 Percent	AI	7701-09-N-019			
	14DCU64	14ZI9530-02	14ZI9530-02_POSITION	Grit Basin 2 Inlet Gate	0	100 Percent	AI	7701-09-N-019			
	14DCU64	14ZI9530-03	14ZI9530-03_POSITION	Grit Basin 3 Inlet Gate	0	100 Percent	AI	7701-09-N-020			
	14DCU64	14ZI9530-04	14ZI9530-04_POSITION	Grit Basin 4 Inlet Gate	0	100 Percent	AI	7701-09-N-020			
	14DCU64	14ZI9530-05	14ZI9530-05_POSITION	Grit Basin 5 Inlet Gate	0	100 Percent	AI	7701-09-N-021			
	14DCU64	14ZI9530-06	14ZI9530-06_POSITION	Grit Basin 6 Inlet Gate	0	100 Percent	AI	7701-09-N-021			
	14DCU64	14SC9508-01	14SC9508-01_SPEED CONTROL	Influent Screen 1	0	100 Percent	AO	7701-09-N-006			
	14DCU64	14SC9508-02	14SC9508-02_SPEED CONTROL	Influent Screen 2	0	100 Percent	AO	7701-09-N-006			
	14DCU64	14SC9508-03	14SC9508-03_SPEED CONTROL	Influent Screen 3	0	100 Percent	AO	7701-09-N-006			
	14DCU64	14SC9655-01	14SC9655-01_SPEED CONTROL	Raw Sewage Pump 1	0	100 Percent	AO	7701-09-N-012			
	14DCU64	14SC9655-02	14SC9655-02_SPEED CONTROL	Raw Sewage Pump 2	0	100 Percent	AO	7701-09-N-013			
	14DCU64	14SC9655-03	14SC9655-03_SPEED CONTROL	Raw Sewage Pump 3	0	100 Percent	AO	7701-09-N-014			

	14DCU64	14SC9655-04	14SC9655-04_SPEED CONTROL	Raw Sewage Pump 4	0	100 Percent	AO	7701-09-N-015			
	14DCU64	14SC9655-05	14SC9655-05_SPEED CONTROL	Raw Sewage Pump 5	0	100 Percent	AO	7701-09-N-016			
	14DCU64	14SC9701-01	14SC9701-01_SPEED CONTROL	Odor Control Exhaust Fan 1	0	100 Percent	AO	7701-09-N-033			
	14DCU64	14SC9701-02	14SC9701-02_SPEED CONTROL	Odor Control Exhaust Fan 2	0	100 Percent	AO	7701-09-N-033			
	14DCU64	23HK2578-01	23HK2578-01_CONTROL	East Meter Vault Primary Influent Flow	0	100 Percent	AO	7701-09-N-031			
	14DCU64	14FAL9507-00	14FAL9507-01_LOW	Plant Influent Combustible Gas	LOW	NORMAL	DI	7701-09-N-007			
	14DCU64	14FAL9507-02	14FAL9507-02_LOW	Plant Influent Combustible Gas	LOW	NORMAL	DI	7701-09-N-033			
	14DCU64	14HSL9501-01	14HSL9501-01_LOCAL	Influent Screen 1 Influent Gate	OFF	LOCAL	DI	7701-09-N-005			
	14DCU64	14HSL9501-02	14HSL9501-02_LOCAL	Influent Screen 2 Influent Gate	OFF	LOCAL	DI	7701-09-N-005			
	14DCU64	14HSL9501-03	14HSL9501-03_LOCAL	Influent Screen 3 Influent Gate	OFF	LOCAL	DI	7701-09-N-005			
	14DCU64	14HSL9505-01	14HSL9505-01_LOCAL	Influent Screen 1 Effluent Gate	OFF	LOCAL	DI	7701-09-N-007			
	14DCU64	14HSL9505-02	14HSL9505-02_LOCAL	Influent Screen 2 Effluent Gate	OFF	LOCAL	DI	7701-09-N-007			
	14DCU64	14HSL9505-03	14HSL9505-03_LOCAL	Influent Screen 3 Effluent Gate	OFF	LOCAL	DI	7701-09-N-007			
	14DCU64	14HSL9510-01	14HSL9510-01_LOCAL	Screening Trough Flow	OFF	LOCAL	DI	7701-09-N-006			
	14DCU64	14HSL9520-01	14HSL9520-01_LOCAL	Screenings Compactor 1 Inlet Valve	OFF	LOCAL	DI	7701-09-N-008			
	14DCU64	14HSL9520-02	14HSL9520-02_LOCAL	Screenings Compactor 2 Inlet Valve	OFF	LOCAL	DI	7701-09-N-008			
	14DCU64	14HSL9520-03	14HSL9520-03_LOCAL	Screenings Compactor 3 Inlet Valve	OFF	LOCAL	DI	7701-09-N-009			
	14DCU64	14HSL9520-04	14HSL9520-04_LOCAL	Screenings Compactor 4 Inlet Valve	OFF	LOCAL	DI	7701-09-N-009			
	14DCU64	14HSL9522-01	14HSL9522-01_LOCAL	Screenings Compactor 1 Flush Water Valve	OFF	LOCAL	DI	7701-09-N-008			
	14DCU64	14HSL9522-02	14HSL9522-02_LOCAL	Screenings Compactor 2 Flush Water Valve	OFF	LOCAL	DI	7701-09-N-008			
	14DCU64	14HSL9522-03	14HSL9522-03_LOCAL	Screenings Compactor 3 Flush Water Valve	OFF	LOCAL	DI	7701-09-N-009			
	14DCU64	14HSL9522-04	14HSL9522-04_LOCAL	Screenings Compactor 4 Flush Water Valve	OFF	LOCAL	DI	7701-09-N-009			
	14DCU64	14HSL9523-01	14HSL9523-01_LOCAL	Screenings Compactor Flush Water Pressure	OFF	LOCAL	DI	7701-09-N-008			
	14DCU64	14HSL9530-01	14HSL9530-01_LOCAL	Grit Basin 1 Inlet Gate	OFF	LOCAL	DI	7701-09-N-019			
	14DCU64	14HSL9530-02	14HSL9530-02_LOCAL	Grit Basin 2 Inlet Gate	OFF	LOCAL	DI	7701-09-N-019			
	14DCU64	14HSL9530-03	14HSL9530-03_LOCAL	Grit Basin 3 Inlet Gate	OFF	LOCAL	DI	7701-09-N-020			
	14DCU64	14HSL9530-04	14HSL9530-04_LOCAL	Grit Basin 4 Inlet Gate	OFF	LOCAL	DI	7701-09-N-020			
	14DCU64	14HSL9530-05	14HSL9530-05_LOCAL	Grit Basin 5 Inlet Gate	OFF	LOCAL	DI	7701-09-N-021			
	14DCU64	14HSL9530-06	14HSL9530-06_LOCAL	Grit Basin 6 Inlet Gate	OFF	LOCAL	DI	7701-09-N-021			
	14DCU64	14HSL9533-01	14HSL9533-01_LOCAL	Grit Basins Effluent Channel Emergency Overflow Gate	OFF	LOCAL	DI	7701-09-N-019			
	14DCU64	14HSL9604-01	14HSL9604-01_LOCAL	Grit Washer 1 Overflow Valve	OFF	LOCAL	DI	7701-09-N-022			
	14DCU64	14HSL9604-02	14HSL9604-02_LOCAL	Grit Washer 2 Overflow Valve	OFF	LOCAL	DI	7701-09-N-023			
	14DCU64	14HSL9604-03	14HSL9604-03_LOCAL	Grit Washer 3 Overflow Valve	OFF	LOCAL	DI	7701-09-N-024			
	14DCU64	14HSL9604-04	14HSL9604-04_LOCAL	Grit Washer 4 Overflow Valve	OFF	LOCAL	DI	7701-09-N-025			
	14DCU64	14HSL9604-05	14HSL9604-05_LOCAL	Grit Washer 5 Overflow Valve	OFF	LOCAL	DI	7701-09-N-026			
	14DCU64	14HSL9604-06	14HSL9604-06_LOCAL	Grit Washer 6 Overflow Valve	OFF	LOCAL	DI	7701-09-N-027			
	14DCU64	14HSL9649-01	14HSL9649-01_LOCAL	Raw Sewage Pump 1 Wetwell Gate	OFF	LOCAL	DI	7701-09-N-012			
	14DCU64	14HSL9649-02	14HSL9649-02_LOCAL	Raw Sewage Pump 2 Wetwell Gate	OFF	LOCAL	DI	7701-09-N-013			
	14DCU64	14HSL9649-03	14HSL9649-03_LOCAL	Raw Sewage Pump 3 Wetwell Gate	OFF	LOCAL	DI	7701-09-N-014			
	14DCU64	14HSL9649-04	14HSL9649-04_LOCAL	Raw Sewage Pump 4 Wetwell Gate	OFF	LOCAL	DI	7701-09-N-015			
	14DCU64	14HSL9649-05	14HSL9649-05_LOCAL	Raw Sewage Pump 5 Wetwell Gate	OFF	LOCAL	DI	7701-09-N-016			
	14DCU64	14HSL9650-01	14HSL9650-01_LOCAL	Raw Sewage Pump 1 Wetwell Gate	OFF	LOCAL	DI	7701-09-N-012			
	14DCU64	14HSL9650-02	14HSL9650-02_LOCAL	Raw Sewage Pump 2 Wetwell Gate	OFF	LOCAL	DI	7701-09-N-013			
	14DCU64	14HSL9650-03	14HSL9650-03_LOCAL	Raw Sewage Pump 3 Wetwell Gate	OFF	LOCAL	DI	7701-09-N-014			
	14DCU64	14HSL9650-04	14HSL9650-04_LOCAL	Raw Sewage Pump 4 Wetwell Gate	OFF	LOCAL	DI	7701-09-N-015			
	14DCU64	14HSL9650-05	14HSL9650-05_LOCAL	Raw Sewage Pump 5 Wetwell Gate	OFF	LOCAL	DI	7701-09-N-016			
	14DCU64	14HSL9670-01	14HSL9670-01_LOCAL	Raw Sewage Pump 1 Vent Valve	OFF	LOCAL	DI	7701-09-N-012			
	14DCU64	14HSL9670-02	14HSL9670-02_LOCAL	Raw Sewage Pump 2 Vent Valve	OFF	LOCAL	DI	7701-09-N-013			
	14DCU64	14HSL9670-03	14HSL9670-03_LOCAL	Raw Sewage Pump 3 Vent Valve	OFF	LOCAL	DI	7701-09-N-014			
	14DCU64	14HSL9670-04	14HSL9670-04_LOCAL	Raw Sewage Pump 4 Vent Valve	OFF	LOCAL	DI	7701-09-N-015			
	14DCU64	14HSL9670-05	14HSL9670-05_LOCAL	Raw Sewage Pump 5 Vent Valve	OFF	LOCAL	DI	7701-09-N-016			
	14DCU64	14HSL9677-01	14HSL9677-01_LOCAL	Raw Sewage Pump 1 Seal Water Flow Valve	OFF	LOCAL	DI	7701-09-N-012			

	14DCU64	14HSL9677-02	14HSL9677-02_LOCAL	Raw Sewage Pump 2 Water Flow Valve	OFF	LOCAL	DI	7701-09-N-013			
	14DCU64	14HSL9677-03	14HSL9677-03_LOCAL	Raw Sewage Pump 3 Water Flow Valve	OFF	LOCAL	DI	7701-09-N-014			
	14DCU64	14HSL9677-04	14HSL9677-04_LOCAL	Raw Sewage Pump 4 Water Flow Valve	OFF	LOCAL	DI	7701-09-N-015			
	14DCU64	14HSL9677-05	14HSL9677-05_LOCAL	Raw Sewage Pump 5 Water Flow Valve	OFF	LOCAL	DI	7701-09-N-016			
	14DCU64	14HSL9926-01	14HSL9926-01_LOCAL	Grit Basin 1 Fluidizing Water Valve	OFF	LOCAL	DI	7701-09-N-019			
	14DCU64	14HSL9926-02	14HSL9926-02_LOCAL	Grit Basin 2 Fluidizing Water Valve	OFF	LOCAL	DI	7701-09-N-019			
	14DCU64	14HSL9926-03	14HSL9926-03_LOCAL	Grit Basin 3 Fluidizing Water Valve	OFF	LOCAL	DI	7701-09-N-020			
	14DCU64	14HSL9926-04	14HSL9926-04_LOCAL	Grit Basin 4 Fluidizing Water Valve	OFF	LOCAL	DI	7701-09-N-020			
	14DCU64	14HSL9926-05	14HSL9926-05_LOCAL	Grit Basin 5 Fluidizing Water Valve	OFF	LOCAL	DI	7701-09-N-021			
	14DCU64	14HSL9926-06	14HSL9926-06_LOCAL	Grit Basin 6 Fluidizing Water Valve	OFF	LOCAL	DI	7701-09-N-021			
	14DCU64	14HSR9501-01	14HSR9501-01_REMOTE	Influent Screen 1 Influent Gate	OFF	REMOTE	DI	7701-09-N-005			
	14DCU64	14HSR9501-02	14HSR9501-02_REMOTE	Influent Screen 2 Influent Gate	OFF	REMOTE	DI	7701-09-N-005			
	14DCU64	14HSR9501-03	14HSR9501-03_REMOTE	Influent Screen 3 Influent Gate	OFF	REMOTE	DI	7701-09-N-005			
	14DCU64	14HSR9505-01	14HSR9505-01_REMOTE	Influent Screen 1 Effluent Gate	OFF	REMOTE	DI	7701-09-N-007			
	14DCU64	14HSR9505-02	14HSR9505-02_REMOTE	Influent Screen 2 Effluent Gate	OFF	REMOTE	DI	7701-09-N-007			
	14DCU64	14HSR9505-03	14HSR9505-03_REMOTE	Influent Screen 3 Effluent Gate	OFF	REMOTE	DI	7701-09-N-007			
	14DCU64	14HSR9510-01	14HSR9510-01_REMOTE	Screening Trough Flow	OFF	REMOTE	DI	7701-09-N-006			
	14DCU64	14HSR9520-01	14HSR9520-01_REMOTE	Screenings Compactor 1 Inlet Valve	OFF	REMOTE	DI	7701-09-N-008			
	14DCU64	14HSR9520-02	14HSR9520-02_REMOTE	Screenings Compactor 2 Inlet Valve	OFF	REMOTE	DI	7701-09-N-008			
	14DCU64	14HSR9520-03	14HSR9520-03_REMOTE	Screenings Compactor 3 Inlet Valve	OFF	REMOTE	DI	7701-09-N-009			
	14DCU64	14HSR9520-04	14HSR9520-04_REMOTE	Screenings Compactor 4 Inlet Valve	OFF	REMOTE	DI	7701-09-N-009			
	14DCU64	14HSR9522-01	14HSR9522-01_REMOTE	Screenings Compactor 1 Flush Water Valve	OFF	REMOTE	DI	7701-09-N-008			
	14DCU64	14HSR9522-02	14HSR9522-02_REMOTE	Screenings Compactor 2 Flush Water Valve	OFF	REMOTE	DI	7701-09-N-008			
	14DCU64	14HSR9522-03	14HSR9522-03_REMOTE	Screenings Compactor 3 Flush Water Valve	OFF	REMOTE	DI	7701-09-N-009			
	14DCU64	14HSR9522-04	14HSR9522-04_REMOTE	Screenings Compactor 4 Flush Water Valve	OFF	REMOTE	DI	7701-09-N-009			
	14DCU64	14HSR9523-01	14HSR9523-01_REMOTE	Screenings Compactor Flush Water Pressure	OFF	REMOTE	DI	7701-09-N-008			
	14DCU64	14HSR9530-01	14HSR9530-01_REMOTE	Grit Basin 1 Inlet Gate	OFF	REMOTE	DI	7701-09-N-019			
	14DCU64	14HSR9530-02	14HSR9530-02_REMOTE	Grit Basin 2 Inlet Gate	OFF	REMOTE	DI	7701-09-N-019			
	14DCU64	14HSR9530-03	14HSR9530-03_REMOTE	Grit Basin 3 Inlet Gate	OFF	REMOTE	DI	7701-09-N-020			
	14DCU64	14HSR9530-04	14HSR9530-04_REMOTE	Grit Basin 4 Inlet Gate	OFF	REMOTE	DI	7701-09-N-020			
	14DCU64	14HSR9530-05	14HSR9530-05_REMOTE	Grit Basin 5 Inlet Gate	OFF	REMOTE	DI	7701-09-N-021			
	14DCU64	14HSR9530-06	14HSR9530-06_REMOTE	Grit Basin 6 Inlet Gate	OFF	REMOTE	DI	7701-09-N-021			
	14DCU64	14HSR9533-01	14HSR9533-01_REMOTE	Grit Basins Effluent Channel Emergency Overflow Gate	OFF	REMOTE	DI	7701-09-N-019			
	14DCU64	14HSR9604-01	14HSR9604-01_REMOTE	Grit Washer 1 Overflow Valve	OFF	REMOTE	DI	7701-09-N-022			
	14DCU64	14HSR9604-02	14HSR9604-02_REMOTE	Grit Washer 2 Overflow Valve	OFF	REMOTE	DI	7701-09-N-023			
	14DCU64	14HSR9604-03	14HSR9604-03_REMOTE	Grit Washer 3 Overflow Valve	OFF	REMOTE	DI	7701-09-N-024			
	14DCU64	14HSR9604-04	14HSR9604-04_REMOTE	Grit Washer 4 Overflow Valve	OFF	REMOTE	DI	7701-09-N-025			
	14DCU64	14HSR9604-05	14HSR9604-05_REMOTE	Grit Washer 5 Overflow Valve	OFF	REMOTE	DI	7701-09-N-026			
	14DCU64	14HSR9604-06	14HSR9604-06_REMOTE	Grit Washer 6 Overflow Valve	OFF	REMOTE	DI	7701-09-N-027			
	14DCU64	14HSR9649-01	14HSR9649-01_REMOTE	Raw Sewage Pump 1 Wetwell Gate	OFF	REMOTE	DI	7701-09-N-012			
	14DCU64	14HSR9649-02	14HSR9649-02_REMOTE	Raw Sewage Pump 2 Wetwell Gate	OFF	REMOTE	DI	7701-09-N-013			
	14DCU64	14HSR9649-03	14HSR9649-03_REMOTE	Raw Sewage Pump 3 Wetwell Gate	OFF	REMOTE	DI	7701-09-N-014			
	14DCU64	14HSR9649-04	14HSR9649-04_REMOTE	Raw Sewage Pump 4 Wetwell Gate	OFF	REMOTE	DI	7701-09-N-015			
	14DCU64	14HSR9649-05	14HSR9649-05_REMOTE	Raw Sewage Pump 5 Wetwell Gate	OFF	REMOTE	DI	7701-09-N-016			
	14DCU64	14HSR9650-01	14HSR9650-01_REMOTE	Raw Sewage Pump 1 Wetwell Gate	OFF	REMOTE	DI	7701-09-N-012			
	14DCU64	14HSR9650-02	14HSR9650-02_REMOTE	Raw Sewage Pump 2 Wetwell Gate	OFF	REMOTE	DI	7701-09-N-013			
	14DCU64	14HSR9650-03	14HSR9650-03_REMOTE	Raw Sewage Pump 3 Wetwell Gate	OFF	REMOTE	DI	7701-09-N-014			
	14DCU64	14HSR9650-04	14HSR9650-04_REMOTE	Raw Sewage Pump 4 Wetwell Gate	OFF	REMOTE	DI	7701-09-N-015			
	14DCU64	14HSR9650-05	14HSR9650-05_REMOTE	Raw Sewage Pump 5 Wetwell Gate	OFF	REMOTE	DI	7701-09-N-016			
	14DCU64	14HSR9670-01	14HSR9670-01_REMOTE	Raw Sewage Pump 1 Vent Valve	OFF	REMOTE	DI	7701-09-N-012			
	14DCU64	14HSR9670-02	14HSR9670-02_REMOTE	Raw Sewage Pump 2 Vent Valve	OFF	REMOTE	DI	7701-09-N-013			
	14DCU64	14HSR9670-03	14HSR9670-03_REMOTE	Raw Sewage Pump 3 Vent Valve	OFF	REMOTE	DI	7701-09-N-014			

	14DCU64	14HSR9670-04	14HSR9670-04_REMOTE	Raw Sewage Pump 4 Vent Valve	OFF	REMOTE	DI	7701-09-N-015			
	14DCU64	14HSR9670-05	14HSR9670-05_REMOTE	Raw Sewage Pump 5 Vent Valve	OFF	REMOTE	DI	7701-09-N-016			
	14DCU64	14HSR9677-01	14HSR9677-01_REMOTE	Raw Sewage Pump 1 Seal Water Flow Valve	OFF	REMOTE	DI	7701-09-N-012			
	14DCU64	14HSR9677-02	14HSR9677-02_REMOTE	Raw Sewage Pump 2 Water Flow Valve	OFF	REMOTE	DI	7701-09-N-013			
	14DCU64	14HSR9677-03	14HSR9677-03_REMOTE	Raw Sewage Pump 3 Water Flow Valve	OFF	REMOTE	DI	7701-09-N-014			
	14DCU64	14HSR9677-04	14HSR9677-04_REMOTE	Raw Sewage Pump 4 Water Flow Valve	OFF	REMOTE	DI	7701-09-N-015			
	14DCU64	14HSR9677-05	14HSR9677-05_REMOTE	Raw Sewage Pump 5 Water Flow Valve	OFF	REMOTE	DI	7701-09-N-016			
	14DCU64	14HSR9926-01	14HSR9926-01_REMOTE	Grit Basin 1 Fluidizing Water Valve	OFF	REMOTE	DI	7701-09-N-019			
	14DCU64	14HSR9926-02	14HSR9926-02_REMOTE	Grit Basin 2 Fluidizing Water Valve	OFF	REMOTE	DI	7701-09-N-019			
	14DCU64	14HSR9926-03	14HSR9926-03_REMOTE	Grit Basin 3 Fluidizing Water Valve	OFF	REMOTE	DI	7701-09-N-020			
	14DCU64	14HSR9926-04	14HSR9926-04_REMOTE	Grit Basin 4 Fluidizing Water Valve	OFF	REMOTE	DI	7701-09-N-020			
	14DCU64	14HSR9926-05	14HSR9926-05_REMOTE	Grit Basin 5 Fluidizing Water Valve	OFF	REMOTE	DI	7701-09-N-021			
	14DCU64	14HSR9926-06	14HSR9926-06_REMOTE	Grit Basin 6 Fluidizing Water Valve	OFF	REMOTE	DI	7701-09-N-021			
	14DCU64	14HX9501-01B	14HX9501-01B_POWER ON	Influent Screen 1 Influent Gate	OFF	POWERED	DI	7701-09-N-005			
	14DCU64	14HX9501-02B	14HX9501-02B_POWER ON	Influent Screen 2 Influent Gate	OFF	POWERED	DI	7701-09-N-005			
	14DCU64	14HX9501-03B	14HX9501-03B_POWER ON	Influent Screen 3 Influent Gate	OFF	POWERED	DI	7701-09-N-005			
	14DCU64	14HX9505-01B	14HX9505-01B_POWER ON	Influent Screen 1 Effluent Gate	OFF	POWERED	DI	7701-09-N-007			
	14DCU64	14HX9505-02B	14HX9505-02B_POWER ON	Influent Screen 2 Effluent Gate	OFF	POWERED	DI	7701-09-N-007			
	14DCU64	14HX9505-03B	14HX9505-03B_POWER ON	Influent Screen 3 Effluent Gate	OFF	POWERED	DI	7701-09-N-007			
	14DCU64	14LAL9716-01	14LAL9716-01_LOW	Odor Control Nutrient Tank Level	LOW	NORMAL	DI	7701-09-N-034			
	14DCU64	14UA9508-01	14UA9508-01_ESTOP	Influent Screen 1	E-STOP	NORMAL	DI	7701-09-N-006			
	14DCU64	14UA9508-02	14UA9508-02_ESTOP	Influent Screen 2	E-STOP	NORMAL	DI	7701-09-N-006			
	14DCU64	14UA9508-03	14UA9508-03_ESTOP	Influent Screen 3	E-STOP	NORMAL	DI	7701-09-N-006			
	14DCU64	14UA9521-01B	14UA9521-01B_ESTOP	Screenings Compactor 1	E-STOP	NORMAL	DI	7701-09-N-008			
	14DCU64	14UA9521-02B	14UA9521-02B_ESTOP	Screenings Compactor 2	E-STOP	NORMAL	DI	7701-09-N-008			
	14DCU64	14UA9521-03B	14UA9521-03B_ESTOP	Screenings Compactor 3	E-STOP	NORMAL	DI	7701-09-N-009			
	14DCU64	14UA9521-04B	14UA9521-04B_ESTOP	Screenings Compactor 4	E-STOP	NORMAL	DI	7701-09-N-009			
	14DCU64	14UA9525-01B	14UA9525-01B_ESTOP	Screenings Winch 1	E-STOP	NORMAL	DI	7701-09-N-008			
	14DCU64	14UA9525-02B	14UA9525-02B_ESTOP	Screenings Winch 2	E-STOP	NORMAL	DI	7701-09-N-009			
	14DCU64	14UA9601-01	14UA9601-01_ESTOP	Grit Pump 1	E-STOP	NORMAL	DI	7701-09-N-022			
	14DCU64	14UA9601-02	14UA9601-02_ESTOP	Grit Pump 2	E-STOP	NORMAL	DI	7701-09-N-023			
	14DCU64	14UA9601-03	14UA9601-03_ESTOP	Grit Pump 3	E-STOP	NORMAL	DI	7701-09-N-024			
	14DCU64	14UA9601-04	14UA9601-04_ESTOP	Grit Pump 4	E-STOP	NORMAL	DI	7701-09-N-025			
	14DCU64	14UA9601-05	14UA9601-05_ESTOP	Grit Pump 5	E-STOP	NORMAL	DI	7701-09-N-026			
	14DCU64	14UA9601-06	14UA9601-06_ESTOP	Grit Pump 6	E-STOP	NORMAL	DI	7701-09-N-027			
	14DCU64	14UA9603-01	14UA9603-01_ESTOP	Grit Classifier 1	E-STOP	NORMAL	DI	7701-09-N-022			
	14DCU64	14UA9603-02	14UA9603-02_ESTOP	Grit Classifier 2	E-STOP	NORMAL	DI	7701-09-N-023			
	14DCU64	14UA9603-03	14UA9603-03_ESTOP	Grit Classifier 3	E-STOP	NORMAL	DI	7701-09-N-024			
	14DCU64	14UA9603-04	14UA9603-04_ESTOP	Grit Classifier 4	E-STOP	NORMAL	DI	7701-09-N-025			
	14DCU64	14UA9603-05	14UA9603-05_ESTOP	Grit Classifier 5	E-STOP	NORMAL	DI	7701-09-N-026			
	14DCU64	14UA9603-06	14UA9603-06_ESTOP	Grit Classifier 6	E-STOP	NORMAL	DI	7701-09-N-027			
	14DCU64	14UA9605-01	14UA9605-01_ESTOP	Grit Washer 1	E-STOP	NORMAL	DI	7701-09-N-022			
	14DCU64	14UA9605-02	14UA9605-02_ESTOP	Grit Washer 2	E-STOP	NORMAL	DI	7701-09-N-023			
	14DCU64	14UA9605-03	14UA9605-03_ESTOP	Grit Washer 3	E-STOP	NORMAL	DI	7701-09-N-024			
	14DCU64	14UA9605-04	14UA9605-04_ESTOP	Grit Washer 4	E-STOP	NORMAL	DI	7701-09-N-025			
	14DCU64	14UA9605-05	14UA9605-05_ESTOP	Grit Washer 5	E-STOP	NORMAL	DI	7701-09-N-026			
	14DCU64	14UA9605-06	14UA9605-06_ESTOP	Grit Washer 6	E-STOP	NORMAL	DI	7701-09-N-027			
	14DCU64	14UA9655-01	14UA9655-01_ESTOP	Raw Sewage Pump 1	E-STOP	NORMAL	DI	7701-09-N-012			
	14DCU64	14UA9655-02	14UA9655-02_ESTOP	Raw Sewage Pump 2	E-STOP	NORMAL	DI	7701-09-N-013			
	14DCU64	14UA9655-03	14UA9655-03_ESTOP	Raw Sewage Pump 3	E-STOP	NORMAL	DI	7701-09-N-014			
	14DCU64	14UA9655-04	14UA9655-04_ESTOP	Raw Sewage Pump 4	E-STOP	NORMAL	DI	7701-09-N-015			
	14DCU64	14UA9655-05	14UA9655-05_ESTOP	Raw Sewage Pump 5	E-STOP	NORMAL	DI	7701-09-N-016			

	14DCU64	14UA9708-01	14UA9708-01_ESTOP	Biotower Scrubber Recirculation Pump	E-STOP	NORMAL	DI	7701-09-N-034			
	14DCU64	14UA9725-01	14UA9725-01_ESTOP	HW3 Recycle Pump Station - Pump 1	E-STOP	NORMAL	DI	7701-09-N-038			
	14DCU64	14UA9725-02	14UA9725-02_ESTOP	HW3 Recycle Pump Station - Pump 2	E-STOP	NORMAL	DI	7701-09-N-038			
	14DCU64	14UA9725-03	14UA9725-03_ESTOP	HW3 Recycle Pump Station - Pump 3	E-STOP	NORMAL	DI	7701-09-N-038			
	14DCU64	14UA9739-01	14UA9739-01_ESTOP	Grit Room Sump Pump 1	E-STOP	NORMAL	DI	7701-09-N-039			
	14DCU64	14UA9808-01	14UA9808-01_ESTOP	Grit Room Supply Fan	E-STOP	NORMAL	DI	7701-09-N-039			
	14DCU64	14UA9809-01	14UA9809-01_ESTOP	Grit Room Exhaust Fan	E-STOP	NORMAL	DI	7701-09-N-039			
	14DCU64	14UH9701-01	14UH9701-01_ESTOP	Odor Control Exhaust Fan 1	E-STOP	NORMAL	DI	7701-09-N-033			
	14DCU64	14UH9701-02	14UH9701-02_ESTOP	Odor Control Exhaust Fan 2	E-STOP	NORMAL	DI	7701-09-N-033			
	14DCU64	14XA9501-01	14XA9501-01_FAULT	Influent Screen 1 Influent Gate	FAULT	NORMAL	DI	7701-09-N-005			
	14DCU64	14XA9501-02	14XA9501-02_FAULT	Influent Screen 2 Influent Gate	FAULT	NORMAL	DI	7701-09-N-005			
	14DCU64	14XA9501-03	14XA9501-03_FAULT	Influent Screen 3 Influent Gate	FAULT	NORMAL	DI	7701-09-N-005			
	14DCU64	14XA9505-01	14XA9505-01_FAULT	Influent Screen 1 Effluent Gate	FAULT	NORMAL	DI	7701-09-N-007			
	14DCU64	14XA9505-02	14XA9505-02_FAULT	Influent Screen 2 Effluent Gate	FAULT	NORMAL	DI	7701-09-N-007			
	14DCU64	14XA9505-03	14XA9505-03_FAULT	Influent Screen 3 Effluent Gate	FAULT	NORMAL	DI	7701-09-N-007			
	14DCU64	14XA9507-00	14XA9507-00_FAULT	Plant Influent Combustible Gas	FAULT	NORMAL	DI	7701-09-N-007			
	14DCU64	14XA9507-00	14XA9507-01_FAULT	Plant Influent Combustible Gas	FAULT	NORMAL	DI	7701-09-N-007			
	14DCU64	14XA9507-02	14XA9507-02_FAULT	Plant Influent Combustible Gas			DI	7701-09-N-033			
	14DCU64	14XA9510-01	14XA9510-01_FAULT	Screening Trough Flow	FAULT	NORMAL	DI	7701-09-N-006			
	14DCU64	14XA9520-01	14XA9520-01_FAULT	Screenings Compactor 1 Inlet Valve	FAULT	NORMAL	DI	7701-09-N-008			
	14DCU64	14XA9520-02	14XA9520-02_FAULT	Screenings Compactor 2 Inlet Valve	FAULT	NORMAL	DI	7701-09-N-008			
	14DCU64	14XA9520-03	14XA9520-03_FAULT	Screenings Compactor 3 Inlet Valve	FAULT	NORMAL	DI	7701-09-N-009			
	14DCU64	14XA9520-04	14XA9520-04_FAULT	Screenings Compactor 4 Inlet Valve	FAULT	NORMAL	DI	7701-09-N-009			
	14DCU64	14XA9522-01	14XA9522-01_FAULT	Screenings Compactor 1 Flush Water Valve	FAULT	NORMAL	DI	7701-09-N-008			
	14DCU64	14XA9522-02	14XA9522-02_FAULT	Screenings Compactor 2 Flush Water Valve	FAULT	NORMAL	DI	7701-09-N-008			
	14DCU64	14XA9522-03	14XA9522-03_FAULT	Screenings Compactor 3 Flush Water Valve	FAULT	NORMAL	DI	7701-09-N-009			
	14DCU64	14XA9522-04	14XA9522-04_FAULT	Screenings Compactor 4 Flush Water Valve	FAULT	NORMAL	DI	7701-09-N-009			
	14DCU64	14XA9523-01	14XA9523-01_FAULT	Screenings Compactor Flush Water Pressure	FAULT	NORMAL	DI	7701-09-N-008			
	14DCU64	14XA9530-01	14XA9530-01_FAULT	Grit Basin 1 Inlet Gate	FAULT	NORMAL	DI	7701-09-N-019			
	14DCU64	14XA9530-02	14XA9530-02_FAULT	Grit Basin 2 Inlet Gate	FAULT	NORMAL	DI	7701-09-N-019			
	14DCU64	14XA9530-03	14XA9530-03_FAULT	Grit Basin 3 Inlet Gate	FAULT	NORMAL	DI	7701-09-N-020			
	14DCU64	14XA9530-04	14XA9530-04_FAULT	Grit Basin 4 Inlet Gate	FAULT	NORMAL	DI	7701-09-N-020			
	14DCU64	14XA9530-05	14XA9530-05_FAULT	Grit Basin 5 Inlet Gate	FAULT	NORMAL	DI	7701-09-N-021			
	14DCU64	14XA9530-06	14XA9530-06_FAULT	Grit Basin 6 Inlet Gate	FAULT	NORMAL	DI	7701-09-N-021			
	14DCU64	14XA9533-01	14XA9533-01_FAULT	Grit Basins Effluent Channel Emergency Overflow Gate	FAULT	NORMAL	DI	7701-09-N-019			
	14DCU64	14XA9604-01	14XA9604-01_FAULT	Grit Washer 1 Overflow Valve	FAULT	NORMAL	DI	7701-09-N-022			
	14DCU64	14XA9604-02	14XA9604-02_FAULT	Grit Washer 2 Overflow Valve	FAULT	NORMAL	DI	7701-09-N-023			
	14DCU64	14XA9604-03	14XA9604-03_FAULT	Grit Washer 3 Overflow Valve	FAULT	NORMAL	DI	7701-09-N-024			
	14DCU64	14XA9604-04	14XA9604-04_FAULT	Grit Washer 4 Overflow Valve	FAULT	NORMAL	DI	7701-09-N-025			
	14DCU64	14XA9604-05	14XA9604-05_FAULT	Grit Washer 5 Overflow Valve	FAULT	NORMAL	DI	7701-09-N-026			
	14DCU64	14XA9604-06	14XA9604-06_FAULT	Grit Washer 6 Overflow Valve	FAULT	NORMAL	DI	7701-09-N-027			
	14DCU64	14XA9649-01	14XA9649-01_FAULT	Raw Sewage Pump 1 Wetwell Gate	FAULT	NORMAL	DI	7701-09-N-012			
	14DCU64	14XA9649-02	14XA9649-02_FAULT	Raw Sewage Pump 2 Wetwell Gate	FAULT	NORMAL	DI	7701-09-N-013			
	14DCU64	14XA9649-03	14XA9649-03_FAULT	Raw Sewage Pump 3 Wetwell Gate	FAULT	NORMAL	DI	7701-09-N-014			
	14DCU64	14XA9649-04	14XA9649-04_FAULT	Raw Sewage Pump 4 Wetwell Gate	FAULT	NORMAL	DI	7701-09-N-015			
	14DCU64	14XA9649-05	14XA9649-05_FAULT	Raw Sewage Pump 5 Wetwell Gate	FAULT	NORMAL	DI	7701-09-N-016			
	14DCU64	14XA9650-01	14XA9650-01_FAULT	Raw Sewage Pump 1 Wetwell Gate	FAULT	NORMAL	DI	7701-09-N-012			
	14DCU64	14XA9650-02	14XA9650-02_FAULT	Raw Sewage Pump 2 Wetwell Gate	FAULT	NORMAL	DI	7701-09-N-013			
	14DCU64	14XA9650-03	14XA9650-03_FAULT	Raw Sewage Pump 3 Wetwell Gate	FAULT	NORMAL	DI	7701-09-N-014			
	14DCU64	14XA9650-04	14XA9650-04_FAULT	Raw Sewage Pump 4 Wetwell Gate	FAULT	NORMAL	DI	7701-09-N-015			
	14DCU64	14XA9650-05	14XA9650-05_FAULT	Raw Sewage Pump 5 Wetwell Gate	FAULT	NORMAL	DI	7701-09-N-016			
	14DCU64	14XA9670-01	14XA9670-01_FAULT	Raw Sewage Pump 1 Vent Valve	FAULT	NORMAL	DI	7701-09-N-012			

	14DCU64	14XA9670-02	14XA9670-02_FAULT	Raw Sewage Pump 2 Vent Valve	FAULT	NORMAL	DI	7701-09-N-013			
	14DCU64	14XA9670-03	14XA9670-03_FAULT	Raw Sewage Pump 3 Vent Valve	FAULT	NORMAL	DI	7701-09-N-014			
	14DCU64	14XA9670-04	14XA9670-04_FAULT	Raw Sewage Pump 4 Vent Valve	FAULT	NORMAL	DI	7701-09-N-015			
	14DCU64	14XA9670-05	14XA9670-05_FAULT	Raw Sewage Pump 5 Vent Valve	FAULT	NORMAL	DI	7701-09-N-016			
	14DCU64	14XA9677-01	14XA9677-01_FAULT	Raw Sewage Pump 1 Seal Water Flow Valve			DI	7701-09-N-012			
	14DCU64	14XA9677-02	14XA9677-02_FAULT	Raw Sewage Pump 2 Water Flow Valve	FAULT	NORMAL	DI	7701-09-N-013			
	14DCU64	14XA9677-03	14XA9677-03_FAULT	Raw Sewage Pump 3 Water Flow Valve	FAULT	NORMAL	DI	7701-09-N-014			
	14DCU64	14XA9677-04	14XA9677-04_FAULT	Raw Sewage Pump 4 Water Flow Valve	FAULT	NORMAL	DI	7701-09-N-015			
	14DCU64	14XA9677-05	14XA9677-05_FAULT	Raw Sewage Pump 5 Water Flow Valve	FAULT	NORMAL	DI	7701-09-N-016			
	14DCU64	14XA9820-01	14XA9820-01_TROUBLE	HVAC Control Panel [14CP0101]	TROUBLE	NORMAL	DI	7701-09-N-039			
	14DCU64	14XA9830-01	14XA9830-01_TROUBLE	Fire Alarm Control Panel [14FACP0100]	TROUBLE	NORMAL	DI	7701-09-N-039			
	14DCU64	14XA9830-02	14XA9830-02_ALARM	Fire Alarm Control Panel [14FACP0100]	FIRE	NORMAL	DI	7701-09-N-039			
	14DCU64	14XA9831-01	14XA9831-01_TROUBLE	Battery Charger [BC-14]	TROUBLE	NORMAL	DI	7701-09-N-039			
	14DCU64	14XA9926-01	14XA9926-01_FAULT	Grit Basin 1 Fluidizing Water Valve	FAULT	NORMAL	DI	7701-09-N-019			
	14DCU64	14XA9926-02	14XA9926-02_FAULT	Grit Basin 2 Fluidizing Water Valve	FAULT	NORMAL	DI	7701-09-N-019			
	14DCU64	14XA9926-03	14XA9926-03_FAULT	Grit Basin 3 Fluidizing Water Valve	FAULT	NORMAL	DI	7701-09-N-020			
	14DCU64	14XA9926-04	14XA9926-04_FAULT	Grit Basin 4 Fluidizing Water Valve	FAULT	NORMAL	DI	7701-09-N-020			
	14DCU64	14XA9926-05	14XA9926-05_FAULT	Grit Basin 5 Fluidizing Water Valve	FAULT	NORMAL	DI	7701-09-N-021			
	14DCU64	14XA9926-06	14XA9926-06_FAULT	Grit Basin 6 Fluidizing Water Valve	FAULT	NORMAL	DI	7701-09-N-021			
	14DCU64	14XA9950-01	14XA9950-01_FAULT	Switchgear Breaker 52-102A	FAULT	NORMAL	DI	7701-09-N-040			
	14DCU64	14XA9951-01	14XA9951-01_FAULT	Switchgear Breaker 52-102B	FAULT	NORMAL	DI	7701-09-N-040			
	14DCU64	14XA9952-01	14XA9952-01_FAULT	Switchgear Breaker 52-106A	FAULT	NORMAL	DI	7701-09-N-040			
	14DCU64	14XA9953-01	14XA9953-01_FAULT	Switchgear Breaker 52-103B	FAULT	NORMAL	DI	7701-09-N-040			
	14DCU64	14XA9953-02	14XA9953-02_FAULT	Switchgear Breaker 52-103B	FAULT	NORMAL	DI	7701-09-N-040			
	14DCU64	14XA9954-01	14XA9954-01_FAULT	Switchgear Breaker 52-103A	FAULT	NORMAL	DI	7701-09-N-040			
	14DCU64	14XA9954-02	14XA9954-02_FAULT	Switchgear Breaker 52-103A	FAULT	NORMAL	DI	7701-09-N-040			
	14DCU64	14XA9955-01	14XA9955-01_FAULT	Switchgear Breaker 52-107A	FAULT	NORMAL	DI	7701-09-N-040			
	14DCU64	14XA9955-02	14XA9955-02_FAULT	Switchgear Breaker 52-107A	FAULT	NORMAL	DI	7701-09-N-040			
	14DCU64	14XA9955-03	14XA9955-03_FAULT	Switchgear Breaker 52-107A Power Monitor	FAULT	NORMAL	DI	7701-09-N-040			
	14DCU64	14XA9956-01	14XA9956-01_FAULT	Switchgear Breaker 52-106B	FAULT	NORMAL	DI	7701-09-N-040			
	14DCU64	14XA9957-01	14XA9957-01_FAULT	Switchgear Breaker 52-107B	FAULT	NORMAL	DI	7701-09-N-040			
	14DCU64	14XA9958-01	14XA9958-01_FAULT	Switchgear Breaker 52-105A	FAULT	NORMAL	DI	7701-09-N-040			
	14DCU64	14XA9958-02	14XA9958-02_FAULT	Switchgear Breaker 52-105A	FAULT	NORMAL	DI	7701-09-N-040			
	14DCU64	14XA9960-01	14XA9960-01_FAULT	Switchgear Breaker 52-101B	FAULT	NORMAL	DI	7701-09-N-040			
	14DCU64	14XL9501-01A	14XL9501-01A_DSC CLOSED	Influent Screen 1 Influent Gate DSC	OPENED	CLOSED	DI	7701-09-N-005			
	14DCU64	14XL9501-02A	14XL9501-02A_DSC CLOSED	Influent Screen 2 Influent Gate DSC	OPENED	CLOSED	DI	7701-09-N-005			
	14DCU64	14XL9501-03A	14XL9501-03A_DSC CLOSED	Influent Screen 3 Influent Gate DSC	OPENED	CLOSED	DI	7701-09-N-005			
	14DCU64	14XL9505-01A	14XL9505-01A_DSC CLOSED	Influent Screen 1 Effluent Gate DSC	OPENED	CLOSED	DI	7701-09-N-007			
	14DCU64	14XL9505-02A	14XL9505-02A_DSC CLOSED	Influent Screen 2 Effluent Gate DSC	OPENED	CLOSED	DI	7701-09-N-007			
	14DCU64	14XL9505-03A	14XL9505-03A_DSC CLOSED	Influent Screen 3 Effluent Gate DSC	OPENED	CLOSED	DI	7701-09-N-007			
	14DCU64	14XL9508-01B	14XL9508-01B_DSC CLOSED	Influent Screen 1 DSC	OPENED	CLOSED	DI	7701-09-N-006			
	14DCU64	14XL9508-02B	14XL9508-02B_DSC CLOSED	Influent Screen 2 DSC	OPENED	CLOSED	DI	7701-09-N-006			
	14DCU64	14XL9508-03B	14XL9508-03B_DSC CLOSED	Influent Screen 3 DSC	OPENED	CLOSED	DI	7701-09-N-006			
	14DCU64	14XL9510-01	14XL9510-01_DSC CLOSED	Screening Trough Flow DSC	OPENED	CLOSED	DI	7701-09-N-006			
	14DCU64	14XL9510-01A	14XL9510-01B_POWER ON	Screening Trough Flow	OFF	POWERED	DI	7701-09-N-006			
	14DCU64	14XL9520-01A	14XL9520-01A_DSC CLOSED	Screenings Compactor 1 Inlet Valve DSC	OPENED	CLOSED	DI	7701-09-N-008			
	14DCU64	14XL9520-01B	14XL9520-01B_POWER ON	Screenings Compactor 1 Inlet Valve	OFF	POWERED	DI	7701-09-N-008			
	14DCU64	14XL9520-02A	14XL9520-02A_DSC CLOSED	Screenings Compactor 2 Inlet Valve DSC	OPENED	CLOSED	DI	7701-09-N-008			
	14DCU64	14XL9520-02B	14XL9520-02B_POWER ON	Screenings Compactor 2 Inlet Valve	OFF	POWERED	DI	7701-09-N-008			
	14DCU64	14XL9520-03A	14XL9520-03A_DSC CLOSED	Screenings Compactor 3 Inlet Valve DSC	OPENED	CLOSED	DI	7701-09-N-009			
	14DCU64	14XL9520-03B	14XL9520-03B_POWER ON	Screenings Compactor 3 Inlet Valve	OFF	POWERED	DI	7701-09-N-009			
	14DCU64	14XL9520-04A	14XL9520-04A_DSC CLOSED	Screenings Compactor 4 Inlet Valve DSC	OPENED	CLOSED	DI	7701-09-N-009			

	14DCU64	14XL9520-04B	14XL9520-04B_POWER ON	Screenings Compactor 4 Inlet Valve	OFF	POWERED	DI	7701-09-N-009			
	14DCU64	14XL9521-01B	14XL9521-01B_DSC CLOSED	Screenings Compactor 1 DSC	OPENED	CLOSED	DI	7701-09-N-008			
	14DCU64	14XL9521-02B	14XL9521-02B_DSC CLOSED	Screenings Compactor 2 DSC	OPENED	CLOSED	DI	7701-09-N-008			
	14DCU64	14XL9521-03B	14XL9521-03B_DSC CLOSED	Screenings Compactor 3 DSC	OPENED	CLOSED	DI	7701-09-N-009			
	14DCU64	14XL9521-04B	14XL9521-04B_DSC CLOSED	Screenings Compactor 4 DSC	OPENED	CLOSED	DI	7701-09-N-009			
	14DCU64	14XL9522-01A	14XL9522-01A_DSC CLOSED	Screenings Compactor 1 Flush Water Valve DSC	OPENED	CLOSED	DI	7701-09-N-008			
	14DCU64	14XL9522-01B	14XL9522-01B_POWER ON	Screenings Compactor 1 Flush Water Valve	OFF	POWERED	DI	7701-09-N-008			
	14DCU64	14XL9522-02A	14XL9522-02A_DSC CLOSED	Screenings Compactor 2 Flush Water Valve DSC	OPENED	CLOSED	DI	7701-09-N-008			
	14DCU64	14XL9522-02B	14XL9522-02B_POWER ON	Screenings Compactor 2 Flush Water Valve	OFF	POWERED	DI	7701-09-N-008			
	14DCU64	14XL9522-03A	14XL9522-03A_DSC CLOSED	Screenings Compactor 3 Flush Water Valve DSC	OPENED	CLOSED	DI	7701-09-N-009			
	14DCU64	14XL9522-03B	14XL9522-03B_POWER ON	Screenings Compactor 3 Flush Water Valve	OFF	POWERED	DI	7701-09-N-009			
	14DCU64	14XL9522-04A	14XL9522-04A_DSC CLOSED	Screenings Compactor 4 Flush Water Valve DSC	OPENED	CLOSED	DI	7701-09-N-009			
	14DCU64	14XL9522-04B	14XL9522-04B_POWER ON	Screenings Compactor 4 Flush Water Valve	OFF	POWERED	DI	7701-09-N-009			
	14DCU64	14XL9523-01A	14XL9523-01A_DSC CLOSED	Screenings Compactor Flush Water Pressure DSC	OPENED	CLOSED	DI	7701-09-N-008			
	14DCU64	14XL9523-01B	14XL9523-01B_POWER ON	Screenings Compactor Flush Water Pressure	OFF	POWERED	DI	7701-09-N-008			
	14DCU64	14XL9525-01B	14XL9525-01B_DSC CLOSED	Screenings Winch 1 DSC	OPENED	CLOSED	DI	7701-09-N-008			
	14DCU64	14XL9525-02B	14XL9525-02B_DSC CLOSED	Screenings Winch 2 DSC	OPENED	CLOSED	DI	7701-09-N-009			
	14DCU64	14XL9530-01A	14XL9530-01A_DSC CLOSED	Grit Basin 1 Inlet Gate DSC	OPENED	CLOSED	DI	7701-09-N-019			
	14DCU64	14XL9530-01B	14XL9530-01B_POWER ON	Grit Basin 1 Inlet Gate	OFF	POWERED	DI	7701-09-N-019			
	14DCU64	14XL9530-02A	14XL9530-02A_DSC CLOSED	Grit Basin 2 Inlet Gate DSC	OPENED	CLOSED	DI	7701-09-N-019			
	14DCU64	14XL9530-02B	14XL9530-02B_POWER ON	Grit Basin 2 Inlet Gate	OFF	POWERED	DI	7701-09-N-019			
	14DCU64	14XL9530-03A	14XL9530-03A_DSC CLOSED	Grit Basin 3 Inlet Gate DSC	OPENED	CLOSED	DI	7701-09-N-020			
	14DCU64	14XL9530-03B	14XL9530-03B_POWER ON	Grit Basin 3 Inlet Gate	OFF	POWERED	DI	7701-09-N-020			
14DCU64	14DCU64	14XL9530-04A	14XL9530-04A_DSC CLOSED	Grit Basin 4 Inlet Gate DSC	OPENED	CLOSED	DI	7701-09-N-020			
	14DCU64	14XL9530-04B	14XL9530-04B_POWER ON	Grit Basin 4 Inlet Gate	OFF	POWERED	DI	7701-09-N-020			
	14DCU64	14XL9530-05A	14XL9530-05A_DSC CLOSED	Grit Basin 5 Inlet Gate DSC	OPENED	CLOSED	DI	7701-09-N-021			
	14DCU64	14XL9530-05B	14XL9530-05B_POWER ON	Grit Basin 5 Inlet Gate	OFF	POWERED	DI	7701-09-N-021			
	14DCU64	14XL9530-06A	14XL9530-06A_DSC CLOSED	Grit Basin 6 Inlet Gate DSC	OPENED	CLOSED	DI	7701-09-N-021			
	14DCU64	14XL9530-06B	14XL9530-06B_POWER ON	Grit Basin 6 Inlet Gate	OFF	POWERED	DI	7701-09-N-021			
	14DCU64	14XL9533-01A	14XL9533-01A_DSC CLOSED	Grit Basins Effluent Channel Emergency Overflow Gate DSC	OPENED	CLOSED	DI	7701-09-N-019			
	14DCU64	14XL9533-01B	14XL9533-01B_POWER ON	Grit Basins Effluent Channel Emergency Overflow Gate	OFF	POWERED	DI	7701-09-N-019			
	14DCU64	14XL9601-01B	14XL9601-01B_DSC CLOSED	Grit Pump 1 DSC	OPENED	CLOSED	DI	7701-09-N-022			
	14DCU64	14XL9601-02B	14XL9601-02B_DSC CLOSED	Grit Pump 2 DSC	OPENED	CLOSED	DI	7701-09-N-023			
	14DCU64	14XL9601-03B	14XL9601-03B_DSC CLOSED	Grit Pump 3 DSC	OPENED	CLOSED	DI	7701-09-N-024			
	14DCU64	14XL9601-04B	14XL9601-04B_DSC CLOSED	Grit Pump 4 DSC	OPENED	CLOSED	DI	7701-09-N-025			
	14DCU64	14XL9601-05B	14XL9601-05B_DSC CLOSED	Grit Pump 5 DSC	OPENED	CLOSED	DI	7701-09-N-026			
	14DCU64	14XL9601-06B	14XL9601-06B_DSC CLOSED	Grit Pump 6 DSC	OPENED	CLOSED	DI	7701-09-N-027			
	14DCU64	14XL9602-01	14XL9602-01_DSC CLOSED	Grit Pump 1 Discharge Flow DSC	OPENED	CLOSED	DI	7701-09-N-022			
	14DCU64	14XL9602-02	14XL9602-02_DSC CLOSED	Grit Pump 2 Discharge Flow DSC	OPENED	CLOSED	DI	7701-09-N-023			
	14DCU64	14XL9602-02	14XL9602-03_DSC CLOSED	Grit Pump 3 Discharge Flow DSC	OPENED	CLOSED	DI	7701-09-N-024			
	14DCU64	14XL9602-04	14XL9602-04_DSC CLOSED	Grit Pump 4 Discharge Flow DSC	OPENED	CLOSED	DI	7701-09-N-025			
	14DCU64	14XL9602-05	14XL9602-05_DSC CLOSED	Grit Pump 5 Discharge Flow DSC	OPENED	CLOSED	DI	7701-09-N-026			
	14DCU64	14XL9602-06	14XL9602-06_DSC CLOSED	Grit Pump 6 Discharge Flow DSC	OPENED	CLOSED	DI	7701-09-N-027			
	14DCU64	14XL9603-01B	14XL9603-01B_DSC CLOSED	Grit Classifier 1 DSC	OPENED	CLOSED	DI	7701-09-N-022			
	14DCU64	14XL9603-02B	14XL9603-02B_DSC CLOSED	Grit Classifier 2 DSC	OPENED	CLOSED	DI	7701-09-N-023			
	14DCU64	14XL9603-03B	14XL9603-03B_DSC CLOSED	Grit Classifier 3 DSC	OPENED	CLOSED	DI	7701-09-N-024			
	14DCU64	14XL9603-04B	14XL9603-04B_DSC CLOSED	Grit Classifier 4 DSC	OPENED	CLOSED	DI	7701-09-N-025			
	14DCU64	14XL9603-05B	14XL9603-05B_DSC CLOSED	Grit Classifier 5 DSC	OPENED	CLOSED	DI	7701-09-N-026			
	14DCU64	14XL9603-06B	14XL9603-06B_DSC CLOSED	Grit Classifier 6 DSC	OPENED	CLOSED	DI	7701-09-N-027			
	14DCU64	14XL9604-01A	14XL9604-01A_DSC CLOSED	Grit Washer 1 Overflow Valve DSC	OPENED	CLOSED	DI	7701-09-N-022			
	14DCU64	14XL9604-01B	14XL9604-01B_POWER ON	Grit Washer 1 Overflow Valve	OFF	POWERED	DI	7701-09-N-022			
	14DCU64	14XL9604-02A	14XL9604-02A_DSC CLOSED	Grit Washer 2 Overflow Valve DSC	OPENED	CLOSED	DI	7701-09-N-023			

	14DCU64	14XL9604-02B	14XL9604-02B_POWER ON	Grit Washer 2 Overflow Valve	OFF	POWERED	DI	7701-09-N-023			
	14DCU64	14XL9604-03A	14XL9604-03A_DSC CLOSED	Grit Washer 3 Overflow Valve DSC	OPENED	CLOSED	DI	7701-09-N-024			
	14DCU64	14XL9604-03B	14XL9604-03B_POWER ON	Grit Washer 3 Overflow Valve	OFF	POWERED	DI	7701-09-N-024			
	14DCU64	14XL9604-04A	14XL9604-04A_DSC CLOSED	Grit Washer 4 Overflow Valve DSC	OPENED	CLOSED	DI	7701-09-N-025			
	14DCU64	14XL9604-04B	14XL9604-04B_POWER ON	Grit Washer 4 Overflow Valve	OFF	POWERED	DI	7701-09-N-025			
	14DCU64	14XL9604-05A	14XL9604-05A_DSC CLOSED	Grit Washer 5 Overflow Valve DSC	OPENED	CLOSED	DI	7701-09-N-026			
	14DCU64	14XL9604-05B	14XL9604-05B_POWER ON	Grit Washer 5 Overflow Valve	OFF	POWERED	DI	7701-09-N-026			
	14DCU64	14XL9604-06A	14XL9604-06A_DSC CLOSED	Grit Washer 6 Overflow Valve DSC	OPENED	CLOSED	DI	7701-09-N-027			
	14DCU64	14XL9604-06B	14XL9604-06B_POWER ON	Grit Washer 6 Overflow Valve	OFF	POWERED	DI	7701-09-N-027			
	14DCU64	14XL9605-01B	14XL9605-01B_DSC CLOSED	Grit Washer 1 DSC	OPENED	CLOSED	DI	7701-09-N-022			
	14DCU64	14XL9605-02B	14XL9605-02B_DSC CLOSED	Grit Washer 2 DSC	OPENED	CLOSED	DI	7701-09-N-023			
	14DCU64	14XL9605-03B	14XL9605-03B_DSC CLOSED	Grit Washer 3 DSC	OPENED	CLOSED	DI	7701-09-N-024			
	14DCU64	14XL9605-04B	14XL9605-04B_DSC CLOSED	Grit Washer 4 DSC	OPENED	CLOSED	DI	7701-09-N-025			
	14DCU64	14XL9605-05B	14XL9605-05B_DSC CLOSED	Grit Washer 5 DSC	OPENED	CLOSED	DI	7701-09-N-026			
	14DCU64	14XL9605-06B	14XL9605-06B_DSC CLOSED	Grit Washer 6 DSC	OPENED	CLOSED	DI	7701-09-N-027			
	14DCU64	14XL9649-01A	14XL9649-01A_DSC CLOSED	Raw Sewage Pump 1 Wetwell Gate DSC	OPENED	CLOSED	DI	7701-09-N-012			
	14DCU64	14XL9649-01B	14XL9649-01B_POWER ON	Raw Sewage Pump 1 Wetwell Gate	OFF	POWERED	DI	7701-09-N-012			
	14DCU64	14XL9649-02A	14XL9649-02A_DSC CLOSED	Raw Sewage Pump 2 Wetwell Gate DSC	OPENED	CLOSED	DI	7701-09-N-013			
	14DCU64	14XL9649-02B	14XL9649-02B_POWER ON	Raw Sewage Pump 2 Wetwell Gate	OFF	POWERED	DI	7701-09-N-013			
	14DCU64	14XL9649-03A	14XL9649-03A_DSC CLOSED	Raw Sewage Pump 3 Wetwell Gate DSC	OPENED	CLOSED	DI	7701-09-N-014			
	14DCU64	14XL9649-03B	14XL9649-03B_POWER ON	Raw Sewage Pump 3 Wetwell Gate	OFF	POWERED	DI	7701-09-N-014			
	14DCU64	14XL9649-04A	14XL9649-04A_DSC CLOSED	Raw Sewage Pump 4 Wetwell Gate DSC	OPENED	CLOSED	DI	7701-09-N-015			
	14DCU64	14XL9649-04B	14XL9649-04B_POWER ON	Raw Sewage Pump 4 Wetwell Gate	OFF	POWERED	DI	7701-09-N-015			
	14DCU64	14XL9649-05A	14XL9649-05A_DSC CLOSED	Raw Sewage Pump 5 Wetwell Gate DSC	OPENED	CLOSED	DI	7701-09-N-016			
	14DCU64	14XL9649-05B	14XL9649-05B_POWER ON	Raw Sewage Pump 5 Wetwell Gate	OFF	POWERED	DI	7701-09-N-016			
	14DCU64	14XL9650-01A	14XL9650-01A_DSC CLOSED	Raw Sewage Pump 1 Wetwell Gate DSC	OPENED	CLOSED	DI	7701-09-N-012			
	14DCU64	14XL9650-01B	14XL9650-01B_POWER ON	Raw Sewage Pump 1 Wetwell Gate	OFF	POWERED	DI	7701-09-N-012			
	14DCU64	14XL9650-02A	14XL9650-02A_DSC CLOSED	Raw Sewage Pump 2 Wetwell Gate DSC	OPENED	CLOSED	DI	7701-09-N-013			
	14DCU64	14XL9650-02B	14XL9650-02B_POWER ON	Raw Sewage Pump 2 Wetwell Gate	OFF	POWERED	DI	7701-09-N-013			
	14DCU64	14XL9650-03A	14XL9650-03A_DSC CLOSED	Raw Sewage Pump 3 Wetwell Gate DSC	OPENED	CLOSED	DI	7701-09-N-014			
	14DCU64	14XL9650-03B	14XL9650-03B_POWER ON	Raw Sewage Pump 3 Wetwell Gate	OFF	POWERED	DI	7701-09-N-014			
	14DCU64	14XL9650-04A	14XL9650-04A_DSC CLOSED	Raw Sewage Pump 4 Wetwell Gate DSC	OPENED	CLOSED	DI	7701-09-N-015			
	14DCU64	14XL9650-04B	14XL9650-04B_POWER ON	Raw Sewage Pump 4 Wetwell Gate	OFF	POWERED	DI	7701-09-N-015			
	14DCU64	14XL9650-05A	14XL9650-05A_DSC CLOSED	Raw Sewage Pump 5 Wetwell Gate DSC	OPENED	CLOSED	DI	7701-09-N-016			
	14DCU64	14XL9650-05B	14XL9650-05B_POWER ON	Raw Sewage Pump 5 Wetwell Gate	OFF	POWERED	DI	7701-09-N-016			
	14DCU64	14XL9655-01B	14XL9655-01B_DSC CLOSED	Raw Sewage Pump 1 DSC	OPENED	CLOSED	DI	7701-09-N-012			
	14DCU64	14XL9655-02B	14XL9655-02B_DSC CLOSED	Raw Sewage Pump 2 DSC	OPENED	CLOSED	DI	7701-09-N-013			
	14DCU64	14XL9655-03B	14XL9655-03B_DSC CLOSED	Raw Sewage Pump 3 DSC	OPENED	CLOSED	DI	7701-09-N-014			
	14DCU64	14XL9655-04B	14XL9655-04B_DSC CLOSED	Raw Sewage Pump 4 DSC	OPENED	CLOSED	DI	7701-09-N-015			
	14DCU64	14XL9655-05B	14XL9655-05B_DSC CLOSED	Raw Sewage Pump 5 DSC	OPENED	CLOSED	DI	7701-09-N-016			
	14DCU64	14XL9669-01	14XL9669-01_DSC CLOSED	Raw Sewage Pump 1 Discharge Flow DSC	OPENED	CLOSED	DI	7701-09-N-012			
	14DCU64	14XL9669-02	14XL9669-02_DSC CLOSED	Raw Sewage Pump 2 Discharge Flow DSC	OPENED	CLOSED	DI	7701-09-N-013			
	14DCU64	14XL9669-02	14XL9669-02_DSC CLOSED	Raw Sewage Pump 2 Discharge Flow DSC	OPENED	CLOSED	DI	7701-09-N-013			
	14DCU64	14XL9669-03	14XL9669-03_DSC CLOSED	Raw Sewage Pump 3 Discharge Flow DSC	OPENED	CLOSED	DI	7701-09-N-014			
	14DCU64	14XL9669-04	14XL9669-04_DSC CLOSED	Raw Sewage Pump 4 Discharge Flow DSC	OPENED	CLOSED	DI	7701-09-N-015			
	14DCU64	14XL9669-05	14XL9669-05_DSC CLOSED	Raw Sewage Pump 5 Discharge Flow DSC	OPENED	CLOSED	DI	7701-09-N-016			
	14DCU64	14XL9670-01A	14XL9670-01A_DSC CLOSED	Raw Sewage Pump 1 Vent Valve DSC	OPENED	CLOSED	DI	7701-09-N-012			
	14DCU64	14XL9670-01B	14XL9670-01B_POWER ON	Raw Sewage Pump 1 Vent Valve	OFF	POWERED	DI	7701-09-N-012			
	14DCU64	14XL9670-02A	14XL9670-02A_DSC CLOSED	Raw Sewage Pump 2 Vent Valve DSC	OPENED	CLOSED	DI	7701-09-N-013			
	14DCU64	14XL9670-02B	14XL9670-02B_POWER ON	Raw Sewage Pump 2 Vent Valve	OFF	POWERED	DI	7701-09-N-013			
	14DCU64	14XL9670-03A	14XL9670-03A_DSC CLOSED	Raw Sewage Pump 3 Vent Valve DSC	OPENED	CLOSED	DI	7701-09-N-014			
	14DCU64	14XL9670-03B	14XL9670-03B_POWER ON	Raw Sewage Pump 3 Vent Valve	OFF	POWERED	DI	7701-09-N-014			

	14DCU64	14XL9670-04A	14XL9670-04A_DSC CLOSED	Raw Sewage Pump 4 Vent Valve DSC	OPENED	CLOSED	DI	7701-09-N-015			
	14DCU64	14XL9670-04B	14XL9670-04B_POWER ON	Raw Sewage Pump 4 Vent Valve	OFF	POWERED	DI	7701-09-N-015			
	14DCU64	14XL9670-05A	14XL9670-05A_DSC CLOSED	Raw Sewage Pump 5 Vent Valve DSC	OPENED	CLOSED	DI	7701-09-N-016			
	14DCU64	14XL9670-05B	14XL9670-05B_POWER ON	Raw Sewage Pump 5 Vent Valve	OFF	POWERED	DI	7701-09-N-016			
	14DCU64	14XL9676-01A	14XL9676-01A_DSC CLOSED	Raw Sewage Pump 1 Seal Water Flow DSC	OPENED	CLOSED	DI	7701-09-N-012			
	14DCU64	14XL9676-02A	14XL9676-02A_DSC CLOSED	Raw Sewage Pump 2 Water Flow DSC	OPENED	CLOSED	DI	7701-09-N-013			
	14DCU64	14XL9676-03A	14XL9676-03A_DSC CLOSED	Raw Sewage Pump 3 Water Flow DSC	OPENED	CLOSED	DI	7701-09-N-014			
	14DCU64	14XL9676-04A	14XL9676-04A_DSC CLOSED	Raw Sewage Pump 4 Water Flow DSC	OPENED	CLOSED	DI	7701-09-N-015			
	14DCU64	14XL9676-05A	14XL9676-05A_DSC CLOSED	Raw Sewage Pump 5 Water Flow DSC	OPENED	CLOSED	DI	7701-09-N-016			
	14DCU64	14XL9677-01A	14XL9677-01A_DSC CLOSED	Raw Sewage Pump 1 Seal Water Flow Valve DSC	OPENED	CLOSED	DI	7701-09-N-012			
	14DCU64	14XL9677-01B	14XL9677-01B_POWER ON	Raw Sewage Pump 1 Seal Water Flow Valve	OFF	POWERED	DI	7701-09-N-012			
	14DCU64	14XL9677-02A	14XL9677-02A_DSC CLOSED	Raw Sewage Pump 2 Water Flow Valve DSC	OPENED	CLOSED	DI	7701-09-N-013			
	14DCU64	14XL9677-02B	14XL9677-02B_POWER ON	Raw Sewage Pump 2 Water Flow Valve	OFF	POWERED	DI	7701-09-N-013			
	14DCU64	14XL9677-03A	14XL9677-03A_DSC CLOSED	Raw Sewage Pump 3 Water Flow Valve DSC	OPENED	CLOSED	DI	7701-09-N-014			
	14DCU64	14XL9677-03B	14XL9677-03B_POWER ON	Raw Sewage Pump 3 Water Flow Valve	OFF	POWERED	DI	7701-09-N-014			
	14DCU64	14XL9677-04A	14XL9677-04A_DSC CLOSED	Raw Sewage Pump 4 Water Flow Valve DSC	OPENED	CLOSED	DI	7701-09-N-015			
	14DCU64	14XL9677-04B	14XL9677-04B_POWER ON	Raw Sewage Pump 4 Water Flow Valve	OFF	POWERED	DI	7701-09-N-015			
	14DCU64	14XL9677-05A	14XL9677-05A_DSC CLOSED	Raw Sewage Pump 5 Water Flow Valve DSC	OPENED	CLOSED	DI	7701-09-N-016			
	14DCU64	14XL9677-05B	14XL9677-05B_POWER ON	Raw Sewage Pump 5 Water Flow Valve	OFF	POWERED	DI	7701-09-N-016			
	14DCU64	14XL9701-01B	14XL9701-01B_DSC CLOSED	Odor Control Exhaust Fan 1 DSC	OPENED	CLOSED	DI	7701-09-N-033			
	14DCU64	14XL9701-02B	14XL9701-02B_DSC CLOSED	Odor Control Exhaust Fan 2 DSC	OPENED	CLOSED	DI	7701-09-N-033			
	14DCU64	14XL9706-01	14XL9706-01_DSC CLOSED	Biotower Scrubber Recirculation pH DSC	OPENED	CLOSED	DI	7701-09-N-034			
	14DCU64	14XL9708-01B	14XL9708-01B_DSC CLOSED	Biotower Scrubber Recirculation Pump DSC	OPENED	CLOSED	DI	7701-09-N-034			
	14DCU64	14XL9710-01	14XL9710-01_DSC CLOSED	Odor Control Water Panel Makeup H2O Pressure DSC	OPENED	CLOSED	DI	7701-09-N-034			
	14DCU64	14XL9725-01B	14XL9725-01B_DSC CLOSED	HW3 Recycle Pump Station - Pump 1 DSC	OPENED	CLOSED	DI	7701-09-N-038			
	14DCU64	14XL9725-02B	14XL9725-02B_DSC CLOSED	HW3 Recycle Pump Station - Pump 2 DSC	OPENED	CLOSED	DI	7701-09-N-038			
	14DCU64	14XL9725-03B	14XL9725-03B_DSC CLOSED	HW3 Recycle Pump Station - Pump 3 DSC	OPENED	CLOSED	DI	7701-09-N-038			
	14DCU64	14XL9728-00	14XL9728-00_DSC CLOSED	HW3 Recycle Pump Station Flow DSC	OPENED	CLOSED	DI	7701-09-N-001			
	14DCU64	14XL9739-01B	14XL9739-01B_DSC CLOSED	Grit Room Sump Pump 1 DSC	OPENED	CLOSED	DI	7701-09-N-039			
	14DCU64	14XL9800-01	14XL9800-01_DSC CLOSED	HW3 Electrical Building Air Handling Unit 1	OPENED	CLOSED	DI	7701-09-N-039			
	14DCU64	14XL9800-02	14XL9800-02_DSC CLOSED	HW3 Electrical Building Air Handling Unit 2	OPENED	CLOSED	DI	7701-09-N-039			
	14DCU64	14XL9801-01	14XL9801-01_DSC CLOSED	Battery Room Fan DSC	OPENED	CLOSED	DI	7701-09-N-039			
	14DCU64	14XL9808-01B	14XL9808-01B_DSC CLOSED	Grit Room Supply Fan DSC	OPENED	CLOSED	DI	7701-09-N-039			
	14DCU64	14XL9809-01B	14XL9809-01B_DSC CLOSED	Grit Room Exhaust Fan DSC	OPENED	CLOSED	DI	7701-09-N-039			
	14DCU64	14XL9810-01	14XL9810-01_DSC CLOSED	HW3 Electrical Building Air Condensing Unit 1	OPENED	CLOSED	DI	7701-09-N-039			
	14DCU64	14XL9810-02	14XL9810-02_DSC CLOSED	HW3 Electrical Building Air Condensing Unit 2	OPENED	CLOSED	DI	7701-09-N-039			
	14DCU64	14XL9830-01	14XL9830-01_SUPERVISORY	Fire Alarm Control Panel [14FACP0100]	SUPERVISORY	NORMAL	DI	7701-09-N-039			
	14DCU64	14XL9831-01	14XL9831-01_DSC CLOSED	Battery Charger [BC-14] DSC	OPENED	CLOSED	DI	7701-09-N-039			
	14DCU64	14XL9926-01A	14XL9926-01A_DSC CLOSED	Grit Basin 1 Fluidizing Water Valve DSC	OPENED	CLOSED	DI	7701-09-N-019			
	14DCU64	14XL9926-01B	14XL9926-01B_POWER ON	Grit Basin 1 Fluidizing Water Valve	OFF	POWERED	DI	7701-09-N-019			
	14DCU64	14XL9926-02A	14XL9926-02A_DSC CLOSED	Grit Basin 2 Fluidizing Water Valve DSC	OPENED	CLOSED	DI	7701-09-N-019			
	14DCU64	14XL9926-02B	14XL9926-02B_POWER ON	Grit Basin 2 Fluidizing Water Valve	OFF	POWERED	DI	7701-09-N-019			
	14DCU64	14XL9926-03A	14XL9926-03A_DSC CLOSED	Grit Basin 3 Fluidizing Water Valve DSC	OPENED	CLOSED	DI	7701-09-N-020			
	14DCU64	14XL9926-03B	14XL9926-03B_POWER ON	Grit Basin 3 Fluidizing Water Valve	OFF	POWERED	DI	7701-09-N-020			
	14DCU64	14XL9926-04A	14XL9926-04A_DSC CLOSED	Grit Basin 4 Fluidizing Water Valve DSC	OPENED	CLOSED	DI	7701-09-N-020			
	14DCU64	14XL9926-04B	14XL9926-04B_POWER ON	Grit Basin 4 Fluidizing Water Valve	OFF	POWERED	DI	7701-09-N-020			
	14DCU64	14XL9926-05A	14XL9926-05A_DSC CLOSED	Grit Basin 5 Fluidizing Water Valve DSC	OPENED	CLOSED	DI	7701-09-N-021			
	14DCU64	14XL9926-05B	14XL9926-05B_POWER ON	Grit Basin 5 Fluidizing Water Valve	OFF	POWERED	DI	7701-09-N-021			
	14DCU64	14XL9926-06A	14XL9926-06A_DSC CLOSED	Grit Basin 6 Fluidizing Water Valve DSC	OPENED	CLOSED	DI	7701-09-N-021			
	14DCU64	14XL9926-06B	14XL9926-06B_POWER ON	Grit Basin 6 Fluidizing Water Valve	OFF	POWERED	DI	7701-09-N-021			
	14DCU64	14XL9950-01	14XL9950-01_TRIP	Switchgear Breaker 52-102A	TRIP	NORMAL	DI	7701-09-N-040			
	14DCU64	14XL9951-01	14XL9951-01_TRIP	Switchgear Breaker 52-102B	TRIP	NORMAL	DI	7701-09-N-040			

	14DCU64	14XL9952-01	14XL9952-01_TRIP	Switchgear Breaker 52-106A	TRIP	NORMAL	DI	7701-09-N-040			
	14DCU64	14XL9953-01	14XL9953-01_TRIP	Switchgear Breaker 52-103B	TRIP	NORMAL	DI	7701-09-N-040			
	14DCU64	14XL9954-01	14XL9954-01_TRIP	Switchgear Breaker 52-103A	TRIP	NORMAL	DI	7701-09-N-040			
	14DCU64	14XL9955-01	14XL9955-01_TRIP	Switchgear Breaker 52-107A	TRIP	NORMAL	DI	7701-09-N-040			
	14DCU64	14XL9956-01	14XL9956-01_TRIP	Switchgear Breaker 52-106B	TRIP	NORMAL	DI	7701-09-N-040			
	14DCU64	14XL9957-01	14XL9957-01_TRIP	Switchgear Breaker 52-107B	TRIP	NORMAL	DI	7701-09-N-040			
	14DCU64	14XL9958-01	14XL9958-01_TRIP	Switchgear Breaker 52-105A	TRIP	NORMAL	DI	7701-09-N-040			
	14DCU64	14XL9960-01	14XL9960-01_TRIP	Switchgear Breaker 52-101B	TRIP	NORMAL	DI	7701-09-N-040			
	14DCU64	14ZI9508-01	14ZI9508-01_HOME POSITION	Influent Screen 1		HOME	DI	7701-09-N-006			
	14DCU64	14ZI9508-02	14ZI9508-02_HOME POSITION	Influent Screen 2		HOME	DI	7701-09-N-006			
	14DCU64	14ZI9508-03	14ZI9508-03_HOME POSITION	Influent Screen 3		HOME	DI	7701-09-N-006			
	14DCU64	14ZIH9501-01	14ZIH9501-01_OPENED	Influent Screen 1 Influent Gate	NOT OPENED	OPENED	DI	7701-09-N-005			
	14DCU64	14ZIH9501-02	14ZIH9501-02_OPENED	Influent Screen 2 Influent Gate	NOT OPENED	OPENED	DI	7701-09-N-005			
	14DCU64	14ZIH9501-03	14ZIH9501-03_OPENED	Influent Screen 3 Influent Gate	NOT OPENED	OPENED	DI	7701-09-N-005			
	14DCU64	14ZIH9505-01	14ZIH9505-01_OPENED	Influent Screen 1 Effluent Gate	NOT OPENED	OPENED	DI	7701-09-N-007			
	14DCU64	14ZIH9505-02	14ZIH9505-02_OPENED	Influent Screen 2 Effluent Gate	NOT OPENED	OPENED	DI	7701-09-N-007			
	14DCU64	14ZIH9505-03	14ZIH9505-03_OPENED	Influent Screen 3 Effluent Gate	NOT OPENED	OPENED	DI	7701-09-N-007			
	14DCU64	14ZIH9510-01	14ZIH9510-01_OPENED	Screening Trough Flow	NOT OPENED	OPENED	DI	7701-09-N-006			
	14DCU64	14ZIH9520-01	14ZIH9520-01_OPENED	Screenings Compactor 1 Inlet Valve	NOT OPENED	OPENED	DI	7701-09-N-008			
	14DCU64	14ZIH9520-02	14ZIH9520-02_OPENED	Screenings Compactor 2 Inlet Valve	NOT OPENED	OPENED	DI	7701-09-N-008			
	14DCU64	14ZIH9520-03	14ZIH9520-03_OPENED	Screenings Compactor 3 Inlet Valve	NOT OPENED	OPENED	DI	7701-09-N-009			
	14DCU64	14ZIH9520-04	14ZIH9520-04_OPENED	Screenings Compactor 4 Inlet Valve	NOT OPENED	OPENED	DI	7701-09-N-009			
	14DCU64	14ZIH9522-01	14ZIH9522-01_OPENED	Screenings Compactor 1 Flush Water Valve	NOT OPENED	OPENED	DI	7701-09-N-008			
	14DCU64	14ZIH9522-02	14ZIH9522-02_OPENED	Screenings Compactor 2 Flush Water Valve	NOT OPENED	OPENED	DI	7701-09-N-008			
	14DCU64	14ZIH9522-03	14ZIH9522-03_OPENED	Screenings Compactor 3 Flush Water Valve	NOT OPENED	OPENED	DI	7701-09-N-009			
	14DCU64	14ZIH9522-04	14ZIH9522-04_OPENED	Screenings Compactor 4 Flush Water Valve	NOT OPENED	OPENED	DI	7701-09-N-009			
	14DCU64	14ZIH9523-01	14ZIH9523-01_OPENED	Screenings Compactor Flush Water Pressure	NOT OPENED	OPENED	DI	7701-09-N-008			
	14DCU64	14ZIH9533-01	14ZIH9533-01_OPENED	Grit Basins Effluent Channel Emergency Overflow Gate	NOT OPENED	OPENED	DI	7701-09-N-019			
	14DCU64	14ZIH9604-01	14ZIH9604-01_OPENED	Grit Washer 1 Overflow Valve	NOT OPENED	OPENED	DI	7701-09-N-022			
	14DCU64	14ZIH9604-02	14ZIH9604-02_OPENED	Grit Washer 2 Overflow Valve	NOT OPENED	OPENED	DI	7701-09-N-023			
	14DCU64	14ZIH9604-03	14ZIH9604-03_OPENED	Grit Washer 3 Overflow Valve	NOT OPENED	OPENED	DI	7701-09-N-024			
	14DCU64	14ZIH9604-04	14ZIH9604-04_OPENED	Grit Washer 4 Overflow Valve	NOT OPENED	OPENED	DI	7701-09-N-025			
	14DCU64	14ZIH9604-05	14ZIH9604-05_OPENED	Grit Washer 5 Overflow Valve	NOT OPENED	OPENED	DI	7701-09-N-026			
	14DCU64	14ZIH9604-06	14ZIH9604-06_OPENED	Grit Washer 6 Overflow Valve	NOT OPENED	OPENED	DI	7701-09-N-027			
	14DCU64	14ZIH9649-01	14ZIH9649-01_OPENED	Raw Sewage Pump 1 Wetwell Gate	NOT OPENED	OPENED	DI	7701-09-N-012			
	14DCU64	14ZIH9649-02	14ZIH9649-02_OPENED	Raw Sewage Pump 2 Wetwell Gate	NOT OPENED	OPENED	DI	7701-09-N-013			
	14DCU64	14ZIH9649-03	14ZIH9649-03_OPENED	Raw Sewage Pump 3 Wetwell Gate	NOT OPENED	OPENED	DI	7701-09-N-014			
	14DCU64	14ZIH9649-04	14ZIH9649-04_OPENED	Raw Sewage Pump 4 Wetwell Gate	NOT OPENED	OPENED	DI	7701-09-N-015			
	14DCU64	14ZIH9649-05	14ZIH9649-05_OPENED	Raw Sewage Pump 5 Wetwell Gate	NOT OPENED	OPENED	DI	7701-09-N-016			
	14DCU64	14ZIH9650-01	14ZIH9650-01_OPENED	Raw Sewage Pump 1 Wetwell Gate	NOT OPENED	OPENED	DI	7701-09-N-012			
	14DCU64	14ZIH9650-02	14ZIH9650-02_OPENED	Raw Sewage Pump 2 Wetwell Gate	NOT OPENED	OPENED	DI	7701-09-N-013			
	14DCU64	14ZIH9650-03	14ZIH9650-03_OPENED	Raw Sewage Pump 3 Wetwell Gate	NOT OPENED	OPENED	DI	7701-09-N-014			
	14DCU64	14ZIH9650-04	14ZIH9650-04_OPENED	Raw Sewage Pump 4 Wetwell Gate	NOT OPENED	OPENED	DI	7701-09-N-015			
	14DCU64	14ZIH9650-05	14ZIH9650-05_OPENED	Raw Sewage Pump 5 Wetwell Gate	NOT OPENED	OPENED	DI	7701-09-N-016			
	14DCU64	14ZIH9670-01	14ZIH9670-01_OPENED	Raw Sewage Pump 1 Vent Valve	NOT OPENED	OPENED	DI	7701-09-N-012			
	14DCU64	14ZIH9670-02	14ZIH9670-02_OPENED	Raw Sewage Pump 2 Vent Valve	NOT OPENED	OPENED	DI	7701-09-N-013			
	14DCU64	14ZIH9670-03	14ZIH9670-03_OPENED	Raw Sewage Pump 3 Vent Valve	NOT OPENED	OPENED	DI	7701-09-N-014			
	14DCU64	14ZIH9670-04	14ZIH9670-04_OPENED	Raw Sewage Pump 4 Vent Valve	NOT OPENED	OPENED	DI	7701-09-N-015			
	14DCU64	14ZIH9670-05	14ZIH9670-05_OPENED	Raw Sewage Pump 5 Vent Valve	NOT OPENED	OPENED	DI	7701-09-N-016			
	14DCU64	14ZIH9677-01	14ZIH9677-01_OPENED	Raw Sewage Pump 1 Seal Water Flow Valve	NOT OPENED	OPENED	DI	7701-09-N-012			
	14DCU64	14ZIH9677-02	14ZIH9677-02_OPENED	Raw Sewage Pump 2 Water Flow Valve	NOT OPENED	OPENED	DI	7701-09-N-013			
	14DCU64	14ZIH9677-03	14ZIH9677-03_OPENED	Raw Sewage Pump 3 Water Flow Valve	NOT OPENED	OPENED	DI	7701-09-N-014			

	14DCU64	14ZIH9677-04	14ZIH9677-04_OPENED	Raw Sewage Pump 4 Water Flow Valve	NOT OPENED	OPENED	DI	7701-09-N-015			
	14DCU64	14ZIH9677-05	14ZIH9677-05_OPENED	Raw Sewage Pump 5 Water Flow Valve	NOT OPENED	OPENED	DI	7701-09-N-016			
	14DCU64	14ZIH9926-01	14ZIH9926-01_OPENED	Grit Basin 1 Fluidizing Water Valve	NOT OPENED	OPENED	DI	7701-09-N-019			
	14DCU64	14ZIH9926-02	14ZIH9926-02_OPENED	Grit Basin 2 Fluidizing Water Valve	NOT OPENED	OPENED	DI	7701-09-N-019			
	14DCU64	14ZIH9926-03	14ZIH9926-03_OPENED	Grit Basin 3 Fluidizing Water Valve	NOT OPENED	OPENED	DI	7701-09-N-020			
	14DCU64	14ZIH9926-04	14ZIH9926-04_OPENED	Grit Basin 4 Fluidizing Water Valve	NOT OPENED	OPENED	DI	7701-09-N-020			
	14DCU64	14ZIH9926-05	14ZIH9926-05_OPENED	Grit Basin 5 Fluidizing Water Valve	NOT OPENED	OPENED	DI	7701-09-N-021			
	14DCU64	14ZIH9926-06	14ZIH9926-06_OPENED	Grit Basin 6 Fluidizing Water Valve	NOT OPENED	OPENED	DI	7701-09-N-021			
	14DCU64	14ZIH9950-01	14ZIH9950-01_OPENED	Switchgear Breaker 52-102A	NOT OPENED	OPENED	DI	7701-09-N-040			
	14DCU64	14ZIH9950-02	14ZIH9950-02_RACKED IN	Switchgear Breaker 52-102A		RACKED-IN	DI	7701-09-N-040			
	14DCU64	14ZIH9951-01	14ZIH9951-01_OPENED	Switchgear Breaker 52-102B	NOT OPENED	OPENED	DI	7701-09-N-040			
	14DCU64	14ZIH9951-02	14ZIH9951-02_RACKED IN	Switchgear Breaker 52-102B		RACKED-IN	DI	7701-09-N-040			
	14DCU64	14ZIH9952-01	14ZIH9952-01_OPENED	Switchgear Breaker 52-106A	NOT OPENED	OPENED	DI	7701-09-N-040			
	14DCU64	14ZIH9952-02	14ZIH9952-02_RACKED IN	Switchgear Breaker 52-106A		RACKED-IN	DI	7701-09-N-040			
	14DCU64	14ZIH9953-01	14ZIH9953-01_OPENED	Switchgear Breaker 52-103B	NOT OPENED	OPENED	DI	7701-09-N-040			
	14DCU64	14ZIH9953-02	14ZIH9953-02_RACKED IN	Switchgear Breaker 52-103B		RACKED-IN	DI	7701-09-N-040			
	14DCU64	14ZIH9954-01	14ZIH9954-01_OPENED	Switchgear Breaker 52-103A	NOT OPENED	OPENED	DI	7701-09-N-040			
	14DCU64	14ZIH9954-02	14ZIH9954-02_RACKED IN	Switchgear Breaker 52-103A		RACKED-IN	DI	7701-09-N-040			
	14DCU64	14ZIH9955-01	14ZIH9955-01_OPENED	Switchgear Breaker 52-107A	NOT OPENED	OPENED	DI	7701-09-N-040			
	14DCU64	14ZIH9955-02	14ZIH9955-02_RACKED IN	Switchgear Breaker 52-107A		RACKED-IN	DI	7701-09-N-040			
	14DCU64	14ZIH9956-01	14ZIH9956-01_OPENED	Switchgear Breaker 52-106B	NOT OPENED	OPENED	DI	7701-09-N-040			
	14DCU64	14ZIH9956-02	14ZIH9956-02_RACKED IN	Switchgear Breaker 52-106B		RACKED-IN	DI	7701-09-N-040			
	14DCU64	14ZIH9957-01	14ZIH9957-01_OPENED	Switchgear Breaker 52-107B	NOT OPENED	OPENED	DI	7701-09-N-040			
	14DCU64	14ZIH9957-02	14ZIH9957-02_RACKED IN	Switchgear Breaker 52-107B		RACKED-IN	DI	7701-09-N-040			
	14DCU64	14ZIH9958-01	14ZIH9958-01_OPENED	Switchgear Breaker 52-105A	NOT OPENED	OPENED	DI	7701-09-N-040			
	14DCU64	14ZIH9958-02	14ZIH9958-02_RACKED IN	Switchgear Breaker 52-105A		RACKED-IN	DI	7701-09-N-040			
	14DCU64	14ZIH9960-01	14ZIH9960-01_OPENED	Switchgear Breaker 52-101B	NOT OPENED	OPENED	DI	7701-09-N-040			
	14DCU64	14ZIH9960-02	14ZIH9960-02_RACKED IN	Switchgear Breaker 52-101B		RACKED-IN	DI	7701-09-N-040			
	14DCU64	14ZIH9961-01	14ZIH9961-01_OPENED	Switchgear Breaker 52-108B	NOT OPENED	OPENED	DI	7701-09-N-040			
	14DCU64	14ZIH9961-02	14ZIH9961-02_RACKED IN	Switchgear Breaker 52-108B		RACKED-IN	DI	7701-09-N-040			
	14DCU64	14ZIH9962-01	14ZIH9962-01_OPENED	Switchgear Breaker 52-104B	NOT OPENED	OPENED	DI	7701-09-N-040			
	14DCU64	14ZIH9962-02	14ZIH9962-02_RACKED IN	Switchgear Breaker 52-104B		RACKED-IN	DI	7701-09-N-040			
	14DCU64	14ZIL9501-01	14ZIL9501-01_CLOSED	Influent Screen 1 Influent Gate	NOT CLOSED	CLOSED	DI	7701-09-N-005			
	14DCU64	14ZIL9501-02	14ZIL9501-02_CLOSED	Influent Screen 2 Influent Gate	NOT CLOSED	CLOSED	DI	7701-09-N-005			
	14DCU64	14ZIL9501-03	14ZIL9501-03_CLOSED	Influent Screen 3 Influent Gate	NOT CLOSED	CLOSED	DI	7701-09-N-005			
	14DCU64	14ZIL9505-01	14ZIL9505-01_CLOSED	Influent Screen 1 Effluent Gate	NOT CLOSED	CLOSED	DI	7701-09-N-007			
	14DCU64	14ZIL9505-02	14ZIL9505-02_CLOSED	Influent Screen 2 Effluent Gate	NOT CLOSED	CLOSED	DI	7701-09-N-007			
	14DCU64	14ZIL9505-03	14ZIL9505-03_CLOSED	Influent Screen 3 Effluent Gate	NOT CLOSED	CLOSED	DI	7701-09-N-007			
	14DCU64	14ZIL9510-01	14ZIL9510-01_CLOSED	Screening Trough Flow	NOT CLOSED	CLOSED	DI	7701-09-N-006			
	14DCU64	14ZIL9520-01	14ZIL9520-01_CLOSED	Screenings Compactor 1 Inlet Valve	NOT CLOSED	CLOSED	DI	7701-09-N-008			
	14DCU64	14ZIL9520-02	14ZIL9520-02_CLOSED	Screenings Compactor 2 Inlet Valve	NOT CLOSED	CLOSED	DI	7701-09-N-008			
	14DCU64	14ZIL9520-03	14ZIL9520-03_CLOSED	Screenings Compactor 3 Inlet Valve	NOT CLOSED	CLOSED	DI	7701-09-N-009			
	14DCU64	14ZIL9520-04	14ZIL9520-04_CLOSED	Screenings Compactor 4 Inlet Valve	NOT CLOSED	CLOSED	DI	7701-09-N-009			
	14DCU64	14ZIL9522-01	14ZIL9522-01_CLOSED	Screenings Compactor 1 Flush Water Valve	NOT CLOSED	CLOSED	DI	7701-09-N-008			
	14DCU64	14ZIL9522-02	14ZIL9522-02_CLOSED	Screenings Compactor 2 Flush Water Valve	NOT CLOSED	CLOSED	DI	7701-09-N-008			
	14DCU64	14ZIL9522-03	14ZIL9522-03_CLOSED	Screenings Compactor 3 Flush Water Valve	NOT CLOSED	CLOSED	DI	7701-09-N-009			
	14DCU64	14ZIL9522-04	14ZIL9522-04_CLOSED	Screenings Compactor 4 Flush Water Valve	NOT CLOSED	CLOSED	DI	7701-09-N-009			
	14DCU64	14ZIL9523-01	14ZIL9523-01_CLOSED	Screenings Compactor Flush Water Pressure	NOT CLOSED	CLOSED	DI	7701-09-N-008			
	14DCU64	14ZIL9533-01	14ZIL9533-01_CLOSED	Grit Basins Effluent Channel Emergency Overflow Gate	NOT CLOSED	CLOSED	DI	7701-09-N-019			
	14DCU64	14ZIL9604-01	14ZIL9604-01_CLOSED	Grit Washer 1 Overflow Valve	NOT CLOSED	CLOSED	DI	7701-09-N-022			
	14DCU64	14ZIL9604-02	14ZIL9604-02_CLOSED	Grit Washer 2 Overflow Valve	NOT CLOSED	CLOSED	DI	7701-09-N-023			
	14DCU64	14ZIL9604-03	14ZIL9604-03_CLOSED	Grit Washer 3 Overflow Valve	NOT CLOSED	CLOSED	DI	7701-09-N-024			

	14DCU64	14ZIL9604-04	14ZIL9604-04_CLOSED	Grit Washer 4 Overflow Valve	NOT CLOSED	CLOSED	DI	7701-09-N-025			
	14DCU64	14ZIL9604-05	14ZIL9604-05_CLOSED	Grit Washer 5 Overflow Valve	NOT CLOSED	CLOSED	DI	7701-09-N-026			
	14DCU64	14ZIL9604-06	14ZIL9604-06_CLOSED	Grit Washer 6 Overflow Valve	NOT CLOSED	CLOSED	DI	7701-09-N-027			
	14DCU64	14ZIL9649-01	14ZIL9649-01_CLOSED	Raw Sewage Pump 1 Wetwell Gate	NOT CLOSED	CLOSED	DI	7701-09-N-012			
	14DCU64	14ZIL9649-02	14ZIL9649-02_CLOSED	Raw Sewage Pump 2 Wetwell Gate	NOT CLOSED	CLOSED	DI	7701-09-N-013			
	14DCU64	14ZIL9649-03	14ZIL9649-03_CLOSED	Raw Sewage Pump 3 Wetwell Gate	NOT CLOSED	CLOSED	DI	7701-09-N-014			
	14DCU64	14ZIL9649-04	14ZIL9649-04_CLOSED	Raw Sewage Pump 4 Wetwell Gate	NOT CLOSED	CLOSED	DI	7701-09-N-015			
	14DCU64	14ZIL9649-05	14ZIL9649-05_CLOSED	Raw Sewage Pump 5 Wetwell Gate	NOT CLOSED	CLOSED	DI	7701-09-N-016			
	14DCU64	14ZIL9650-01	14ZIL9650-01_CLOSED	Raw Sewage Pump 1 Wetwell Gate	NOT CLOSED	CLOSED	DI	7701-09-N-012			
	14DCU64	14ZIL9650-02	14ZIL9650-02_CLOSED	Raw Sewage Pump 2 Wetwell Gate	NOT CLOSED	CLOSED	DI	7701-09-N-013			
	14DCU64	14ZIL9650-03	14ZIL9650-03_CLOSED	Raw Sewage Pump 3 Wetwell Gate	NOT CLOSED	CLOSED	DI	7701-09-N-014			
	14DCU64	14ZIL9650-04	14ZIL9650-04_CLOSED	Raw Sewage Pump 4 Wetwell Gate	NOT CLOSED	CLOSED	DI	7701-09-N-015			
	14DCU64	14ZIL9650-05	14ZIL9650-05_CLOSED	Raw Sewage Pump 5 Wetwell Gate	NOT CLOSED	CLOSED	DI	7701-09-N-016			
	14DCU64	14ZIL9670-01	14ZIL9670-01_CLOSED	Raw Sewage Pump 1 Vent Valve	NOT CLOSED	CLOSED	DI	7701-09-N-012			
	14DCU64	14ZIL9670-02	14ZIL9670-02_CLOSED	Raw Sewage Pump 2 Vent Valve	NOT CLOSED	CLOSED	DI	7701-09-N-013			
	14DCU64	14ZIL9670-03	14ZIL9670-03_CLOSED	Raw Sewage Pump 3 Vent Valve	NOT CLOSED	CLOSED	DI	7701-09-N-014			
	14DCU64	14ZIL9670-04	14ZIL9670-04_CLOSED	Raw Sewage Pump 4 Vent Valve	NOT CLOSED	CLOSED	DI	7701-09-N-015			
	14DCU64	14ZIL9670-05	14ZIL9670-05_CLOSED	Raw Sewage Pump 5 Vent Valve	NOT CLOSED	CLOSED	DI	7701-09-N-016			
	14DCU64	14ZIL9677-01	14ZIL9677-01_CLOSED	Raw Sewage Pump 1 Seal Water Flow Valve	NOT CLOSED	CLOSED	DI	7701-09-N-012			
	14DCU64	14ZIL9677-02	14ZIL9677-02_CLOSED	Raw Sewage Pump 2 Water Flow Valve	NOT CLOSED	CLOSED	DI	7701-09-N-013			
	14DCU64	14ZIL9677-03	14ZIL9677-03_CLOSED	Raw Sewage Pump 3 Water Flow Valve	NOT CLOSED	CLOSED	DI	7701-09-N-014			
	14DCU64	14ZIL9677-04	14ZIL9677-04_CLOSED	Raw Sewage Pump 4 Water Flow Valve	NOT CLOSED	CLOSED	DI	7701-09-N-015			
	14DCU64	14ZIL9677-05	14ZIL9677-05_CLOSED	Raw Sewage Pump 5 Water Flow Valve	NOT CLOSED	CLOSED	DI	7701-09-N-016			
	14DCU64	14ZIL9926-01	14ZIL9926-01_CLOSED	Grit Basin 1 Fluidizing Water Valve	NOT CLOSED	CLOSED	DI	7701-09-N-019			
	14DCU64	14ZIL9926-02	14ZIL9926-02_CLOSED	Grit Basin 2 Fluidizing Water Valve	NOT CLOSED	CLOSED	DI	7701-09-N-019			
	14DCU64	14ZIL9926-03	14ZIL9926-03_CLOSED	Grit Basin 3 Fluidizing Water Valve	NOT CLOSED	CLOSED	DI	7701-09-N-020			
	14DCU64	14ZIL9926-04	14ZIL9926-04_CLOSED	Grit Basin 4 Fluidizing Water Valve	NOT CLOSED	CLOSED	DI	7701-09-N-020			
	14DCU64	14ZIL9926-05	14ZIL9926-05_CLOSED	Grit Basin 5 Fluidizing Water Valve	NOT CLOSED	CLOSED	DI	7701-09-N-021			
	14DCU64	14ZIL9926-06	14ZIL9926-06_CLOSED	Grit Basin 6 Fluidizing Water Valve	NOT CLOSED	CLOSED	DI	7701-09-N-021			
	14DCU64	14ZIL9950-01	14ZIL9950-01_CLOSED	Switchgear Breaker 52-102A	NOT CLOSED	CLOSED	DI	7701-09-N-040			
	14DCU64	14ZIL9950-02	14ZIL9950-02_RACKED OUT	Switchgear Breaker 52-102A		RACKED-OUT	DI	7701-09-N-040			
	14DCU64	14ZIL9951-01	14ZIL9951-01_CLOSED	Switchgear Breaker 52-102B		CLOSED	DI	7701-09-N-040			
	14DCU64	14ZIL9951-02	14ZIL9951-02_RACKED OUT	Switchgear Breaker 52-102B		RACKED-OUT	DI	7701-09-N-040			
	14DCU64	14ZIL9952-01	14ZIL9952-01_CLOSED	Switchgear Breaker 52-106A		CLOSED	DI	7701-09-N-040			
	14DCU64	14ZIL9952-02	14ZIL9952-02_RACKED OUT	Switchgear Breaker 52-106A		RACKED-OUT	DI	7701-09-N-040			
	14DCU64	14ZIL9953-01	14ZIL9953-01_CLOSED	Switchgear Breaker 52-103B		CLOSED	DI	7701-09-N-040			
	14DCU64	14ZIL9953-02	14ZIL9953-02_RACKED OUT	Switchgear Breaker 52-103B		RACKED-OUT	DI	7701-09-N-040			
	14DCU64	14ZIL9954-01	14ZIL9954-01_CLOSED	Switchgear Breaker 52-103A		CLOSED	DI	7701-09-N-040			
	14DCU64	14ZIL9954-02	14ZIL9954-02_RACKED OUT	Switchgear Breaker 52-103A		RACKED-OUT	DI	7701-09-N-040			
	14DCU64	14ZIL9955-01	14ZIL9955-01_CLOSED	Switchgear Breaker 52-107A		CLOSED	DI	7701-09-N-040			
	14DCU64	14ZIL9955-02	14ZIL9955-02_RACKED OUT	Switchgear Breaker 52-107A		RACKED-OUT	DI	7701-09-N-040			
	14DCU64	14ZIL9956-01	14ZIL9956-01_CLOSED	Switchgear Breaker 52-106B		CLOSED	DI	7701-09-N-040			
	14DCU64	14ZIL9956-02	14ZIL9956-02_RACKED OUT	Switchgear Breaker 52-106B		RACKED-OUT	DI	7701-09-N-040			
	14DCU64	14ZIL9957-01	14ZIL9957-01_CLOSED	Switchgear Breaker 52-107B		CLOSED	DI	7701-09-N-040			
	14DCU64	14ZIL9957-02	14ZIL9957-02_RACKED OUT	Switchgear Breaker 52-107B		RACKED-OUT	DI	7701-09-N-040			
	14DCU64	14ZIL9958-01	14ZIL9958-01_CLOSED	Switchgear Breaker 52-105A		CLOSED	DI	7701-09-N-040			
	14DCU64	14ZIL9958-02	14ZIL9958-02_RACKED OUT	Switchgear Breaker 52-105A		RACKED-OUT	DI	7701-09-N-040			
	14DCU64	14ZIL9960-01	14ZIL9960-01_CLOSED	Switchgear Breaker 52-101B		CLOSED	DI	7701-09-N-040			
	14DCU64	14ZIL9960-02	14ZIL9960-02_RACKED OUT	Switchgear Breaker 52-101B		RACKED-OUT	DI	7701-09-N-040			
	14DCU64	14ZIL9961-01	14ZIL9961-01_CLOSED	Switchgear Breaker 52-108B		CLOSED	DI	7701-09-N-040			
	14DCU64	14ZIL9961-02	14ZIL9961-02_RACKED OUT	Switchgear Breaker 52-108B		RACKED-OUT	DI	7701-09-N-040			
	14DCU64	14ZIL9962-01	14ZIL9962-01_CLOSED	Switchgear Breaker 52-104B		CLOSED	DI	7701-09-N-040			

	14DCU64	14ZIL9962-02	14ZIL9962-02_RACKED OUT	Switchgear Breaker 52-104B		RACKED-OUT	DI	7701-09-N-040			
	14DCU64	14HS9505-01C	14HS9505-01C_OPEN	Influent Screen 1 Effluent Gate		OPEN	DO	7701-09-N-007			
	14DCU64	14HS9505-01D	14HS9505-01D_CLOSE	Influent Screen 1 Effluent Gate		CLOSE	DO	7701-09-N-007			
	14DCU64	14HS9520-03C	14HS9520-03C_OPEN	Screenings Compactor 3 Inlet Valve		OPEN	DO	7701-09-N-009			
	14DCU64	14HS9520-03D	14HS9520-03D_CLOSE	Screenings Compactor 3 Inlet Valve		CLOSE	DO	7701-09-N-009			
	14DCU64	14HS9520-04C	14HS9520-04C_OPEN	Screenings Compactor 4 Inlet Valve		OPEN	DO	7701-09-N-009			
	14DCU64	14HS9520-04D	14HS9520-04D_CLOSE	Screenings Compactor 4 Inlet Valve		CLOSE	DO	7701-09-N-009			
	14DCU64	14HS9521-03C	14HS9521-03C_START	Screenings Compactor 3		START	DO	7701-09-N-009			
	14DCU64	14HS9521-03D	14HS9521-03D_STOP	Screenings Compactor 3		STOP	DO	7701-09-N-009			
	14DCU64	14HS9521-04C	14HS9521-04C_START	Screenings Compactor 4		START	DO	7701-09-N-009			
	14DCU64	14HS9521-04D	14HS9521-04D_STOP	Screenings Compactor 4		STOP	DO	7701-09-N-009			
	14DCU64	14HS9522-03C	14HS9522-03C_OPEN	Screenings Compactor 3 Flush Water Valve		OPEN	DO	7701-09-N-009			
	14DCU64	14HS9522-03D	14HS9522-03D_CLOSE	Screenings Compactor 3 Flush Water Valve		CLOSE	DO	7701-09-N-009			
	14DCU64	14HS9522-04C	14HS9522-04C_OPEN	Screenings Compactor 4 Flush Water Valve		OPEN	DO	7701-09-N-009			
	14DCU64	14HS9522-04D	14HS9522-04D_CLOSE	Screenings Compactor 4 Flush Water Valve		CLOSE	DO	7701-09-N-009			
	14DCU64	14HS9525-02C	14HS9525-02C_START	Screenings Winch 2		START	DO	7701-09-N-009			
	14DCU64	14HS9525-02D	14HS9525-02D_STOP	Screenings Winch 2		STOP	DO	7701-09-N-009			
	14DCU64	14HS9601-01C	14HS9601-01C_START	Grit Pump 1		START	DO	7701-09-N-022			
	14DCU64	14HS9601-01D	14HS9601-01D_STOP	Grit Pump 1		STOP	DO	7701-09-N-022			
	14DCU64	14HS9601-02C	14HS9601-02C_START	Grit Pump 2		START	DO	7701-09-N-023			
	14DCU64	14HS9601-02D	14HS9601-02D_STOP	Grit Pump 2		STOP	DO	7701-09-N-023			
	14DCU64	14HS9601-03C	14HS9601-03C_START	Grit Pump 3		START	DO	7701-09-N-024			
	14DCU64	14HS9601-03D	14HS9601-03D_STOP	Grit Pump 3		STOP	DO	7701-09-N-024			
	14DCU64	14HS9601-04C	14HS9601-04C_START	Grit Pump 4		START	DO	7701-09-N-025			
	14DCU64	14HS9601-04D	14HS9601-04D_STOP	Grit Pump 4		STOP	DO	7701-09-N-025			
	14DCU64	14HS9601-05C	14HS9601-05C_START	Grit Pump 5		START	DO	7701-09-N-026			
	14DCU64	14HS9601-05D	14HS9601-05D_STOP	Grit Pump 5		STOP	DO	7701-09-N-026			
	14DCU64	14HS9601-06C	14HS9601-06C_START	Grit Pump 6		START	DO	7701-09-N-027			
	14DCU64	14HS9601-06D	14HS9601-06D_STOP	Grit Pump 6		STOP	DO	7701-09-N-027			
	14DCU64	14HS9603-01C	14HS9603-01C_START	Grit Classifier 1		START	DO	7701-09-N-022			
	14DCU64	14HS9603-01D	14HS9603-01D_STOP	Grit Classifier 1		STOP	DO	7701-09-N-022			
	14DCU64	14HS9603-02C	14HS9603-02C_START	Grit Classifier 2		START	DO	7701-09-N-023			
	14DCU64	14HS9603-02D	14HS9603-02D_STOP	Grit Classifier 2		STOP	DO	7701-09-N-023			
	14DCU64	14HS9603-03C	14HS9603-03C_START	Grit Classifier 3		START	DO	7701-09-N-024			
	14DCU64	14HS9603-03D	14HS9603-03D_STOP	Grit Classifier 3		STOP	DO	7701-09-N-024			
	14DCU64	14HS9603-04C	14HS9603-04C_START	Grit Classifier 4		START	DO	7701-09-N-025			
	14DCU64	14HS9603-04D	14HS9603-04D_STOP	Grit Classifier 4		STOP	DO	7701-09-N-025			
	14DCU64	14HS9603-05C	14HS9603-05C_START	Grit Classifier 5		START	DO	7701-09-N-026			
	14DCU64	14HS9603-05D	14HS9603-05D_STOP	Grit Classifier 5		STOP	DO	7701-09-N-026			
	14DCU64	14HS9603-06C	14HS9603-06C_START	Grit Classifier 6		START	DO	7701-09-N-027			
	14DCU64	14HS9603-06D	14HS9603-06D_STOP	Grit Classifier 6		STOP	DO	7701-09-N-027			
	14DCU64	14HS9604-01C	14HS9604-01C_OPEN	Grit Washer 1 Overflow Valve		OPEN	DO	7701-09-N-022			
	14DCU64	14HS9604-01D	14HS9604-01D_CLOSE	Grit Washer 1 Overflow Valve		CLOSE	DO	7701-09-N-022			
	14DCU64	14HS9604-02C	14HS9604-02C_OPEN	Grit Washer 2 Overflow Valve		OPEN	DO	7701-09-N-023			
	14DCU64	14HS9604-02D	14HS9604-02D_CLOSE	Grit Washer 2 Overflow Valve		CLOSE	DO	7701-09-N-023			
	14DCU64	14HS9604-03C	14HS9604-03C_OPEN	Grit Washer 3 Overflow Valve		OPEN	DO	7701-09-N-024			
	14DCU64	14HS9604-03D	14HS9604-03D_CLOSE	Grit Washer 3 Overflow Valve		CLOSE	DO	7701-09-N-024			
	14DCU64	14HS9604-04C	14HS9604-04C_OPEN	Grit Washer 4 Overflow Valve		OPEN	DO	7701-09-N-025			
	14DCU64	14HS9604-04D	14HS9604-04D_CLOSE	Grit Washer 4 Overflow Valve		CLOSE	DO	7701-09-N-025			
	14DCU64	14HS9604-05C	14HS9604-05C_OPEN	Grit Washer 5 Overflow Valve		OPEN	DO	7701-09-N-026			
	14DCU64	14HS9604-05D	14HS9604-05D_CLOSE	Grit Washer 5 Overflow Valve		CLOSE	DO	7701-09-N-026			
	14DCU64	14HS9604-06C	14HS9604-06C_OPEN	Grit Washer 6 Overflow Valve		OPEN	DO	7701-09-N-027			

	14DCU64	14HS9604-06D	14HS9604-06D_CLOSE	Grit Washer 6 Overflow Valve		CLOSE	DO	7701-09-N-027			
	14DCU64	14HS9605-01C	14HS9605-01C_START	Grit Washer 1		START	DO	7701-09-N-022			
	14DCU64	14HS9605-01D	14HS9605-01D_STOP	Grit Washer 1		STOP	DO	7701-09-N-022			
	14DCU64	14HS9605-02C	14HS9605-02C_START	Grit Washer 2		START	DO	7701-09-N-023			
	14DCU64	14HS9605-02D	14HS9605-02D_STOP	Grit Washer 2		STOP	DO	7701-09-N-023			
	14DCU64	14HS9605-03C	14HS9605-03C_START	Grit Washer 3		START	DO	7701-09-N-024			
	14DCU64	14HS9605-03D	14HS9605-03D_STOP	Grit Washer 3		STOP	DO	7701-09-N-024			
	14DCU64	14HS9605-04C	14HS9605-04C_START	Grit Washer 4		START	DO	7701-09-N-025			
	14DCU64	14HS9605-04D	14HS9605-04D_STOP	Grit Washer 4		STOP	DO	7701-09-N-025			
	14DCU64	14HS9605-05C	14HS9605-05C_START	Grit Washer 5		START	DO	7701-09-N-026			
	14DCU64	14HS9605-05D	14HS9605-05D_STOP	Grit Washer 5		STOP	DO	7701-09-N-026			
	14DCU64	14HS9605-06C	14HS9605-06C_START	Grit Washer 6		START	DO	7701-09-N-027			
	14DCU64	14HS9605-06D	14HS9605-06D_STOP	Grit Washer 6		STOP	DO	7701-09-N-027			
	14DCU64	14HS9607-01	14HS9607-01_OPEN	Grit Washer 1 Fluidizing Water Valve	CLOSE	OPEN	DO	7701-09-N-022			
	14DCU64	14HS9607-02E	14HS9607-02E_OPEN	Grit Washer 2 Fluidizing Water Valve	CLOSE	OPEN	DO	7701-09-N-023			
	14DCU64	14HS9607-03	14HS9607-03_OPEN	Grit Washer 3 Fluidizing Water Valve	CLOSE	OPEN	DO	7701-09-N-024			
	14DCU64	14HS9607-04	14HS9607-04_OPEN	Grit Washer 4 Fluidizing Water Valve	CLOSE	OPEN	DO	7701-09-N-025			
	14DCU64	14HS9607-05	14HS9607-05_OPEN	Grit Washer 5 Fluidizing Water Valve	CLOSE	OPEN	DO	7701-09-N-026			
	14DCU64	14HS9607-06	14HS9607-06_OPEN	Grit Washer 6 Fluidizing Water Valve	CLOSE	OPEN	DO	7701-09-N-027			
	14DCU64	14HS9649-01C	14HS9649-01C_OPEN	Raw Sewage Pump 1 Wetwell Gate		OPEN	DO	7701-09-N-012			
	14DCU64	14HS9649-01D	14HS9649-01D_CLOSE	Raw Sewage Pump 1 Wetwell Gate		CLOSE	DO	7701-09-N-012			
	14DCU64	14HS9649-02C	14HS9649-02C_OPEN	Raw Sewage Pump 2 Wetwell Gate		OPEN	DO	7701-09-N-013			
	14DCU64	14HS9649-02D	14HS9649-02D_CLOSE	Raw Sewage Pump 2 Wetwell Gate		CLOSE	DO	7701-09-N-013			
	14DCU64	14HS9649-03C	14HS9649-03C_OPEN	Raw Sewage Pump 3 Wetwell Gate		OPEN	DO	7701-09-N-014			
	14DCU64	14HS9649-03D	14HS9649-03D_CLOSE	Raw Sewage Pump 3 Wetwell Gate		CLOSE	DO	7701-09-N-014			
	14DCU64	14HS9649-04C	14HS9649-04C_OPEN	Raw Sewage Pump 4 Wetwell Gate		OPEN	DO	7701-09-N-015			
	14DCU64	14HS9649-04D	14HS9649-04D_CLOSE	Raw Sewage Pump 4 Wetwell Gate		CLOSE	DO	7701-09-N-015			
	14DCU64	14HS9650-01C	14HS9650-01C_OPEN	Raw Sewage Pump 1 Wetwell Gate		OPEN	DO	7701-09-N-012			
	14DCU64	14HS9650-01D	14HS9650-01D_CLOSE	Raw Sewage Pump 1 Wetwell Gate		CLOSE	DO	7701-09-N-012			
	14DCU64	14HS9650-02C	14HS9650-02C_OPEN	Raw Sewage Pump 2 Wetwell Gate		OPEN	DO	7701-09-N-013			
	14DCU64	14HS9650-02D	14HS9650-02D_CLOSE	Raw Sewage Pump 2 Wetwell Gate		CLOSE	DO	7701-09-N-013			
	14DCU64	14HS9650-03C	14HS9650-03C_OPEN	Raw Sewage Pump 3 Wetwell Gate		OPEN	DO	7701-09-N-014			
	14DCU64	14HS9650-03D	14HS9650-03D_CLOSE	Raw Sewage Pump 3 Wetwell Gate		CLOSE	DO	7701-09-N-014			
	14DCU64	14HS9650-04C	14HS9650-04C_OPEN	Raw Sewage Pump 4 Wetwell Gate		OPEN	DO	7701-09-N-015			
	14DCU64	14HS9650-04D	14HS9650-04D_CLOSE	Raw Sewage Pump 4 Wetwell Gate		CLOSE	DO	7701-09-N-015			
	14DCU64	14HS9655-01C	14HS9655-01C_START	Raw Sewage Pump 1		START	DO	7701-09-N-012			
	14DCU64	14HS9655-01D	14HS9655-01D_STOP	Raw Sewage Pump 1		STOP	DO	7701-09-N-012			
	14DCU64	14HS9655-02C	14HS9655-02C_START	Raw Sewage Pump 2		START	DO	7701-09-N-013			
	14DCU64	14HS9655-02D	14HS9655-02D_STOP	Raw Sewage Pump 2		STOP	DO	7701-09-N-013			
	14DCU64	14HS9655-03C	14HS9655-03C_START	Raw Sewage Pump 3		START	DO	7701-09-N-014			
	14DCU64	14HS9655-03D	14HS9655-03D_STOP	Raw Sewage Pump 3		STOP	DO	7701-09-N-014			
	14DCU64	14HS9655-04C	14HS9655-04C_START	Raw Sewage Pump 4		START	DO	7701-09-N-015			
	14DCU64	14HS9655-04D	14HS9655-04D_STOP	Raw Sewage Pump 4		STOP	DO	7701-09-N-015			
	14DCU64	14HS9670-01C	14HS9670-01C_OPEN	Raw Sewage Pump 1 Vent Valve		OPEN	DO	7701-09-N-012			
	14DCU64	14HS9670-01D	14HS9670-01D_CLOSE	Raw Sewage Pump 1 Vent Valve		CLOSE	DO	7701-09-N-012			
	14DCU64	14HS9670-02C	14HS9670-02C_OPEN	Raw Sewage Pump 2 Vent Valve		OPEN	DO	7701-09-N-013			
	14DCU64	14HS9670-02D	14HS9670-02D_CLOSE	Raw Sewage Pump 2 Vent Valve		CLOSE	DO	7701-09-N-013			
	14DCU64	14HS9670-03C	14HS9670-03C_OPEN	Raw Sewage Pump 3 Vent Valve		OPEN	DO	7701-09-N-014			
	14DCU64	14HS9670-03D	14HS9670-03D_CLOSE	Raw Sewage Pump 3 Vent Valve		CLOSE	DO	7701-09-N-014			
	14DCU64	14HS9670-04C	14HS9670-04C_OPEN	Raw Sewage Pump 4 Vent Valve		OPEN	DO	7701-09-N-015			
	14DCU64	14HS9670-04D	14HS9670-04D_CLOSE	Raw Sewage Pump 4 Vent Valve		CLOSE	DO	7701-09-N-015			
	14DCU64	14HS9677-01C	14HS9677-01C_OPEN	Raw Sewage Pump 1 Seal Water Flow Valve		OPEN	DO	7701-09-N-012			

	14DCU64	14HS9677-01D	14HS9677-01D_CLOSE	Raw Sewage Pump 1 Seal Water Flow Valve		CLOSE	DO	7701-09-N-012			
	14DCU64	14HS9677-02C	14HS9677-02C_OPEN	Raw Sewage Pump 2 Water Flow Valve		OPEN	DO	7701-09-N-013			
	14DCU64	14HS9677-02D	14HS9677-02D_CLOSE	Raw Sewage Pump 2 Water Flow Valve		CLOSE	DO	7701-09-N-013			
	14DCU64	14HS9677-03C	14HS9677-03C_OPEN	Raw Sewage Pump 3 Water Flow Valve		OPEN	DO	7701-09-N-014			
	14DCU64	14HS9677-03D	14HS9677-03D_CLOSE	Raw Sewage Pump 3 Water Flow Valve		CLOSE	DO	7701-09-N-014			
	14DCU64	14HS9677-04C	14HS9677-04C_OPEN	Raw Sewage Pump 4 Water Flow Valve		OPEN	DO	7701-09-N-015			
	14DCU64	14HS9677-04D	14HS9677-04D_CLOSE	Raw Sewage Pump 4 Water Flow Valve		CLOSE	DO	7701-09-N-015			
	14DCU64	14HS9677-05C	14HS9677-05C_OPEN	Raw Sewage Pump 5 Water Flow Valve		OPEN	DO	7701-09-N-016			
	14DCU64	14HS9677-05D	14HS9677-05D_CLOSE	Raw Sewage Pump 5 Water Flow Valve		CLOSE	DO	7701-09-N-016			
	14DCU64	14HS9701-01C	14HS9701-01C_START	Odor Control Exhaust Fan 1		START	DO	7701-09-N-033			
	14DCU64	14HS9701-01D	14HS9701-01D_STOP	Odor Control Exhaust Fan 1		STOP	DO	7701-09-N-033			
	14DCU64	14HS9701-02C	14HS9701-02C_START	Odor Control Exhaust Fan 2		START	DO	7701-09-N-033			
	14DCU64	14HS9701-02D	14HS9701-02D_STOP	Odor Control Exhaust Fan 2		STOP	DO	7701-09-N-033			
	14DCU64	14HS9708-01C	14HS9708-01C_START	Biotower Scrubber Recirculation Pump		START	DO	7701-09-N-034			
	14DCU64	14HS9708-01D	14HS9708-01D_STOP	Biotower Scrubber Recirculation Pump		STOP	DO	7701-09-N-034			
	14DCU64	14HS9712-01	14HS9712-01_OPEN	Odor Control Nutrient Feed Dilution Water Valve	CLOSE	OPEN	DO	7701-09-N-034			
	14DCU64	14HS9712-01	14HS9712-01_OPEN	Odor Control Water Panel Makeup H2O Flow Valve		OPEN	DO	7701-09-N-034			
	14DCU64	14HS9715-01	14HS9715-01_RUN	Odor Control Nutrient Feed Pump	STOP	RUN	DO	7701-09-N-034			
	14DCU64	14HS9725-01C	14HS9725-01C_START	HW3 Recycle Pump Station - Pump 1		START	DO	7701-09-N-038			
	14DCU64	14HS9725-01D	14HS9725-01D_STOP	HW3 Recycle Pump Station - Pump 1		STOP	DO	7701-09-N-038			
	14DCU64	14HS9725-02C	14HS9725-02C_START	HW3 Recycle Pump Station - Pump 2		START	DO	7701-09-N-038			
	14DCU64	14HS9725-02D	14HS9725-02D_STOP	HW3 Recycle Pump Station - Pump 2		STOP	DO	7701-09-N-038			
	14DCU64	14HS9725-03C	14HS9725-03C_START	HW3 Recycle Pump Station - Pump 3		START	DO	7701-09-N-038			
	14DCU64	14HS9725-03D	14HS9725-03D_STOP	HW3 Recycle Pump Station - Pump 3		STOP	DO	7701-09-N-038			
	14DCU64	14HS-C19501-01	14HS-C19501-01_OPEN	Influent Screen 1 Influent Gate		OPEN	DO	7701-09-N-005			
	14DCU64	14HS-C19501-02	14HS-C19501-02_OPEN	Influent Screen 2 Influent Gate		OPEN	DO	7701-09-N-005			
	14DCU64	14HS-C19501-03	14HS-C19501-03_OPEN	Influent Screen 3 Influent Gate		OPEN	DO	7701-09-N-005			
	14DCU64	14HS-C19505-02	14HS-C19505-02_OPEN	Influent Screen 2 Effluent Gate		OPEN	DO	7701-09-N-007			
	14DCU64	14HS-C19505-03	14HS-C19505-03_OPEN	Influent Screen 3 Effluent Gate		OPEN	DO	7701-09-N-007			
	14DCU64	14HS-C19508-01	14HS-C19508-01_START	Influent Screen 1		START	DO	7701-09-N-006			
	14DCU64	14HS-C19508-02	14HS-C19508-02_START	Influent Screen 2		START	DO	7701-09-N-006			
	14DCU64	14HS-C19508-03	14HS-C19508-03_START	Influent Screen 3		START	DO	7701-09-N-006			
	14DCU64	14HS-C19510-01	14HS-C19510-01_OPEN	Screening Trough Flow		OPEN	DO	7701-09-N-006			
	14DCU64	14HS-C19520-01	14HS-C19520-01_OPEN	Screenings Compactor 1 Inlet Valve		OPEN	DO	7701-09-N-008			
	14DCU64	14HS-C19520-02	14HS-C19520-02_OPEN	Screenings Compactor 2 Inlet Valve		OPEN	DO	7701-09-N-008			
	14DCU64	14HS-C19521-01	14HS-C19521-01_START	Screenings Compactor 1		START	DO	7701-09-N-008			
	14DCU64	14HS-C19521-02	14HS-C19521-02_START	Screenings Compactor 2		START	DO	7701-09-N-008			
	14DCU64	14HS-C19522-01	14HS-C19522-01_OPEN	Screenings Compactor 1 Flush Water Valve		OPEN	DO	7701-09-N-008			
	14DCU64	14HS-C19522-02	14HS-C19522-02_OPEN	Screenings Compactor 2 Flush Water Valve		OPEN	DO	7701-09-N-008			
	14DCU64	14HS-C19523-01	14HS-C19523-01_OPEN	Screenings Compactor Flush Water Pressure		OPEN	DO	7701-09-N-008			
	14DCU64	14HS-C19525-01	14HS-C19525-01_START	Screenings Winch 1		START	DO	7701-09-N-008			
	14DCU64	14HS-C19530-01	14HS-C19530-01_OPEN	Grit Basin 1 Inlet Gate		OPEN	DO	7701-09-N-019			
	14DCU64	14HS-C19530-02	14HS-C19530-02_OPEN	Grit Basin 2 Inlet Gate		OPEN	DO	7701-09-N-019			
	14DCU64	14HS-C19530-03	14HS-C19530-03_OPEN	Grit Basin 3 Inlet Gate		OPEN	DO	7701-09-N-020			
	14DCU64	14HS-C19530-04	14HS-C19530-04_OPEN	Grit Basin 4 Inlet Gate		OPEN	DO	7701-09-N-020			
	14DCU64	14HS-C19530-05	14HS-C19530-05_OPEN	Grit Basin 5 Inlet Gate		OPEN	DO	7701-09-N-021			
	14DCU64	14HS-C19530-06	14HS-C19530-06_OPEN	Grit Basin 6 Inlet Gate		OPEN	DO	7701-09-N-021			
	14DCU64	14HS-C19533-01	14HS-C19533-01_OPEN	Grit Basins Effluent Channel Emergency Overflow Gate		OPEN	DO	7701-09-N-019			
	14DCU64	14HS-C19649-05	14HS-C19649-05_OPEN	Raw Sewage Pump 5 Wetwell Gate		OPEN	DO	7701-09-N-016			
	14DCU64	14HS-C19650-05	14HS-C19650-05_OPEN	Raw Sewage Pump 5 Wetwell Gate		OPEN	DO	7701-09-N-016			
	14DCU64	14HS-C19655-05	14HS-C19655-05_START	Raw Sewage Pump 5		START	DO	7701-09-N-016			
	14DCU64	14HS-C19670-05	14HS-C19670-05_OPEN	Raw Sewage Pump 5 Vent Valve		OPEN	DO	7701-09-N-016			

	14DCU64	14HS-C19739-01	14HS-C19739-01_START	Grit Room Sump Pump 1		START	DO	7701-09-N-039			
	14DCU64	14HS-C19808-01	14HS-C19808-01_START	Grit Room Supply Fan		START	DO	7701-09-N-039			
	14DCU64	14HS-C19809-01	14HS-C19809-01_START	Grit Room Exhaust Fan		START	DO	7701-09-N-039			
	14DCU64	14HS-C19926-01	14HS-C19926-01_OPEN	Grit Basin 1 Fluidizing Water Valve		OPEN	DO	7701-09-N-019			
	14DCU64	14HS-C19926-02	14HS-C19926-02_OPEN	Grit Basin 2 Fluidizing Water Valve		OPEN	DO	7701-09-N-019			
	14DCU64	14HS-C19926-03	14HS-C19926-03_OPEN	Grit Basin 3 Fluidizing Water Valve		OPEN	DO	7701-09-N-020			
	14DCU64	14HS-C19926-04	14HS-C19926-04_OPEN	Grit Basin 4 Fluidizing Water Valve		OPEN	DO	7701-09-N-020			
	14DCU64	14HS-C19926-05	14HS-C19926-05_OPEN	Grit Basin 5 Fluidizing Water Valve		OPEN	DO	7701-09-N-021			
	14DCU64	14HS-C19926-06	14HS-C19926-06_OPEN	Grit Basin 6 Fluidizing Water Valve		OPEN	DO	7701-09-N-021			
	14DCU64	14HS-C29501-01	14HS-C29501-01_CLOSE	Influent Screen 1 Influent Gate		CLOSE	DO	7701-09-N-005			
	14DCU64	14HS-C29501-02	14HS-C29501-02_CLOSE	Influent Screen 2 Influent Gate		CLOSE	DO	7701-09-N-005			
	14DCU64	14HS-C29501-03	14HS-C29501-03_CLOSE	Influent Screen 3 Influent Gate		CLOSE	DO	7701-09-N-005			
	14DCU64	14HS-C29505-02	14HS-C29505-02_CLOSE	Influent Screen 2 Effluent Gate		CLOSE	DO	7701-09-N-007			
	14DCU64	14HS-C29505-03	14HS-C29505-03_CLOSE	Influent Screen 3 Effluent Gate		CLOSE	DO	7701-09-N-007			
	14DCU64	14HS-C29508-01	14HS-C29508-01_STOP	Influent Screen 1		STOP	DO	7701-09-N-006			
	14DCU64	14HS-C29508-02	14HS-C29508-02_STOP	Influent Screen 2		STOP	DO	7701-09-N-006			
	14DCU64	14HS-C29508-03	14HS-C29508-03_STOP	Influent Screen 3		STOP	DO	7701-09-N-006			
	14DCU64	14HS-C29510-01	14HS-C29510-01_CLOSE	Screening Trough Flow		CLOSE	DO	7701-09-N-006			
	14DCU64	14HS-C29520-01	14HS-C29520-01_CLOSE	Screenings Compactor 1 Inlet Valve		CLOSE	DO	7701-09-N-008			
	14DCU64	14HS-C29520-02	14HS-C29520-02_CLOSE	Screenings Compactor 2 Inlet Valve		CLOSE	DO	7701-09-N-008			
	14DCU64	14HS-C29521-01	14HS-C29521-01_STOP	Screenings Compactor 1		STOP	DO	7701-09-N-008			
	14DCU64	14HS-C29521-02	14HS-C29521-02_STOP	Screenings Compactor 2		STOP	DO	7701-09-N-008			
	14DCU64	14HS-C29522-01	14HS-C29522-01_CLOSE	Screenings Compactor 1 Flush Water Valve		CLOSE	DO	7701-09-N-008			
	14DCU64	14HS-C29522-02	14HS-C29522-02_CLOSE	Screenings Compactor 2 Flush Water Valve		CLOSE	DO	7701-09-N-008			
	14DCU64	14HS-C29523-01	14HS-C29523-01_CLOSE	Screenings Compactor Flush Water Pressure		CLOSE	DO	7701-09-N-008			
	14DCU64	14HS-C29525-01	14HS-C29525-01_STOP	Screenings Winch 1		STOP	DO	7701-09-N-008			
	14DCU64	14HS-C29530-01	14HS-C29530-01_CLOSE	Grit Basin 1 Inlet Gate		CLOSE	DO	7701-09-N-019			
	14DCU64	14HS-C29530-02	14HS-C29530-02_CLOSE	Grit Basin 2 Inlet Gate		CLOSE	DO	7701-09-N-019			
	14DCU64	14HS-C29530-03	14HS-C29530-03_CLOSE	Grit Basin 3 Inlet Gate		CLOSE	DO	7701-09-N-020			
	14DCU64	14HS-C29530-04	14HS-C29530-04_CLOSE	Grit Basin 4 Inlet Gate		CLOSE	DO	7701-09-N-020			
	14DCU64	14HS-C29530-05	14HS-C29530-05_CLOSE	Grit Basin 5 Inlet Gate		CLOSE	DO	7701-09-N-021			
	14DCU64	14HS-C29530-06	14HS-C29530-06_CLOSE	Grit Basin 6 Inlet Gate		CLOSE	DO	7701-09-N-021			
	14DCU64	14HS-C29533-01	14HS-C29533-01_CLOSE	Grit Basins Effluent Channel Emergency Overflow Gate		CLOSE	DO	7701-09-N-019			
	14DCU64	14HS-C29649-05	14HS-C29649-05_CLOSE	Raw Sewage Pump 5 Wetwell Gate		CLOSE	DO	7701-09-N-016			
	14DCU64	14HS-C29650-05	14HS-C29650-05_CLOSE	Raw Sewage Pump 5 Wetwell Gate		CLOSE	DO	7701-09-N-016			
	14DCU64	14HS-C29655-05	14HS-C29655-05_STOP	Raw Sewage Pump 5		STOP	DO	7701-09-N-016			
	14DCU64	14HS-C29670-05	14HS-C29670-05_CLOSE	Raw Sewage Pump 5 Vent Valve		CLOSE	DO	7701-09-N-016			
	14DCU64	14HS-C29739-01	14HS-C29739-01_STOP	Grit Room Sump Pump 1		STOP	DO	7701-09-N-039			
	14DCU64	14HS-C29808-01	14HS-C29808-01_STOP	Grit Room Supply Fan		STOP	DO	7701-09-N-039			
	14DCU64	14HS-C29809-01	14HS-C29809-01_STOP	Grit Room Exhaust Fan		STOP	DO	7701-09-N-039			
	14DCU64	14HS-C29926-01	14HS-C29926-01_CLOSE	Grit Basin 1 Fluidizing Water Valve		CLOSE	DO	7701-09-N-019			
	14DCU64	14HS-C29926-02	14HS-C29926-02_CLOSE	Grit Basin 2 Fluidizing Water Valve		CLOSE	DO	7701-09-N-019			
	14DCU64	14HS-C29926-03	14HS-C29926-03_CLOSE	Grit Basin 3 Fluidizing Water Valve		CLOSE	DO	7701-09-N-020			
	14DCU64	14HS-C29926-04	14HS-C29926-04_CLOSE	Grit Basin 4 Fluidizing Water Valve		CLOSE	DO	7701-09-N-020			
	14DCU64	14HS-C29926-05	14HS-C29926-05_CLOSE	Grit Basin 5 Fluidizing Water Valve		CLOSE	DO	7701-09-N-021			
	14DCU64	14HS-C29926-06	14HS-C29926-06_CLOSE	Grit Basin 6 Fluidizing Water Valve		CLOSE	DO	7701-09-N-021			
	14DCU64	14HS-C39530-01	14HS-C39530-01_STOP	Grit Basin 1 Inlet Gate		STOP	DO	7701-09-N-019			
	14DCU64	14HS-C39530-02	14HS-C39530-02_STOP	Grit Basin 2 Inlet Gate		STOP	DO	7701-09-N-019			
	14DCU64	14HS-C39530-03	14HS-C39530-03_STOP	Grit Basin 3 Inlet Gate		STOP	DO	7701-09-N-020			
	14DCU64	14HS-C39530-04	14HS-C39530-04_STOP	Grit Basin 4 Inlet Gate		STOP	DO	7701-09-N-020			
	14DCU64	14HS-C39530-05	14HS-C39530-05_STOP	Grit Basin 5 Inlet Gate		STOP	DO	7701-09-N-021			
	14DCU64	14HS-C39530-06	14HS-C39530-06_STOP	Grit Basin 6 Inlet Gate		STOP	DO	7701-09-N-021			

	14DCU64	14LI9560-00	14LI9560-00_LEVEL	EBOS - Compartment B Level			AI	7701-09-N-001			
	14DCU64	14LI9570-00	14LI9570-00_LEVEL	EBOS - Compartment B Level			AI	7701-09-N-001			
	14DCU64	14HS-C19550-00	14HS-C19550-00_OPEN	EBOS - Headworks 2 Gate		OPEN	DO	7701-09-N-001			
	14DCU64	14HS-C29550-00	14HS-C29550-00_CLOSE	EBOS - Headworks 2 Gate		CLOSE	DO	7701-09-N-001			
	14DCU64	14HSL9550-00	14HSL9550-00_LOCAL	EBOS - Headworks 2 Gate	OFF	LOCAL	DI	7701-09-N-001			
	14DCU64	14HSR9550-00	14HSR9550-00_REMOTE	EBOS - Headworks 2 Gate	OFF	REMOTE	DI	7701-09-N-001			
	14DCU64	14XA9550-00	14XA9550-00_FAULT	EBOS - Headworks 2 Gate	FAULT	NORMAL	DI	7701-09-N-001			
	14DCU64	14XL9550-00A	14XL9550-00A_DSC CLOSED	EBOS - Headworks 2 Gate DSC	OPENED	CLOSED	DI	7701-09-N-001			
	14DCU64	14XL9550-00B	14XL9550-00B_POWER ON	EBOS - Headworks 2 Gate	OFF	POWERED	DI	7701-09-N-001			
	14DCU64	14ZIH9550-00	14ZIH9550-00_OPENED	EBOS - Headworks 2 Gate	NOT OPENED	OPENED	DI	7701-09-N-001			
	14DCU64	14ZIL9550-00	14ZIL9550-00_CLOSED	EBOS - Headworks 2 Gate	NOT CLOSED	CLOSED	DI	7701-09-N-001			
	DCU1	23HK2578-01	23HK2578-01_CONTROL	East Meter Vault Primary Influent Flow	0	100 Percent	AO	7701-09-N-031			

PANEL	DCU	TAG NO	IO TAG NUMBER	LOOP TITLE	ZERO STATE	ONE STATE	TYPE	P+ID NO	ADDRESS	SLOT	POINT
	14DCU64	14HSL9708-01	14HSL9708_LOCAL	Biotower Scrubber Recirculation Pump		LOCAL	MBDI	7701-09-N-034			
	14DCU64	14HSR9708-01	14HSR9708_REMOTE	Biotower Scrubber Recirculation Pump		REMOTE	MBDI	7701-09-N-034			
	14DCU64	14JI9708-01	14JI9708_POWER	Biotower Scrubber Recirculation Pump			MBAI	7701-09-N-034			
	14DCU64	14NL9708-01	14NL9708_RUNNING	Biotower Scrubber Recirculation Pump	OFF	RUNNING	MBDI	7701-09-N-034			
	14DCU64	14XA9708-01	14XA9708_FAULT	Biotower Scrubber Recirculation Pump	NORMAL	FAULT	MBDI	7701-09-N-034			
	14DCU64	14XL9708-01	14XL9708_READY	Biotower Scrubber Recirculation Pump	NOT READY	READY	MBDI	7701-09-N-034			
	14DCU64	14HSL9603-01	14HSL9603_LOCAL	Grit Classifier 1		LOCAL	MBDI	7701-09-N-022			
	14DCU64	14HSR9603-01	14HSR9603_REMOTE	Grit Classifier 1		REMOTE	MBDI	7701-09-N-022			
	14DCU64	14JI9603-01	14JI9603_POWER	Grit Classifier 1			MBAI	7701-09-N-022			
	14DCU64	14NL9603-01	14NL9603_RUNNING	Grit Classifier 1	OFF	RUNNING	MBDI	7701-09-N-022			
	14DCU64	14XA9603-01	14XA9603_FAULT	Grit Classifier 1	NORMAL	FAULT	MBDI	7701-09-N-022			
	14DCU64	14XL9603-01A	14XL9603A_READY	Grit Classifier 1	NOT READY	READY	MBDI	7701-09-N-022			
	14DCU64	14HSL9603-02	14HSL9603_LOCAL	Grit Classifier 2		LOCAL	MBDI	7701-09-N-023			
	14DCU64	14HSR9603-02	14HSR9603_REMOTE	Grit Classifier 2		REMOTE	MBDI	7701-09-N-023			
	14DCU64	14JI9603-02	14JI9603_POWER	Grit Classifier 2			MBAI	7701-09-N-023			
	14DCU64	14NL9603-02	14NL9603_RUNNING	Grit Classifier 2	OFF	RUNNING	MBDI	7701-09-N-023			
	14DCU64	14XA9603-02	14XA9603_FAULT	Grit Classifier 2	NORMAL	FAULT	MBDI	7701-09-N-023			
	14DCU64	14XL9603-02A	14XL9603A_READY	Grit Classifier 2	NOT READY	READY	MBDI	7701-09-N-023			
	14DCU64	14HSL9603-03	14HSL9603_LOCAL	Grit Classifier 3		LOCAL	MBDI	7701-09-N-024			
	14DCU64	14HSR9603-03	14HSR9603_REMOTE	Grit Classifier 3		REMOTE	MBDI	7701-09-N-024			
	14DCU64	14JI9603-03	14JI9603_POWER	Grit Classifier 3			MBAI	7701-09-N-024			
	14DCU64	14NL9603-03	14NL9603_RUNNING	Grit Classifier 3	OFF	RUNNING	MBDI	7701-09-N-024			
	14DCU64	14XA9603-03	14XA9603_FAULT	Grit Classifier 3	NORMAL	FAULT	MBDI	7701-09-N-024			
	14DCU64	14XL9603-03A	14XL9603A_READY	Grit Classifier 3	NOT READY	READY	MBDI	7701-09-N-024			
	14DCU64	14HSL9603-04	14HSL9603_LOCAL	Grit Classifier 4		LOCAL	MBDI	7701-09-N-025			
	14DCU64	14HSR9603-04	14HSR9603_REMOTE	Grit Classifier 4		REMOTE	MBDI	7701-09-N-025			
	14DCU64	14JI9603-04	14JI9603_POWER	Grit Classifier 4			MBAI	7701-09-N-025			
	14DCU64	14NL9603-04	14NL9603_RUNNING	Grit Classifier 4	OFF	RUNNING	MBDI	7701-09-N-025			
	14DCU64	14XA9603-04	14XA9603_FAULT	Grit Classifier 4	NORMAL	FAULT	MBDI	7701-09-N-025			
	14DCU64	14XL9603-04A	14XL9603A_READY	Grit Classifier 4	NOT READY	READY	MBDI	7701-09-N-025			
	14DCU64	14HSL9603-05	14HSL9603_LOCAL	Grit Classifier 5		LOCAL	MBDI	7701-09-N-026			
	14DCU64	14HSR9603-05	14HSR9603_REMOTE	Grit Classifier 5		REMOTE	MBDI	7701-09-N-026			
	14DCU64	14JI9603-05	14JI9603_POWER	Grit Classifier 5			MBAI	7701-09-N-026			
	14DCU64	14NL9603-05	14NL9603_RUNNING	Grit Classifier 5	OFF	RUNNING	MBDI	7701-09-N-026			
	14DCU64	14XA9603-05	14XA9603_FAULT	Grit Classifier 5	NORMAL	FAULT	MBDI	7701-09-N-026			
	14DCU64	14XL9603-05A	14XL9603A_READY	Grit Classifier 5	NOT READY	READY	MBDI	7701-09-N-026			
	14DCU64	14HSL9603-06	14HSL9603_LOCAL	Grit Classifier 6		LOCAL	MBDI	7701-09-N-027			
	14DCU64	14HSR9603-06	14HSR9603_REMOTE	Grit Classifier 6		REMOTE	MBDI	7701-09-N-027			
	14DCU64	14JI9603-06	14JI9603_POWER	Grit Classifier 6			MBAI	7701-09-N-027			
	14DCU64	14NL9603-06	14NL9603_RUNNING	Grit Classifier 6	OFF	RUNNING	MBDI	7701-09-N-027			
	14DCU64	14XA9603-06	14XA9603_FAULT	Grit Classifier 6	NORMAL	FAULT	MBDI	7701-09-N-027			
	14DCU64	14XL9603-06A	14XL9603A_READY	Grit Classifier 6	NOT READY	READY	MBDI	7701-09-N-027			
	14DCU64	14HSL9601-01	14HSL9601_LOCAL	Grit Pump 1		LOCAL	MBDI	7701-09-N-022			
	14DCU64	14HSR9601-01	14HSR9601_REMOTE	Grit Pump 1		REMOTE	MBDI	7701-09-N-022			
	14DCU64	14JI9601-01	14JI9601_POWER	Grit Pump 1			MBAI	7701-09-N-022			
	14DCU64	14NL9601-01	14NL9601_RUNNING	Grit Pump 1	OFF	RUNNING	MBDI	7701-09-N-022			
	14DCU64	14XA9601-01	14XA9601_FAULT	Grit Pump 1	NORMAL	FAULT	MBDI	7701-09-N-022			
	14DCU64	14XL9601-01A	14XL9601A_READY	Grit Pump 1	NOT READY	READY	MBDI	7701-09-N-022			

	14DCU64	14HSL9601-02	14HSL9601_LOCAL	Grit Pump 2		LOCAL	MBDI	7701-09-N-023			
	14DCU64	14HSR9601-02	14HSR9601_REMOTE	Grit Pump 2		REMOTE	MBDI	7701-09-N-023			
	14DCU64	14JI9601-02	14JI9601_POWER	Grit Pump 2			MBAI	7701-09-N-023			
	14DCU64	14NL9601-02	14NL9601_RUNNING	Grit Pump 2	OFF	RUNNING	MBDI	7701-09-N-023			
	14DCU64	14XA9601-02	14XA9601_FAULT	Grit Pump 2	NORMAL	FAULT	MBDI	7701-09-N-023			
	14DCU64	14XL9601-02A	14XL9601A_READY	Grit Pump 2	NOT READY	READY	MBDI	7701-09-N-023			
	14DCU64	14HSL9601-03	14HSL9601_LOCAL	Grit Pump 3		LOCAL	MBDI	7701-09-N-024			
	14DCU64	14HSR9601-03	14HSR9601_REMOTE	Grit Pump 3		REMOTE	MBDI	7701-09-N-024			
	14DCU64	14JI9601-03	14JI9601_POWER	Grit Pump 3			MBAI	7701-09-N-024			
	14DCU64	14NL9601-03	14NL9601_RUNNING	Grit Pump 3	OFF	RUNNING	MBDI	7701-09-N-024			
	14DCU64	14XA9601-03	14XA9601_FAULT	Grit Pump 3	NORMAL	FAULT	MBDI	7701-09-N-024			
	14DCU64	14XL9601-03A	14XL9601A_READY	Grit Pump 3	NOT READY	READY	MBDI	7701-09-N-024			
	14DCU64	14HSL9601-04	14HSL9601_LOCAL	Grit Pump 4		LOCAL	MBDI	7701-09-N-025			
	14DCU64	14HSR9601-04	14HSR9601_REMOTE	Grit Pump 4		REMOTE	MBDI	7701-09-N-025			
	14DCU64	14JI9601-04	14JI9601_POWER	Grit Pump 4			MBAI	7701-09-N-025			
	14DCU64	14NL9601-04	14NL9601_RUNNING	Grit Pump 4	OFF	RUNNING	MBDI	7701-09-N-025			
	14DCU64	14XA9601-04	14XA9601_FAULT	Grit Pump 4	NORMAL	FAULT	MBDI	7701-09-N-025			
	14DCU64	14XL9601-04A	14XL9601A_READY	Grit Pump 4	NOT READY	READY	MBDI	7701-09-N-025			
	14DCU64	14HSL9601-05	14HSL9601_LOCAL	Grit Pump 5		LOCAL	MBDI	7701-09-N-026			
	14DCU64	14HSR9601-05	14HSR9601_REMOTE	Grit Pump 5		REMOTE	MBDI	7701-09-N-026			
	14DCU64	14JI9601-05	14JI9601_POWER	Grit Pump 5			MBAI	7701-09-N-026			
	14DCU64	14NL9601-05	14NL9601_RUNNING	Grit Pump 5	OFF	RUNNING	MBDI	7701-09-N-026			
	14DCU64	14XA9601-05	14XA9601_FAULT	Grit Pump 5	NORMAL	FAULT	MBDI	7701-09-N-026			
	14DCU64	14XL9601-05A	14XL9601A_READY	Grit Pump 5	NOT READY	READY	MBDI	7701-09-N-026			
	14DCU64	14HSL9601-06	14HSL9601_LOCAL	Grit Pump 6		LOCAL	MBDI	7701-09-N-027			
	14DCU64	14HSR9601-06	14HSR9601_REMOTE	Grit Pump 6		REMOTE	MBDI	7701-09-N-027			
	14DCU64	14JI9601-06	14JI9601_POWER	Grit Pump 6			MBAI	7701-09-N-027			
	14DCU64	14NL9601-06	14NL9601_RUNNING	Grit Pump 6	OFF	RUNNING	MBDI	7701-09-N-027			
	14DCU64	14XA9601-06	14XA9601_FAULT	Grit Pump 6	NORMAL	FAULT	MBDI	7701-09-N-027			
	14DCU64	14XL9601-06A	14XL9601A_READY	Grit Pump 6	NOT READY	READY	MBDI	7701-09-N-027			
	14DCU64	14HSL9809-01	14HSL9809_LOCAL	Grit Room Exhaust Fan		LOCAL	MBDI	7701-09-N-039			
	14DCU64	14HSR9809-01	14HSR9809_REMOTE	Grit Room Exhaust Fan		REMOTE	MBDI	7701-09-N-039			
	14DCU64	14JI9809-01	14JI9809_POWER	Grit Room Exhaust Fan			MBAI	7701-09-N-039			
	14DCU64	14NL9809-01	14NL9809_ON	Grit Room Exhaust Fan	OFF	RUNNING	MBDI	7701-09-N-039			
	14DCU64	14XA9809-01	14XA9809_FAULT	Grit Room Exhaust Fan	NORMAL	FAULT	MBDI	7701-09-N-039			
	14DCU64	14XL9809-01A	14XL9809A_READY	Grit Room Exhaust Fan	NOT READY	READY	MBDI	7701-09-N-039			
	14DCU64	14HSL9739-01	14HSL9739_LOCAL	Grit Room Sump Pump 1		LOCAL	MBDI	7701-09-N-039			
	14DCU64	14HSR9739-01	14HSR9739_REMOTE	Grit Room Sump Pump 1		REMOTE	MBDI	7701-09-N-039			
	14DCU64	14JI9739-01	14JI9739_POWER	Grit Room Sump Pump 1			MBAI	7701-09-N-039			
	14DCU64	14NL9739-01	14NL9739_ON	Grit Room Sump Pump 1	OFF	RUNNING	MBDI	7701-09-N-039			
	14DCU64	14XA9739-01	14XA9739_FAULT	Grit Room Sump Pump 1	NORMAL	FAULT	MBDI	7701-09-N-039			
	14DCU64	14XL9739-01A	14XL9739A_READY	Grit Room Sump Pump 1	NOT READY	READY	MBDI	7701-09-N-039			
	14DCU64	14HSL9739-02	14HSL9739_LOCAL	Grit Room Sump Pump 2		LOCAL	MBDI	7701-09-N-039			
	14DCU64	14HSR9739-02	14HSR9739_REMOTE	Grit Room Sump Pump 2		REMOTE	MBDI	7701-09-N-039			
	14DCU64	14JI9739-02	14JI9739_POWER	Grit Room Sump Pump 2			MBAI	7701-09-N-039			
	14DCU64	14NL9739-02	14NL9739_ON	Grit Room Sump Pump 2	OFF	RUNNING	MBDI	7701-09-N-039			
	14DCU64	14XA9739-02	14XA9739_FAULT	Grit Room Sump Pump 2	NORMAL	FAULT	MBDI	7701-09-N-039			
	14DCU64	14XL9739-02A	14XL9739A_READY	Grit Room Sump Pump 2	NOT READY	READY	MBDI	7701-09-N-039			
	14DCU64	14HSL9808-01	14HSL9808_LOCAL	Grit Room Supply Fan		LOCAL	MBDI	7701-09-N-039			
	14DCU64	14HSR9808-01	14HSR9808_REMOTE	Grit Room Supply Fan		REMOTE	MBDI	7701-09-N-039			
	14DCU64	14JI9808-01	14JI9808_POWER	Grit Room Supply Fan			MBAI	7701-09-N-039			

	14DCU64	14NL9808-01	14NL9808_ON	Grit Room Supply Fan	OFF	RUNNING	MBDI	7701-09-N-039			
	14DCU64	14XA9808-01	14XA9808_FAULT	Grit Room Supply Fan	NORMAL	FAULT	MBDI	7701-09-N-039			
	14DCU64	14XL9808-01A	14XL9808A_READY	Grit Room Supply Fan	NOT READY	READY	MBDI	7701-09-N-039			
	14DCU64	14HSL9605-01	14HSL9605_LOCAL	Grit Washer 1		LOCAL	MBDI	7701-09-N-022			
	14DCU64	14HSR9605-01	14HSR9605_REMOTE	Grit Washer 1		REMOTE	MBDI	7701-09-N-022			
	14DCU64	14JI9605-01	14JI9605_POWER	Grit Washer 1			MBAI	7701-09-N-022			
	14DCU64	14NL9605-01	14NL9605_RUNNING	Grit Washer 1	OFF	RUNNING	MBDI	7701-09-N-022			
	14DCU64	14XA9605-01	14XA9605_FAULT	Grit Washer 1	NORMAL	FAULT	MBDI	7701-09-N-022			
	14DCU64	14XL9605-01A	14XL9605A_READY	Grit Washer 1	NOT READY	READY	MBDI	7701-09-N-022			
	14DCU64	14HSL9605-02	14HSL9605_LOCAL	Grit Washer 2		LOCAL	MBDI	7701-09-N-023			
	14DCU64	14HSR9605-02	14HSR9605_REMOTE	Grit Washer 2		REMOTE	MBDI	7701-09-N-023			
	14DCU64	14JI9605-02	14JI9605_POWER	Grit Washer 2			MBAI	7701-09-N-023			
	14DCU64	14NL9605-02	14NL9605_RUNNING	Grit Washer 2	OFF	RUNNING	MBDI	7701-09-N-023			
	14DCU64	14XA9605-02	14XA9605_FAULT	Grit Washer 2	NORMAL	FAULT	MBDI	7701-09-N-023			
	14DCU64	14XL9605-02A	14XL9605A_READY	Grit Washer 2	NOT READY	READY	MBDI	7701-09-N-023			
	14DCU64	14HSL9605-03	14HSL9605_LOCAL	Grit Washer 3		LOCAL	MBDI	7701-09-N-024			
	14DCU64	14HSR9605-03	14HSR9605_REMOTE	Grit Washer 3		REMOTE	MBDI	7701-09-N-024			
	14DCU64	14JI9605-03	14JI9605_POWER	Grit Washer 3			MBAI	7701-09-N-024			
	14DCU64	14NL9605-03	14NL9605_RUNNING	Grit Washer 3	OFF	RUNNING	MBDI	7701-09-N-024			
	14DCU64	14XA9605-03	14XA9605_FAULT	Grit Washer 3	NORMAL	FAULT	MBDI	7701-09-N-024			
	14DCU64	14XL9605-03A	14XL9605A_READY	Grit Washer 3	NOT READY	READY	MBDI	7701-09-N-024			
	14DCU64	14HSL9605-04	14HSL9605_LOCAL	Grit Washer 4		LOCAL	MBDI	7701-09-N-025			
	14DCU64	14HSR9605-04	14HSR9605_REMOTE	Grit Washer 4		REMOTE	MBDI	7701-09-N-025			
	14DCU64	14JI9605-04	14JI9605_POWER	Grit Washer 4			MBAI	7701-09-N-025			
	14DCU64	14NL9605-04	14NL9605_RUNNING	Grit Washer 4	OFF	RUNNING	MBDI	7701-09-N-025			
	14DCU64	14XA9605-04	14XA9605_FAULT	Grit Washer 4	NORMAL	FAULT	MBDI	7701-09-N-025			
	14DCU64	14XL9605-04A	14XL9605A_READY	Grit Washer 4	NOT READY	READY	MBDI	7701-09-N-025			
	14DCU64	14HSL9605-05	14HSL9605_LOCAL	Grit Washer 5		LOCAL	MBDI	7701-09-N-026			
	14DCU64	14HSR9605-05	14HSR9605_REMOTE	Grit Washer 5		REMOTE	MBDI	7701-09-N-026			
	14DCU64	14JI9605-05	14JI9605_POWER	Grit Washer 5			MBAI	7701-09-N-026			
	14DCU64	14NL9605-05	14NL9605_RUNNING	Grit Washer 5	OFF	RUNNING	MBDI	7701-09-N-026			
	14DCU64	14XA9605-05	14XA9605_FAULT	Grit Washer 5	NORMAL	FAULT	MBDI	7701-09-N-026			
	14DCU64	14XL9605-05A	14XL9605A_READY	Grit Washer 5	NOT READY	READY	MBDI	7701-09-N-026			
	14DCU64	14HSL9605-06	14HSL9605_LOCAL	Grit Washer 6		LOCAL	MBDI	7701-09-N-027			
	14DCU64	14HSR9605-06	14HSR9605_REMOTE	Grit Washer 6		REMOTE	MBDI	7701-09-N-027			
	14DCU64	14JI9605-06	14JI9605_POWER	Grit Washer 6			MBAI	7701-09-N-027			
	14DCU64	14NL9605-06	14NL9605_RUNNING	Grit Washer 6	OFF	RUNNING	MBDI	7701-09-N-027			
	14DCU64	14XA9605-06	14XA9605_FAULT	Grit Washer 6	NORMAL	FAULT	MBDI	7701-09-N-027			
	14DCU64	14XL9605-06A	14XL9605A_READY	Grit Washer 6	NOT READY	READY	MBDI	7701-09-N-027			
	14DCU64	14HSL9725-01	14HSL9725_LOCAL	HW3 Recycle Pump Station - Pump 1		LOCAL	MBDI	7701-09-N-038			
	14DCU64	14HSR9725-01	14HSR9725_REMOTE	HW3 Recycle Pump Station - Pump 1		REMOTE	MBDI	7701-09-N-038			
	14DCU64	14JI9725-01	14JI9725_POWER	HW3 Recycle Pump Station - Pump 1			MBAI	7701-09-N-038			
	14DCU64	14NL9725-01	14NL9725_RUNNING	HW3 Recycle Pump Station - Pump 1	OFF	RUNNING	MBDI	7701-09-N-038			
	14DCU64	14XA9725-01	14XA9725_FAULT	HW3 Recycle Pump Station - Pump 1	NORMAL	FAULT	MBDI	7701-09-N-038			
	14DCU64	14XL9725-01A	14XL9725A_READY	HW3 Recycle Pump Station - Pump 1	NOT READY	READY	MBDI	7701-09-N-038			
	14DCU64	14HSL9725-02	14HSL9725_LOCAL	HW3 Recycle Pump Station - Pump 2		LOCAL	MBDI	7701-09-N-038			
	14DCU64	14HSR9725-02	14HSR9725_REMOTE	HW3 Recycle Pump Station - Pump 2		REMOTE	MBDI	7701-09-N-038			
	14DCU64	14JI9725-02	14JI9725_POWER	HW3 Recycle Pump Station - Pump 2			MBAI	7701-09-N-038			
	14DCU64	14NL9725-02	14NL9725_RUNNING	HW3 Recycle Pump Station - Pump 2	OFF	RUNNING	MBDI	7701-09-N-038			
	14DCU64	14XA9725-02	14XA9725_FAULT	HW3 Recycle Pump Station - Pump 2	NORMAL	FAULT	MBDI	7701-09-N-038			
	14DCU64	14XL9725-02A	14XL9725A_READY	HW3 Recycle Pump Station - Pump 2	NOT READY	READY	MBDI	7701-09-N-038			

	14DCU64	14HSL9725-03	14HSL9725_LOCAL	HW3 Recycle Pump Station - Pump 3		LOCAL	MBDI	7701-09-N-038			
	14DCU64	14HSR9725-03	14HSR9725_REMOTE	HW3 Recycle Pump Station - Pump 3		REMOTE	MBDI	7701-09-N-038			
	14DCU64	14JI9725-03	14JI9725_POWER	HW3 Recycle Pump Station - Pump 3			MBAI	7701-09-N-038			
	14DCU64	14NL9725-03	14NL9725_RUNNING	HW3 Recycle Pump Station - Pump 3	OFF	RUNNING	MBDI	7701-09-N-038			
	14DCU64	14XA9725-03	14XA9725_FAULT	HW3 Recycle Pump Station - Pump 3	NORMAL	FAULT	MBDI	7701-09-N-038			
	14DCU64	14XL9725-03A	14XL9725A_READY	HW3 Recycle Pump Station - Pump 3	NOT READY	READY	MBDI	7701-09-N-038			
	14DCU64	14HSL9508-01	14HSL9508_LOCAL	Influent Screen 1		LOCAL	MBDI	7701-09-N-006			
	14DCU64	14HSR9508-01	14HSR9508_REMOTE	Influent Screen 1		REMOTE	MBDI	7701-09-N-006			
	14DCU64	14JI9508-01	14JI9508_POWER	Influent Screen 1			MBAI	7701-09-N-006			
	14DCU64	14NL9508-01	14NL9508_RUNNING	Influent Screen 1	OFF	RUNNING	MBDI	7701-09-N-006			
	14DCU64	14VAH9508-01	14VAH9508_TORQUE	Influent Screen 1	NORMAL	HIGH	MBDI	7701-09-N-006			
	14DCU64	14XA9508-01	14XA9508_FAULT	Influent Screen 1	NORMAL	FAULT	MBDI	7701-09-N-006			
	14DCU64	14XL9508-01A	14XL9508A_READY	Influent Screen 1	NOT READY	READY	MBDI	7701-09-N-006			
	14DCU64	14HSL9508-02	14HSL9508_LOCAL	Influent Screen 2		LOCAL	MBDI	7701-09-N-006			
	14DCU64	14HSR9508-02	14HSR9508_REMOTE	Influent Screen 2		REMOTE	MBDI	7701-09-N-006			
	14DCU64	14JI9508-02	14JI9508_POWER	Influent Screen 2			MBAI	7701-09-N-006			
	14DCU64	14NL9508-02	14NL9508_RUNNING	Influent Screen 2	OFF	RUNNING	MBDI	7701-09-N-006			
	14DCU64	14VAH9508-02	14VAH9508_TORQUE	Influent Screen 2	NORMAL	HIGH	MBDI	7701-09-N-006			
	14DCU64	14XA9508-02	14XA9508_FAULT	Influent Screen 2	NORMAL	FAULT	MBDI	7701-09-N-006			
	14DCU64	14XL9508-02A	14XL9508A_READY	Influent Screen 2	NOT READY	READY	MBDI	7701-09-N-006			
	14DCU64	14HSL9508-03	14HSL9508_LOCAL	Influent Screen 3		LOCAL	MBDI	7701-09-N-006			
	14DCU64	14HSR9508-03	14HSR9508_REMOTE	Influent Screen 3		REMOTE	MBDI	7701-09-N-006			
	14DCU64	14JI9508-03	14JI9508_POWER	Influent Screen 3			MBAI	7701-09-N-006			
	14DCU64	14NL9508-03	14NL9508_RUNNING	Influent Screen 3	OFF	RUNNING	MBDI	7701-09-N-006			
	14DCU64	14VAH9508-03	14VAH9508_TORQUE	Influent Screen 3	NORMAL	HIGH	MBDI	7701-09-N-006			
	14DCU64	14XA9508-03	14XA9508_FAULT	Influent Screen 3	NORMAL	FAULT	MBDI	7701-09-N-006			
	14DCU64	14XL9508-03A	14XL9508A_READY	Influent Screen 3	NOT READY	READY	MBDI	7701-09-N-006			
	14DCU64	14HSL9701-01	14HSL9701_LOCAL	Odor Control Exhaust Fan 1		LOCAL	MBDI	7701-09-N-033			
	14DCU64	14HSR9701-01	14HSR9701_REMOTE	Odor Control Exhaust Fan 1		REMOTE	MBDI	7701-09-N-033			
	14DCU64	14JI9701-01	14JI9701_POWER	Odor Control Exhaust Fan 1			MBAI	7701-09-N-033			
	14DCU64	14NL9701-01	14NL9701_RUNNING	Odor Control Exhaust Fan 1	OFF	RUNNING	MBDI	7701-09-N-033			
	14DCU64	14XA9701-01	14XA9701_FAULT	Odor Control Exhaust Fan 1	NORMAL	FAULT	MBDI	7701-09-N-033			
	14DCU64	14XL9701-01A	14XL9701A_READY	Odor Control Exhaust Fan 1	NOT READY	READY	MBDI	7701-09-N-033			
	14DCU64	14HSL9701-02	14HSL9701_LOCAL	Odor Control Exhaust Fan 2		LOCAL	MBDI	7701-09-N-033			
	14DCU64	14HSR9701-02	14HSR9701_REMOTE	Odor Control Exhaust Fan 2		REMOTE	MBDI	7701-09-N-033			
	14DCU64	14JI9701-02	14JI9701_POWER	Odor Control Exhaust Fan 2			MBAI	7701-09-N-033			
	14DCU64	14NL9701-02	14NL9701_RUNNING	Odor Control Exhaust Fan 2	OFF	RUNNING	MBDI	7701-09-N-033			
	14DCU64	14XA9701-02	14XA9701_FAULT	Odor Control Exhaust Fan 2	NORMAL	FAULT	MBDI	7701-09-N-033			
	14DCU64	14XL9701-02A	14XL9701A_READY	Odor Control Exhaust Fan 2	NOT READY	READY	MBDI	7701-09-N-033			
	14DCU64	14HSL9655-01	14HSL9655_LOCAL	Raw Sewage Pump 1		LOCAL	MBDI	7701-09-N-012			
	14DCU64	14HSR9655-01	14HSR9655_REMOTE	Raw Sewage Pump 1		REMOTE	MBDI	7701-09-N-012			
	14DCU64	14JI9655-01	14JI9655_POWER	Raw Sewage Pump 1			MBAI	7701-09-N-012			
	14DCU64	14NL9655-01	14NL9655_RUNNING	Raw Sewage Pump 1	OFF	RUNNING	MBDI	7701-09-N-012			
	14DCU64	14XA9655-01	14XA9655_FAULT	Raw Sewage Pump 1	NORMAL	FAULT	MBDI	7701-09-N-012			
	14DCU64	14XL9655-01A	14XL9655A_READY	Raw Sewage Pump 1	NOT READY	READY	MBDI	7701-09-N-012			
	14DCU64	14TI9683-01	14TI9683_TEMPERATURE INDICATION	Raw Sewage Pump 1 - Inboard Bearing Temperature			MBAI	7701-09-N-012			
	14DCU64	14VI9686-01	14VI9686_VIBRATION INDICATION	Raw Sewage Pump 1 - Inboard Bearing Vibration			MBAI	7701-09-N-012			
	14DCU64	14VI9687-01	14VI9687_VIBRATION INDICATION	Raw Sewage Pump 1 - Inboard Bearing Vibration			MBAI	7701-09-N-012			
	14DCU64	14TI9684-01	14TI9684_TEMPERATURE INDICATION	Raw Sewage Pump 1 - Outboard Bearing Temperature			MBAI	7701-09-N-012			
	14DCU64	14VI9688-01	14VI9688_VIBRATION INDICATION	Raw Sewage Pump 1 - Outboard Bearing Vibration			MBAI	7701-09-N-012			
	14DCU64	14VI9689-01	14VI9689_VIBRATION INDICATION	Raw Sewage Pump 1 - Outboard Bearing Vibration			MBAI	7701-09-N-012			

	14DCU64	14TI9680-01A	14TI9680A_TEMPERATURE INDICATION	Raw Sewage Pump 1 - Winding A Temperature			MBAI	7701-09-N-012			
	14DCU64	14TI9680-01B	14TI9680B_TEMPERATURE INDICATION	Raw Sewage Pump 1 - Winding A Temperature			MBAI	7701-09-N-012			
	14DCU64	14TI9681-01A	14TI9681A_TEMPERATURE INDICATION	Raw Sewage Pump 1 - Winding B Temperature			MBAI	7701-09-N-012			
	14DCU64	14TI9681-01B	14TI9681B_TEMPERATURE INDICATION	Raw Sewage Pump 1 - Winding B Temperature			MBAI	7701-09-N-012			
	14DCU64	14TI9682-01A	14TI9682A_TEMPERATURE INDICATION	Raw Sewage Pump 1 - Winding C Temperature			MBAI	7701-09-N-012			
	14DCU64	14TI9682-01B	14TI9682B_TEMPERATURE INDICATION	Raw Sewage Pump 1 - Winding C Temperature			MBAI	7701-09-N-012			
	14DCU64	14TI9680-01A	14TI9680A_TEMPERATURE INDICATION	Raw Sewage Pump 1 Winding Temperature			MBAI	7701-09-N-012			
	14DCU64	14TI9680-01A	14TI9680A_TEMPERATURE INDICATION	Raw Sewage Pump 1 Winding Temperature			MBAI	7701-09-N-012			
	14DCU64	14TI9680-01B	14TI9680B_TEMPERATURE INDICATION	Raw Sewage Pump 1 Winding Temperature			MBAI	7701-09-N-012			
	14DCU64	14TI9680-01B	14TI9680B_TEMPERATURE INDICATION	Raw Sewage Pump 1 Winding Temperature			MBAI	7701-09-N-012			
	14DCU64	14TI9681-01A	14TI9681A_TEMPERATURE INDICATION	Raw Sewage Pump 1 Winding Temperature			MBAI	7701-09-N-012			
	14DCU64	14TI9681-01B	14TI9681B_TEMPERATURE INDICATION	Raw Sewage Pump 1 Winding Temperature			MBAI	7701-09-N-012			
	14DCU64	14HSL9655-02	14HSL9655_LOCAL	Raw Sewage Pump 2		LOCAL	MBDI	7701-09-N-013			
	14DCU64	14HSR9655-02	14HSR9655_REMOTE	Raw Sewage Pump 2		REMOTE	MBDI	7701-09-N-013			
	14DCU64	14JI9655-02	14JI9655_POWER	Raw Sewage Pump 2			MBAI	7701-09-N-013			
	14DCU64	14NL9655-02	14NL9655_RUNNING	Raw Sewage Pump 2	OFF	RUNNING	MBDI	7701-09-N-013			
	14DCU64	14XA9655-02	14XA9655_FAULT	Raw Sewage Pump 2	NORMAL	FAULT	MBDI	7701-09-N-013			
	14DCU64	14XL9655-02	14XL9655_READY	Raw Sewage Pump 2	NOT READY	READY	MBDI	7701-09-N-013			
	14DCU64	14TI9683-02	14TI9683_TEMPERATURE INDICATION	Raw Sewage Pump 2 - Inboard Bearing Temperature			MBAI	7701-09-N-013			
	14DCU64	14VI9686-02	14VI9686_VIBRATION INDICATION	Raw Sewage Pump 2 - Inboard Bearing Vibration			MBAI	7701-09-N-013			
	14DCU64	14VI9687-02	14VI9687_VIBRATION INDICATION	Raw Sewage Pump 2 - Inboard Bearing Vibration			MBAI	7701-09-N-013			
	14DCU64	14TI9684-02	14TI9684_TEMPERATURE INDICATION	Raw Sewage Pump 2 - Outboard Bearing Temperature			MBAI	7701-09-N-013			
	14DCU64	14VI9688-02	14VI9688_VIBRATION INDICATION	Raw Sewage Pump 2 - Outboard Bearing Vibration			MBAI	7701-09-N-013			
	14DCU64	14VI9689-02	14VI9689_VIBRATION INDICATION	Raw Sewage Pump 2 - Outboard Bearing Vibration			MBAI	7701-09-N-013			
	14DCU64	14TI9680-02A	14TI9680A_TEMPERATURE INDICATION	Raw Sewage Pump 2 - Winding A Temperature			MBAI	7701-09-N-013			
	14DCU64	14TI9680-02B	14TI9680B_TEMPERATURE INDICATION	Raw Sewage Pump 2 - Winding A Temperature			MBAI	7701-09-N-013			
	14DCU64	14TI9681-02A	14TI9681A_TEMPERATURE INDICATION	Raw Sewage Pump 2 - Winding B Temperature			MBAI	7701-09-N-013			
	14DCU64	14TI9681-02B	14TI9681B_TEMPERATURE INDICATION	Raw Sewage Pump 2 - Winding B Temperature			MBAI	7701-09-N-013			
	14DCU64	14TI9682-02A	14TI9682A_TEMPERATURE INDICATION	Raw Sewage Pump 2 - Winding C Temperature			MBAI	7701-09-N-013			
	14DCU64	14TI9682-02B	14TI9682B_TEMPERATURE INDICATION	Raw Sewage Pump 2 - Winding C Temperature			MBAI	7701-09-N-013			
	14DCU64	14HSL9655-03	14HSL9655_LOCAL	Raw Sewage Pump 3		LOCAL	MBDI	7701-09-N-014			
	14DCU64	14HSR9655-03	14HSR9655_REMOTE	Raw Sewage Pump 3		REMOTE	MBDI	7701-09-N-014			
	14DCU64	14JI9655-03	14JI9655_POWER	Raw Sewage Pump 3			MBAI	7701-09-N-014			
	14DCU64	14NL9655-03	14NL9655_RUNNING	Raw Sewage Pump 3	OFF	RUNNING	MBDI	7701-09-N-014			
	14DCU64	14XA9655-03	14XA9655_FAULT	Raw Sewage Pump 3	NORMAL	FAULT	MBDI	7701-09-N-014			
	14DCU64	14XL9655-03	14XL9655_READY	Raw Sewage Pump 3	NOT READY	READY	MBDI	7701-09-N-014			
	14DCU64	14TI9683-03	14TI9683_TEMPERATURE INDICATION	Raw Sewage Pump 3 - Inboard Bearing Temperature			MBAI	7701-09-N-014			
	14DCU64	14TI9686-03	14TI9686_VIBRATION INDICATION	Raw Sewage Pump 3 - Inboard Bearing Vibration			MBAI	7701-09-N-014			
	14DCU64	14TI9687-03	14TI9687_VIBRATION INDICATION	Raw Sewage Pump 3 - Inboard Bearing Vibration			MBAI	7701-09-N-014			
	14DCU64	14TI9684-03	14TI9684_TEMPERATURE INDICATION	Raw Sewage Pump 3 - Outboard Bearing Temperature			MBAI	7701-09-N-014			
	14DCU64	14TI9688-03	14TI9688_VIBRATION INDICATION	Raw Sewage Pump 3 - Outboard Bearing Vibration			MBAI	7701-09-N-014			
	14DCU64	14TI9689-03	14TI9689_VIBRATION INDICATION	Raw Sewage Pump 3 - Outboard Bearing Vibration			MBAI	7701-09-N-014			
	14DCU64	14TI9680-03A	14TI9680A_TEMPERATURE INDICATION	Raw Sewage Pump 3 - Winding A Temperature			MBAI	7701-09-N-014			
	14DCU64	14TI9680-03B	14TI9680B_TEMPERATURE INDICATION	Raw Sewage Pump 3 - Winding A Temperature			MBAI	7701-09-N-014			
	14DCU64	14TI9681-03A	14TI9681A_TEMPERATURE INDICATION	Raw Sewage Pump 3 - Winding B Temperature			MBAI	7701-09-N-014			
	14DCU64	14TI9681-03B	14TI9681B_TEMPERATURE INDICATION	Raw Sewage Pump 3 - Winding B Temperature			MBAI	7701-09-N-014			
	14DCU64	14TI9682-03A	14TI9682A_TEMPERATURE INDICATION	Raw Sewage Pump 3 - Winding C Temperature			MBAI	7701-09-N-014			
	14DCU64	14TI9682-03B	14TI9682B_TEMPERATURE INDICATION	Raw Sewage Pump 3 - Winding C Temperature			MBAI	7701-09-N-014			
	14DCU64	14HSL9655-04	14HSL9655_LOCAL	Raw Sewage Pump 4		LOCAL	MBDI	7701-09-N-015			
	14DCU64	14HSR9655-04	14HSR9655_REMOTE	Raw Sewage Pump 4		REMOTE	MBDI	7701-09-N-015			
	14DCU64	14JI9655-04	14JI9655_POWER	Raw Sewage Pump 4			MBAI	7701-09-N-015			

	14DCU64	14NL9655-04	14NL9655_RUNNING	Raw Sewage Pump 4	OFF	RUNNING	MBDI	7701-09-N-015			
	14DCU64	14XA9655-04	14XA9655_FAULT	Raw Sewage Pump 4	NORMAL	FAULT	MBDI	7701-09-N-015			
	14DCU64	14XL9655-04A	14XL9655A_READY	Raw Sewage Pump 4	NOT READY	READY	MBDI	7701-09-N-015			
	14DCU64	14TI9683-04	14TI9683_TEMPERATURE INDICATION	Raw Sewage Pump 4 - Inboard Bearing Temperature			MBAI	7701-09-N-015			
	14DCU64	14VI9686-04	14VI9686_VIBRATION INDICATION	Raw Sewage Pump 4 - Inboard Bearing Vibration			MBAI	7701-09-N-015			
	14DCU64	14VI9687-04	14VI9687_VIBRATION INDICATION	Raw Sewage Pump 4 - Inboard Bearing Vibration			MBAI	7701-09-N-015			
	14DCU64	14TI9684-04	14TI9684_TEMPERATURE INDICATION	Raw Sewage Pump 4 - Outboard Bearing Temperature			MBAI	7701-09-N-015			
	14DCU64	14VI9688-04	14VI9688_VIBRATION INDICATION	Raw Sewage Pump 4 - Outboard Bearing Vibration			MBAI	7701-09-N-015			
	14DCU64	14VI9689-04	14VI9689_VIBRATION INDICATION	Raw Sewage Pump 4 - Outboard Bearing Vibration			MBAI	7701-09-N-015			
	14DCU64	14TI9680-04A	14TI9680A_TEMPERATURE INDICATION	Raw Sewage Pump 4 - Winding A Temperature			MBAI	7701-09-N-015			
	14DCU64	14TI9680-04B	14TI9680B_TEMPERATURE INDICATION	Raw Sewage Pump 4 - Winding A Temperature			MBAI	7701-09-N-015			
	14DCU64	14TI9681-04A	14TI9681A_TEMPERATURE INDICATION	Raw Sewage Pump 4 - Winding B Temperature			MBAI	7701-09-N-015			
	14DCU64	14TI9681-04B	14TI9681B_TEMPERATURE INDICATION	Raw Sewage Pump 4 - Winding B Temperature			MBAI	7701-09-N-015			
	14DCU64	14TI9682-04A	14TI9682A_TEMPERATURE INDICATION	Raw Sewage Pump 4 - Winding C Temperature			MBAI	7701-09-N-015			
	14DCU64	14TI9682-04B	14TI9682B_TEMPERATURE INDICATION	Raw Sewage Pump 4 - Winding C Temperature			MBAI	7701-09-N-015			
	14DCU64	14HSL9655-05	14HSL9655_LOCAL	Raw Sewage Pump 5		LOCAL	MBDI	7701-09-N-016			
	14DCU64	14HSR9655-05	14HSR9655_REMOTE	Raw Sewage Pump 5		REMOTE	MBDI	7701-09-N-016			
	14DCU64	14JI9655-05	14JI9655_POWER	Raw Sewage Pump 5			MBAI	7701-09-N-016			
	14DCU64	14NL9655-05	14NL9655_RUNNING	Raw Sewage Pump 5	OFF	RUNNING	MBDI	7701-09-N-016			
	14DCU64	14XA9655-05	14XA9655_FAULT	Raw Sewage Pump 5	NORMAL	FAULT	MBDI	7701-09-N-016			
	14DCU64	14XL9655-05A	14XL9655A_READY	Raw Sewage Pump 5	NOT READY	READY	MBDI	7701-09-N-016			
	14DCU64	14TI9683-05	14TI9683_TEMPERATURE INIDCATION	Raw Sewage Pump 5 - Inboard Bearing Temperature			MBAI	7701-09-N-016			
	14DCU64	14VI9686-05	14VI9686_VIBRATION INIDCATION	Raw Sewage Pump 5 - Inboard Bearing Vibration			MBAI	7701-09-N-016			
	14DCU64	14VI9687-05	14VI9687_VIBRATION INIDCATION	Raw Sewage Pump 5 - Inboard Bearing Vibration			MBAI	7701-09-N-016			
	14DCU64	14TI9684-05	14TI9684_TEMPERATURE INIDCATION	Raw Sewage Pump 5 - Outboard Bearing Temperature			MBAI	7701-09-N-016			
	14DCU64	14VI9688-05	14VI9688_VIBRATION INIDCATION	Raw Sewage Pump 5 - Outboard Bearing Vibration			MBAI	7701-09-N-016			
	14DCU64	14VI9689-05	14VI9689_VIBRATION INIDCATION	Raw Sewage Pump 5 - Outboard Bearing Vibration			MBAI	7701-09-N-016			
	14DCU64	14TI9680-05A	14TI9680A_TEMPERATURE INIDCATION	Raw Sewage Pump 5 - Winding A Temperature			MBAI	7701-09-N-016			
	14DCU64	14TI9680-05B	14TI9680B_TEMPERATURE INIDCATION	Raw Sewage Pump 5 - Winding A Temperature			MBAI	7701-09-N-016			
	14DCU64	14TI9681-05A	14TI9681A_TEMPERATURE INIDCATION	Raw Sewage Pump 5 - Winding B Temperature			MBAI	7701-09-N-016			
	14DCU64	14TI9681-05B	14TI9681B_TEMPERATURE INIDCATION	Raw Sewage Pump 5 - Winding B Temperature			MBAI	7701-09-N-016			
	14DCU64	14TI9682-05A	14TI9682A_TEMPERATURE INIDCATION	Raw Sewage Pump 5 - Winding C Temperature			MBAI	7701-09-N-016			
	14DCU64	14TI9682-05B	14TI9682B_TEMPERATURE INIDCATION	Raw Sewage Pump 5 - Winding C Temperature			MBAI	7701-09-N-016			
	14DCU64	12HSL9705-01	12HSL9705_LOCAL	Recycle Pump Station 1 - Pump 1		LOCAL	MBDI	7701-09-N-037			
	14DCU64	12HSR9705-01	12HSR9705_REMOTE	Recycle Pump Station 1 - Pump 1		REMOTE	MBDI	7701-09-N-037			
	14DCU64	12JI9705-01	12JI9705_POWER	Recycle Pump Station 1 - Pump 1			MBAI	7701-09-N-037			
	14DCU64	12NL9705-01	12NL9705_RUNNING	Recycle Pump Station 1 - Pump 1	OFF	RUNNING	MBDI	7701-09-N-037			
	14DCU64	12XA9705-01	12XA9705_FAULT	Recycle Pump Station 1 - Pump 1	NORMAL	FAULT	MBDI	7701-09-N-037			
	14DCU64	12XL9705-01A	12XL9705A_READY	Recycle Pump Station 1 - Pump 1	NOT READY	READY	MBDI	7701-09-N-037			
	14DCU64	12HSL9705-02	12HSL9705_LOCAL	Recycle Pump Station 1 - Pump 2		LOCAL	MBDI	7701-09-N-037			
	14DCU64	12HSR9705-02	12HSR9705_REMOTE	Recycle Pump Station 1 - Pump 2		REMOTE	MBDI	7701-09-N-037			
	14DCU64	12JI9705-02	12JI9705_POWER	Recycle Pump Station 1 - Pump 2			MBAI	7701-09-N-037			
	14DCU64	12NL9705-02	12NL9705_RUNNING	Recycle Pump Station 1 - Pump 2	OFF	RUNNING	MBDI	7701-09-N-037			
	14DCU64	12XA9705-02	12XA9705_FAULT	Recycle Pump Station 1 - Pump 2	NORMAL	FAULT	MBDI	7701-09-N-037			
	14DCU64	12XL9705-02A	12XL9705A_READY	Recycle Pump Station 1 - Pump 2	NOT READY	READY	MBDI	7701-09-N-037			
	14DCU64	12HSL9705-03	12HSL9705_LOCAL	Recycle Pump Station 1 - Pump 3		LOCAL	MBDI	7701-09-N-037			
	14DCU64	12HSR9705-03	12HSR9705_REMOTE	Recycle Pump Station 1 - Pump 3		REMOTE	MBDI	7701-09-N-037			
	14DCU64	12JI9705-03	12JI9705_POWER	Recycle Pump Station 1 - Pump 3			MBAI	7701-09-N-037			
	14DCU64	12NL9705-03	12NL9705_RUNNING	Recycle Pump Station 1 - Pump 3	OFF	RUNNING	MBDI	7701-09-N-037			
	14DCU64	12XA9705-03	12XA9705_FAULT	Recycle Pump Station 1 - Pump 3	NORMAL	FAULT	MBDI	7701-09-N-037			
	14DCU64	12XL9705-03A	12XL9705A_READY	Recycle Pump Station 1 - Pump 3	NOT READY	READY	MBDI	7701-09-N-037			

	14DCU64	12HSL9705-04	12HSL9705_LOCAL	Recycle Pump Station 1 - Pump 4		LOCAL	MBDI	7701-09-N-037			
	14DCU64	12HSR9705-04	12HSR9705_REMOTE	Recycle Pump Station 1 - Pump 4		REMOTE	MBDI	7701-09-N-037			
	14DCU64	12JI9705-04	12JI9705_POWER	Recycle Pump Station 1 - Pump 4			MBAI	7701-09-N-037			
	14DCU64	12NL9705-04	12NL9705_RUNNING	Recycle Pump Station 1 - Pump 4	OFF	RUNNING	MBDI	7701-09-N-037			
	14DCU64	12XA9705-04	12XA9705_FAULT	Recycle Pump Station 1 - Pump 4	NORMAL	FAULT	MBDI	7701-09-N-037			
	14DCU64	12XL9705-04A	12XL9705A_READY	Recycle Pump Station 1 - Pump 4	NOT READY	READY	MBDI	7701-09-N-037			
	14DCU64	14HSL9521-01	14HSL9521_POWER ON	Screenings Compactor 1		LOCAL	MBDI	7701-09-N-008			
	14DCU64	14HSR9521-01	14HSR9521_REMOTE	Screenings Compactor 1		REMOTE	MBDI	7701-09-N-008			
	14DCU64	14JI9521-01	14JI9521_POWER	Screenings Compactor 1			MBAI	7701-09-N-008			
	14DCU64	14NL9521-01	14NL9521_RUNNING	Screenings Compactor 1	OFF	RUNNING	MBDI	7701-09-N-008			
	14DCU64	14XA9521-01	14XA9521_FAULT	Screenings Compactor 1	NORMAL	FAULT	MBDI	7701-09-N-008			
	14DCU64	14XL9521-01A	14XL9521A_READY	Screenings Compactor 1	NOT READY	READY	MBDI	7701-09-N-008			
	14DCU64	14HSL9521-02	14HSL9521_POWER ON	Screenings Compactor 2		LOCAL	MBDI	7701-09-N-008			
	14DCU64	14HSR9521-02	14HSR9521_REMOTE	Screenings Compactor 2		REMOTE	MBDI	7701-09-N-008			
	14DCU64	14JI9521-02	14JI9521_POWER	Screenings Compactor 2			MBAI	7701-09-N-008			
	14DCU64	14NL9521-02	14NL9521_RUNNING	Screenings Compactor 2	OFF	RUNNING	MBDI	7701-09-N-008			
	14DCU64	14XA9521-02	14XA9521_FAULT	Screenings Compactor 2	NORMAL	FAULT	MBDI	7701-09-N-008			
	14DCU64	14XL9521-02A	14XL9521A_READY	Screenings Compactor 2	NOT READY	READY	MBDI	7701-09-N-008			
	14DCU64	14HSL9521-03	14HSL9521_LOCAL	Screenings Compactor 3		LOCAL	MBDI	7701-09-N-009			
	14DCU64	14HSR9521-03	14HSR9521_REMOTE	Screenings Compactor 3		REMOTE	MBDI	7701-09-N-009			
	14DCU64	14JI9521-03	14JI9521_POWER	Screenings Compactor 3			MBAI	7701-09-N-009			
	14DCU64	14NL9521-03	14NL9521_RUNNING	Screenings Compactor 3	OFF	RUNNING	MBDI	7701-09-N-009			
	14DCU64	14XA9521-03	14XA9521_FAULT	Screenings Compactor 3	NORMAL	FAULT	MBDI	7701-09-N-009			
	14DCU64	14XL9521-03A	14XL9521A_READY	Screenings Compactor 3	NOT READY	READY	MBDI	7701-09-N-009			
	14DCU64	14HSL9521-04	14HSL9521_LOCAL	Screenings Compactor 4		LOCAL	MBDI	7701-09-N-009			
	14DCU64	14HSR9521-04	14HSR9521_REMOTE	Screenings Compactor 4		REMOTE	MBDI	7701-09-N-009			
	14DCU64	14JI9521-04	14JI9521_POWER	Screenings Compactor 4			MBAI	7701-09-N-009			
	14DCU64	14NL9521-04	14NL9521_RUNNING	Screenings Compactor 4	OFF	RUNNING	MBDI	7701-09-N-009			
	14DCU64	14XA9521-04	14XA9521_FAULT	Screenings Compactor 4	NORMAL	FAULT	MBDI	7701-09-N-009			
	14DCU64	14XL9521-04A	14XL9521A_READY	Screenings Compactor 4	NOT READY	READY	MBDI	7701-09-N-009			
	14DCU64	14HSL9525-01	14HSL9525_LOCAL	Screenings Winch 1		LOCAL	MBDI	7701-09-N-008			
	14DCU64	14HSR9525-01	14HSR9525_REMOTE	Screenings Winch 1		REMOTE	MBDI	7701-09-N-008			
	14DCU64	14JI9525-01	14JI9525_POWER	Screenings Winch 1			MBAI	7701-09-N-008			
	14DCU64	14NL9525-01	14NL9525_RUNNING	Screenings Winch 1	OFF	RUNNING	MBDI	7701-09-N-008			
	14DCU64	14XA9525-01	14XA9525_FAULT	Screenings Winch 1	NORMAL	FAULT	MBDI	7701-09-N-008			
	14DCU64	14XL9525-01A	14XL9525A_READY	Screenings Winch 1	NOT READY	READY	MBDI	7701-09-N-008			
	14DCU64	14HSL9525-02	14HSL9525_LOCAL	Screenings Winch 2		LOCAL	MBDI	7701-09-N-009			
	14DCU64	14HSR9525-02	14HSR9525_REMOTE	Screenings Winch 2		REMOTE	MBDI	7701-09-N-009			
	14DCU64	14JI9525-02	14JI9525_POWER	Screenings Winch 2			MBAI	7701-09-N-009			
	14DCU64	14NL9525-02	14NL9525_RUNNING	Screenings Winch 2	OFF	RUNNING	MBDI	7701-09-N-009			
	14DCU64	14XA9525-02	14XA9525_FAULT	Screenings Winch 2	NORMAL	FAULT	MBDI	7701-09-N-009			
	14DCU64	14XL9525-02A	14XL9525A_READY	Screenings Winch 2	NOT READY	READY	MBDI	7701-09-N-009			
	14DCU64	14JI9960-03	14JI9960_POWER	Switchgear Breaker 52-101B Power Monitor			MBAI	7701-09-N-040			
	14DCU64	14JI9950-03	14JI9950_POWER	Switchgear Breaker 52-102A Power Monitor			MBAI	7701-09-N-040			
	14DCU64	14JI9951-03	14JI9951_POWER	Switchgear Breaker 52-102B Power Monitor			MBAI	7701-09-N-040			
	14DCU64	14JI9954-03	14JI9954_POWER	Switchgear Breaker 52-103A Power Monitor			MBAI	7701-09-N-040			
	14DCU64	14JI9953-03	14JI9953_POWER	Switchgear Breaker 52-103B Power Monitor			MBAI	7701-09-N-040			
	14DCU64	14JI9958-03	14JI9958_POWER	Switchgear Breaker 52-105A Power Monitor			MBAI	7701-09-N-040			
	14DCU64	14JI9952-03	14JI9952_POWER	Switchgear Breaker 52-106A Power Monitor			MBAI	7701-09-N-040			
	14DCU64	14JI9956-03	14JI9956_POWER	Switchgear Breaker 52-106B Power Monitor			MBAI	7701-09-N-040			
	14DCU64	14JI9955-03	14JI9955_POWER	Switchgear Breaker 52-107A Power Monitor			MBAI	7701-09-N-040			

	14DCU64	14JI9957-03	14JI9957_POWER	Switchgear Breaker 52-107B Power Monitor			MBAI	7701-09-N-040			
	14DCU64	14JI9961-03	14JI9961_POWER	Switchgear Breaker 52-108B Power Monitor			MBAI	7701-09-N-040			

CONTROL PANEL SCHEDULE

ITEM	NAME	DESCRIPTION	PANEL RATING	PANEL ASSEMBLY DRAWINGS		
1	14 DCU	Headworks 3 Controller Panel	NEMA 12			
2	14 S800	Headworks 3 Input/Output Panel	NEMA 12			
3	14 S800	Headworks 3 Input/Output Panel	NEMA 12			
4	14 S800	Headworks 3 Input/Output Panel	NEMA 12			
5	12 S800	Headworks 2 Input/Output Panel	NEMA 12			
6	14NET	Headworks 3 MIS Network Panel	NEMA 12			
7	14NET	Headworks 3 Fiber Patch Panel	NEMA 12			
8	14LCP9520	Screenings Washer/Compactor Gate Control Panel	NEMA 4X			

LOOP TEST SHEET—EXAMPLE FORMAT

City of San Jose Environmental
Services Department
700 Los Esteros Road
San Jose, California 95134

San José-Santa Clara Regional Wastewater Facility

Loop Test Sheet

☐ Loop Check
☐ SLVT ☐ Precommissioning

Separate Calibration/Verification Sheets Are To Be Attached, Except Precommissioning.

Project: _____

Loop Number: _____
Loop Description: _____

Tag Numbers	Description	Manufacturer	Model Number	ISA S-20 Spec.	Install Details	Checked By	Date

Print Name: _____ DCN _____ Comments: _____
Signed By: _____ Date _____ _____
Approved By: _____ Date _____ _____

AG-RWF-007-AF Loop Test Sheet

PERFORMANCE TEST SHEET - EXAMPLE Rev.06.05.92

Project Name: *SFO SEWPCP Plant Expansion*	Project No.: *SF012345.C1*
Demonstration test(s): For each functional Requirement of the loop: (a) List and number the requirement. (b) Briefly describe the demonstration test. (c) Cite the results that will verify the required performance. (d) Provide space for signoff.	
1. MEASURE EFFLUENT FLOW	
1.a With no flow, water level over weir should be zero and	
FIT indicator should read zero.	*Jun-20-92 BDG*
2. FLOW INDICATION AND TRANSMISSION TO LP & CCS	
With flow, water level and FIT indicator should be related by expression	
*Q(MGD) = 429*H**(2/3) (H = height in inches of water over weir).*	
Vary H and observe that following.	
2.a Reading of FIT indicator.	*Jun-6-92 BDG*
2.b Reading is transmitted to FI on LP-521-1	*Jun-6-92 BDG*
2.c Reading is transmitted and displayed to CCS.	*Jun-6-92 BDG*
H(measured) 0 5 10 15	
Q(computed) 0 47.96 135.7 251.7	
Q(FIT indicator)0 48.1 137 253	
Q(LI on LP-521-1) 0 48.2 138 254	
Q(display by CCS) 0 48.1 136.2 252.4	

Forms/Sheets Verified	By	Date	**Loop Accepted By City**
Loop Status Report	*J.D. Sewell*	*May-18-92*	By: *J.D. Smith*
Instrument Calibration Sheet	*J.D. Sewell*	*May-18-92*	Date: *Jun-6-92*
I&C Valve Calibration Sheet	*N.A.*		
Performance Test	By	Date	
Performed	*J. Blow MPSDC Co.*	*Jun-6-92*	
Witnessed	*B. DeGlanville*	*Jun-6-92*	Loop No.: *30-12*

SECTION 40 91 00
INSTRUMENTATION COMPONENTS

PART 1 GENERAL

1.01 SUMMARY

A. This section gives the requirements for furnishing instrumentation components.

1.02 RELATED SECTIONS

A. Related sections include the following:
   1. Division 01, General Requirements.

1.03 SUBMITTALS

A. General: In accordance with Section 01 33 00, Submittal Procedures.

B. Action Submittals:
   1. Purchase Quotation: Proposed listing of instruments, components, and accessories to be provided. Include applicable tag numbers and component codes assigned in the Instrument Data Sheets in Article Supplements at the end of this Section.
   2. Order Confirmation Summary: Final listing of instruments, components, and accessories to be provided.
   3. Data Sheets:
      a. Neat and legible markups of data sheets provided in this Section.
      b. Markup the data sheets to include complete product information and corrections to reflect all items in the purchase quotation.

C. Informational Submittals:
   1. Provide Manufacturer's O&M: In accordance with Section 01 78 23, Operation and Maintenance Data.
      a. Content for Each O&M Manual:
         1) Table of Contents.
         2) Operations procedures.
         3) Installation requirements and procedures.
         4) Maintenance requirements and procedures.
         5) Troubleshooting procedures.
         6) Calibration procedures.
         7) Internal schematic and wiring diagrams.

8) Component factory calibration sheets.

2. List of spares, expendables, test equipment and tools provided.
3. List of additional recommended spares, expendables, test equipment, and tools. Include quantities, unit prices, and total costs.
4. Provide Manufacturer's Certificate of Proper Installation.

1.04 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01 61 00, Common Product Requirements.

B. Packaged at the factory prior to shipment to protect each item from damage during shipment and storage. Containers protected against impact, abrasion, corrosion, discoloration and/or other damages. Clearly label contents of each container and provide information on the required storage conditions necessary for the equipment.

C. Notify Jacobs of the storage requirements and recommendations for the equipment prior to shipment.

D. Prior to shipment, include corrosive inhibitive vapor capsules in shipping containers, and related equipment as recommended by capsule manufacturer.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide components that are listed in the Instrument List in Article Supplements at the end of this Section. Specific component requirements are defined in the Instrument Data Sheets in Article Supplements at the end of this Section.

PART 3 EXECUTION

3.01 MANUFACTURER'S SERVICES

A. Manufacturer's Certificate of Proper Installation: Provide for each component listed in the component data sheets.

B. Specialty Equipment: For certain components identified in the component data sheets provide services of qualified manufacturer's representative during installation, startup, demonstration testing, and training.

3.02 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are part of this Specification.

1. Instrument List.
2. Instrument Data Sheets.

END OF SECTION

TAG NO	ACCESSORY TAG	LOOP TITLE	COMP CODE	INSTRUMENT NAME	P+ID NO	DESIGN DETAIL	MANUFACTURER 1	MANUFACTURER 2	MODEL1	MODEL2
14AET9507-00		Plant Influent Combustible Gas	A10	Combustible Gas Analyzer & Transmitter	7701-09-N-007	4091-151	MSA			
12FET9708-00		Recycle Pump Station 1 Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-037	4091-219	Toshiba	Endress+Hauser		
14FIT9510-01	14FE9510-01	Screening Trough Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-006	4091-219	Toshiba	Endress+Hauser		
14FET9602-01		Grit Pump 1 Discharge Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-022	4091-219	Toshiba	Endress+Hauser		
14FET9602-02		Grit Pump 2 Discharge Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-023	4091-219	Toshiba	Endress+Hauser		
14FET9602-03		Grit Pump 3 Discharge Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-024	4091-219	Toshiba	Endress+Hauser		
14FET9602-04		Grit Pump 4 Discharge Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-025	4091-219	Toshiba	Endress+Hauser		
14FET9602-05		Grit Pump 5 Discharge Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-026	4091-219	Toshiba	Endress+Hauser		
14FET9602-06		Grit Pump 6 Discharge Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-027	4091-219	Toshiba	Endress+Hauser		
14FIT9669-01	14FE9669-01	Raw Sewage Pump 1 Discharge Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-012	4091-219	Toshiba	Endress+Hauser		
14FIT9669-02	23FE9669-02	Raw Sewage Pump 2 Discharge Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-013	4091-219	Toshiba	Endress+Hauser		
14FIT9669-03	14FE9669-03	Raw Sewage Pump 3 Discharge Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-014	4091-219	Toshiba	Endress+Hauser		
14FIT9669-04	14FE9669-04	Raw Sewage Pump 4 Discharge Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-015	4091-219	Toshiba	Endress+Hauser		
14FIT9669-05	14FE9669-05	Raw Sewage Pump 5 Discharge Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-016	4091-219	Toshiba	Endress+Hauser		
14FET9676-01		Raw Sewage Pump 1 Seal Water Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-012	4091-219	Toshiba	Endress+Hauser		
14FET9676-02		Raw Sewage Pump 2 Seal Water Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-013	4091-219	Toshiba	Endress+Hauser		
14FET9676-03		Raw Sewage Pump 3 Seal Water Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-014	4091-219	Toshiba	Endress+Hauser		
14FET9676-04		Raw Sewage Pump 4 Seal Water Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-015	4091-219	Toshiba	Endress+Hauser		
14FET9676-05		Raw Sewage Pump 5 Seal Water Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-016	4091-219	Toshiba	Endress+Hauser		
14FIT9728-00	14FE9728-00	HW3 Recycle Pump Station Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-001	4091-219	Toshiba	Endress+Hauser		
23FIT2378-01	23FE2378-01	West Meter Vault Primary Influent Flow Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-031	4091-219	Toshiba	Endress+Hauser		
23FIT2354-01	23FE2354-01	West Meter Vault Primary Influent Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-031	4091-219	Toshiba	Endress+Hauser		
23FIT2577-01	23FE2577-01	East Meter Vault Primary Influent Flow Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-031	4091-219	Toshiba	Endress+Hauser		
23FIT2578-01	23FE2578-01	East Meter Vault Primary Influent Flow	F04	Flow Transmitter, Electromagnetic	7701-09-N-031	4091-219	Toshiba	Endress+Hauser		
14FI9531-01		Grit Basin 1 Fluidizing Water Flow	F16	Flow Element, Rotameter	7701-09-N-018					
14FI9531-02		Grit Basin 2 Fluidizing Water Flow	F16	Flow Element, Rotameter	7701-09-N-019					
14FI9531-03		Grit Basin 3 Fluidizing Water Flow	F16	Flow Element, Rotameter	7701-09-N-020					
14FI9531-04		Grit Basin 4 Fluidizing Water Flow	F16	Flow Element, Rotameter	7701-09-N-020					
14FI9531-05		Grit Basin 5 Fluidizing Water Flow	F16	Flow Element, Rotameter	7701-09-N-021					
14FI9531-06		Grit Basin 6 Fluidizing Water Flow	F16	Flow Element, Rotameter	7701-09-N-021					
11LIT9750-01	11LE9750-01	California Structure Level	L29	Level Transmitter, Radar	7701-09-N-030	4091-261	Endress+Hauser			
12LIT9701-00	12LE9701-00	Recycle Pump Station 1 Level	L29	Level Transmitter, Radar	7701-09-N-037		Endress+Hauser			
14LIT9500-01	14LE9500-01	Influent Screens Influent Channel Level	L29	Level Transmitter, Radar	7701-09-N-005	4091-258	Endress+Hauser			
14LIT9500-02	14LE9500-02	Influent Screens Influent Channel Level	L29	Level Transmitter, Radar	7701-09-N-005	4091-258	Endress+Hauser			
14LIT9506-01	14LE9506-01	Influent Screens Effluent Channel Level	L29	Level Transmitter, Radar	7701-09-N-007	4091-258	Endress+Hauser			
14LIT9506-02	14LE9506-02	Influent Screens Effluent Channel Level	L29	Level Transmitter, Radar	7701-09-N-007	4091-258	Endress+Hauser			
14LIT9532-01	14LE9532-02	Grit Basin 1 Flow	L29	Level Transmitter, Radar	7701-09-N-019		Endress+Hauser			
14LIT9532-02	14LE9532-02	Grit Basin 2 Flow	L29	Level Transmitter, Radar	7701-09-N-019		Endress+Hauser			
14LIT9532-03	14LE9532-03	Grit Basin 3 Flow	L29	Level Transmitter, Radar	7701-09-N-020		Endress+Hauser			
14LIT9532-04	14LE9532-04	Grit Basin 4 Flow	L29	Level Transmitter, Radar	7701-09-N-020		Endress+Hauser			
14LIT9532-05	14LE9532-05	Grit Basin 5 Flow	L29	Level Transmitter, Radar	7701-09-N-021		Endress+Hauser			
14LIT9532-06	14LE9532-06	Grit Basin 6 Flow	L29	Level Transmitter, Radar	7701-09-N-021		Endress+Hauser			
14LIT9560-00	14LE9560-00	EBOS - Compartment B Level	L29	Level Transmitter, Radar	7701-09-N-001	4091-261	Endress+Hauser			
14LIT9561-00	14LE9561-00	Grit Basin Effluent Channel Bypass Flow	L29	Level Transmitter, Radar	7701-09-N-002	4091-261	Endress+Hauser			
14LIT9561-00	14LE9561-00	Emergency Overflow Basin Level	L29	Level Transmitter, Radar	7701-09-N-002	4091-261	Endress+Hauser			
14LIT9570-00	14LE9570-00	EBOS - Compartment B Level	L29	Level Transmitter, Radar	7701-09-N-001	4091-261	Endress+Hauser			
14LIT9651-01	14LE9651-01	Raw Sewage Pump 1 Wet Well Level	L29	Level Transmitter, Radar	7701-09-N-012	4091-258	Endress+Hauser			
14LIT9651-02	14LE9651-02	Raw Sewage Pump 2 Wet Well Level	L29	Level Transmitter, Radar	7701-09-N-013		Endress+Hauser			
14LIT9651-03	14LE9651-03	Raw Sewage Pump 3 Wet Well Level	L29	Level Transmitter, Radar	7701-09-N-014		Endress+Hauser			
14LIT9651-04	14LE9651-04	Raw Sewage Pump 4 Wet Well Level	L29	Level Transmitter, Radar	7701-09-N-015		Endress+Hauser			
14LIT9651-05	14LE9651-05	Raw Sewage Pump 5 Wet Well Level	L29	Level Transmitter, Radar	7701-09-N-016		Endress+Hauser			
14LIT9721-00	14LE9721-00	HW3 Recycle Pump Station Level	L29	Level Transmitter, Radar	7701-09-N-038	4091-258	Endress+Hauser			
14LIT9739-00	14LE9739-00	Grit Pump Room Sump Level	L29	Level Transmitter, Radar	7701-09-N-039		Endress+Hauser			

12LSH9702-00		Recycle Pump Station 1 Level	L50	Level Switch, Tuning Fork	7701-09-N-037	4091-266	Endress+Hauser			
14LSH9511-01		Screenings Trough Level	L50	Level Switch, Tuning Fork	7701-09-N-006	4091-268	Endress+Hauser			
14LSH9532-01		Grit Basin 1 Flow	L50	Level Switch, Tuning Fork	7701-09-N-021		Endress+Hauser			
14LSH9722-00		HW3 Recycle Pump Station Level	L50	Level Switch, Tuning Fork	7701-09-N-038	4091-266	Endress+Hauser			
14LSH9739-00		Grit Pump Room Sump Level	L50	Level Switch, Tuning Fork	7701-09-N-039		Endress+Hauser			
14PDIT9702-01		Odor Control Exhaust Fan 1 Headloss	P03	Pressure Differential Transmitter	7701-09-N-033		Rosemount	Endress+Hauser	3051	
14PDIT9702-02		Odor Control Exhaust Fan 2 Headloss	P03	Pressure Differential Transmitter	7701-09-N-033		Rosemount	Endress+Hauser	3051	
14PI9509-01		Screenings Sluice Water Pressure	P04	Pressure Gauge	7701-09-N-006	4091-302	Ashcroft		1279	
14PI9523-01		Screenings Compactor Flush Water Pressure	P04	Pressure Gauge	7701-09-N-008	4091-302	Ashcroft		1279	
14PI9678-01		Raw Sewage Pump 1 Seal Water Pressure	P04	Pressure Gauge	7701-09-N-012	4091-302	Ashcroft		1279	
14PI9678-02		Raw Sewage Pump 2 Seal Water Pressure	P04	Pressure Gauge	7701-09-N-013		Ashcroft		1279	
14PI9678-03		Raw Sewage Pump 3 Seal Water Pressure	P04	Pressure Gauge	7701-09-N-014		Ashcroft		1279	
14PI9678-04		Raw Sewage Pump 4 Seal Water Pressure	P04	Pressure Gauge	7701-09-N-015		Ashcroft		1279	
14PI9678-05		Raw Sewage Pump 5 Seal Water Pressure	P04	Pressure Gauge	7701-09-N-016		Ashcroft		1279	
12PIT9706-01		Recycle Pump Station 1 - Pump 1 Pressure	P09	Pressure Transmitter	7701-09-N-037	4091-304	Rosemount	Endress+Hauser	3051	
12PIT9706-02		Recycle Pump Station 1 - Pump 2 Pressure	P09	Pressure Transmitter	7701-09-N-037	4091-304	Rosemount	Endress+Hauser	3051	
12PIT9706-03		Recycle Pump Station 1 - Pump 3 Pressure	P09	Pressure Transmitter	7701-09-N-037	4091-304	Rosemount	Endress+Hauser	3051	
12PIT9706-04		Recycle Pump Station 1 - Pump 4 Pressure	P09	Pressure Transmitter	7701-09-N-037	4091-304	Rosemount	Endress+Hauser	3051	
14PIT9726-01		HW3 Recycle Pump Station - Pump 1 Pressure	P09	Pressure Transmitter	7701-09-N-038	4091-304	Rosemount	Endress+Hauser	3051	
14PIT9726-02		HW3 Recycle Pump Station - Pump 2 Pressure	P09	Pressure Transmitter	7701-09-N-038	4091-304	Rosemount	Endress+Hauser	3051	

A10
COMBUSTIBLE GAS ELEMENT AND TRANSMITTER

OPPID Reports - A10 Combustible Gas Analyzer & Transmitter

GENERAL	1	Tag Number	P&ID	14AET9507-00	7701-09-N-007_706370
	2	Loop Title		TBD	
	3	Area Classification			
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
	6				
	7				
ELEMENT	8	Element Tag Number		14AET9507-00	
	9	Element Type		Infrared	
	10	Range		0 to 100 Percent LEL	
	11	Element Material			
	12	Element Mounting		Duct	
	13				
	14	Element Cable Length			
	15				
	16	Ambient Temperature Limits		40 to 175 degF	
	17	Ambient Humidity		0 to 100 Percent	
TRANSMITTER	18	Transmitter Tag		14AET9507-00	
	19	Mounting			
	20	Enclosure Rating		NEMA 7	
	21	Power Supply	Voltage	3-Wire	24V dc
	22	Output Signal		4 to 20 madc	
	23	Communication Protocol			
	24	Display		Backlit LCD	
	25				
	26				
SWITCH	27	Switch Type		Relay Output - (2)	
	28	Set Point		10 Percent | FAULT	
	29	Set Point Direction		Rising	
	30	Deadband			
	31	Failure State			
	32	Voltage		120 VAC	
	33	Contact Arrangement		SPDT	
	34	Contact Rating		5 Amps	
	35				
	36				
CALIBRATION	37	Calibrated Range			
	38	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	39				
	40				
	41	Accuracy	Repeatability	1.0 Percent LEL	
	42				
OPTIONS	43	Tagging		Stainless steel tag with Tag Number	
	44	Calibration Kit		Yes	
	45				
	46				
PURCHASE	47	Manufacturer		MSA	
	48	Model Number			
	49				
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

A10 **Combustible Gas Analyzer & Transmitter**	**706370 - SAN JOSE HEADWORKS** **14AET9507-00**

OPPID Reports - A10 Combustible Gas Analyzer & Transmitter

GENERAL	1	Tag Number	P&ID	14AET9507-02	7701-09-N-033_706370
	2	Loop Title		Plant Influent Combustible Gas	
	3	Area Classification			
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
	6				
	7				
ELEMENT	8	Element Tag Number		14AET9507-02	
	9	Element Type		Infrared	
	10	Range		0 to 100 Percent LEL	
	11	Element Material			
	12	Element Mounting		Duct	
	13				
	14	Element Cable Length			
	15				
	16	Ambient Temperature Limits		40 to 175 degF	
	17	Ambient Humidity		0 to 100 Percent	
TRANSMITTER	18	Transmitter Tag		14AET9507-02	
	19	Mounting			
	20	Enclosure Rating		NEMA 7	
	21	Power Supply	Voltage	3-Wire	24V dc
	22	Output Signal		4 to 20 madc	
	23	Communication Protocol			
	24	Display		Backlit LCD	
	25				
	26				
SWITCH	27	Switch Type		Relay Output - (2)	
	28	Set Point		10 Percent | FAULT	
	29	Set Point Direction		Rising	
	30	Deadband			
	31	Failure State			
	32	Voltage		120 VAC	
	33	Contact Arrangement		SPDT	
	34	Contact Rating		5 Amps	
	35				
	36				
CALIBRATION	37	Calibrated Range			
	38	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	39				
	40				
	41	Accuracy	Repeatability	1.0 Percent LEL	
	42				
OPTIONS	43	Tagging		Stainless steel tag with Tag Number	
	44	Calibration Kit		Yes	
	45				
	46				
PURCHASE	47	Manufacturer		MSA	
	48	Model Number			
	49				
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

A10 **Combustible Gas Analyzer & Transmitter**	**706370 - SAN JOSE HEADWORKS** **14AET9507-02**

F04
FLOW ELEMENT AND TRANSMITTER, ELECTROMAGNETIC

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	12FET9708-00	7701-09-N-037_706370
	2	Loop Title		Recycle Pump Station 1 Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		24 Inch	
	7	Fluid		Pumped Drainage	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow		
	10	Nominal Pressure			
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag			
METERING ELEMENT	19	Element Size		24 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		Hard Rubber	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Integral	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range			
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	LF664	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS** **12FET9708-00**

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	14FET9510-01	7701-09-N-006_706370
	2	Loop Title		Screening Trough Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		4 Inch	
	7	Fluid			
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow		
	10	Nominal Pressure			
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag			
METERING ELEMENT	19	Element Size		4 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		Hard Rubber	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Integral	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range			
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	GF630	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS**
	14FET9510-01

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	14FET9602-01	7701-09-N-022_706370
	2	Loop Title		Grit Pump 1 Discharge Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		6 Inch	
	7	Fluid		Grit	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow	200 gpm	500 gpm
	10	Nominal Pressure		10 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag			
METERING ELEMENT	19	Element Size		6 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		PTFE	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Integral	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range			
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	GF630	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS** **14FET9602-01**

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	14FET9602-02	7701-09-N-023_706370
	2	Loop Title		Grit Pump 2 Discharge Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		6 Inch	
	7	Fluid		Grit	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow	200 gpm	500 gpm
	10	Nominal Pressure		10 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag			
METERING ELEMENT	19	Element Size		6 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		PTFE	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Integral	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range			
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	GF630	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS**
	14FET9602-02

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	14FET9602-03	7701-09-N-024_706370
	2	Loop Title		Grit Pump 3 Discharge Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		6 Inch	
	7	Fluid		Grit	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow	200 gpm	500 gpm
	10	Nominal Pressure		10 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag			
METERING ELEMENT	19	Element Size		6 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		PTFE	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Integral	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range			
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	GF630	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS** **14FET9602-03**

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	14FET9602-04	7701-09-N-025_706370
	2	Loop Title		Grit Pump 4 Discharge Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		6 Inch	
	7	Fluid		Grit	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow	200 gpm	500 gpm
	10	Nominal Pressure		10 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag			
METERING ELEMENT	19	Element Size		6 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		PTFE	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Integral	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range			
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	GF630	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS** **14FET9602-04**

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	14FET9602-05	7701-09-N-026_706370
	2	Loop Title		Grit Pump 5 Discharge Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		6 Inch	
	7	Fluid		Grit	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow	200 gpm	500 gpm
	10	Nominal Pressure		10 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag			
METERING ELEMENT	19	Element Size		6 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		PTFE	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Integral	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range			
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	GF630	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS**
	14FET9602-05

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	14FET9602-06	7701-09-N-027_706370
	2	Loop Title		Grit Pump 6 Discharge Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		6 Inch	
	7	Fluid		Grit	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow	200 gpm	500 gpm
	10	Nominal Pressure		10 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag			
METERING ELEMENT	19	Element Size		6 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		PTFE	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Integral	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range			
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	GF630	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS**
	14FET9602-06

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	14FET9676-01	7701-09-N-012_706370
	2	Loop Title		Raw Sewage Pump 1 Seal Water Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		1 Inch	
	7	Fluid		No. 3 Water	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow	0.4 gpm	2.4 gpm
	10	Nominal Pressure		60 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag			
METERING ELEMENT	19	Element Size		3/8 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		Hard Rubber	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Integral	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range			
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	GF630	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS** **14FET9676-01**

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	14FET9676-02	7701-09-N-013_706370
	2	Loop Title		Raw Sewage Pump 2 Water Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		1 Inch	
	7	Fluid		No. 3 Water	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow	0.4 gpm	2.4 gpm
	10	Nominal Pressure		60 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag			
METERING ELEMENT	19	Element Size		3/8 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		Hard Rubber	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Integral	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range			
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	GF630	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS**
	14FET9676-02

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	14FET9676-03	7701-09-N-014_706370
	2	Loop Title		Raw Sewage Pump 3 Water Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		1 Inch	
	7	Fluid		No. 3 Water	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow	0.4 gpm	2.4 gpm
	10	Nominal Pressure		60 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag			
METERING ELEMENT	19	Element Size		3/8 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		Hard Rubber	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Integral	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range			
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	GF630	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS** **14FET9676-03**

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	14FET9676-04	7701-09-N-015_706370
	2	Loop Title		Raw Sewage Pump 4 Water Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		1 Inch	
	7	Fluid		No. 3 Water	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow	0.4 gpm	2.4 gpm
	10	Nominal Pressure		60 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag			
METERING ELEMENT	19	Element Size		3/8 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		Hard Rubber	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Integral	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range			
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	GF630	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS** **14FET9676-04**

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	14FET9676-05	7701-09-N-016_706370
	2	Loop Title		Raw Sewage Pump 5 Water Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		1 Inch	
	7	Fluid		No. 3 Water	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow	0.4 gpm	2.4 gpm
	10	Nominal Pressure		60 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag			
METERING ELEMENT	19	Element Size		3/8 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		Hard Rubber	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Integral	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range			
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	GF630	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS** **14FET9676-05**

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	14FIT9669-01	7701-09-N-012_706370
	2	Loop Title		Raw Sewage Pump 1 Discharge Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		42 Inch	
	7	Fluid		Raw Sewage	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow	25 mgd	52.5 mgd
	10	Nominal Pressure		10 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag		14FE9669-01	
METERING ELEMENT	19	Element Size		42 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		Hard Rubber	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Remote	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range		0 - 60 mgd	
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	LF664	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS** **14FIT9669-01**

GENERAL	1	Tag Number	P&ID	14FIT9669-02	7701-09-N-013_706370
	2	Loop Title		Raw Sewage Pump 2 Discharge Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		42 Inch	
	7	Fluid		Raw Sewage	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow	25 mgd	52.5 mgd
	10	Nominal Pressure		10 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag		14FE9669-02	
METERING ELEMENT	19	Element Size		42 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		Hard Rubber	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Remote	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range		0 - 60 mgd	
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	LF664	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS** **14FIT9669-02**

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	14FIT9669-03	7701-09-N-014_706370
	2	Loop Title		Raw Sewage Pump 3 Discharge Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		42 Inch	
	7	Fluid		Raw Sewage	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow	25 mgd	52.5 mgd
	10	Nominal Pressure		10 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag		14FE9669-03	
METERING ELEMENT	19	Element Size		42 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		Hard Rubber	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Remote	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range		0 - 60 mgd	
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	LF664	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS** **14FIT9669-03**

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	14FIT9669-04	7701-09-N-015_706370
	2	Loop Title		Raw Sewage Pump 4 Discharge Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		42 Inch	
	7	Fluid		Raw Sewage	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow	25 mgd	52.5 mgd
	10	Nominal Pressure		10 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag		14FE9669-04	
METERING ELEMENT	19	Element Size		42 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		Hard Rubber	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Remote	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range		0 - 60 mgd	
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	LF664	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS** **14FIT9669-04**

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	14FIT9669-05	7701-09-N-016_706370
	2	Loop Title		Raw Sewage Pump 5 Discharge Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		42 Inch	
	7	Fluid		Raw Sewage	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow	25 mgd	52.5 mgd
	10	Nominal Pressure		10 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag		14FE9669-05	
METERING ELEMENT	19	Element Size		42 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		Hard Rubber	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Remote	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range		0 - 60 mgd	
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	LF664	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS** **14FIT9669-05**

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	14FIT9728-00	7701-09-N-001_706370
	2	Loop Title		HW3 Recycle Pump Station Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		8 Inch	
	7	Fluid		Pumped Drainage	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow		
	10	Nominal Pressure		5 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag		14FE9728-00	
METERING ELEMENT	19	Element Size		8 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		Hard Rubber	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Remote	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range			
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	GF630	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS** **14FIT9728-00**

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	23FIT2354-01	7701-09-N-031_706370
	2	Loop Title		West Meter Vault Primary Influent Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		54 Inch	
	7	Fluid		Raw Sewage	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow		
	10	Nominal Pressure		10 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag		23FE2354-01	
METERING ELEMENT	19	Element Size		54 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		Hard Rubber	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Remote	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range		0 - 50 mgd	
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	LF664	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS** **23FIT2354-01**

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	23FIT2378-01	7701-09-N-031_706370
	2	Loop Title		West Meter Vault Primary Influent Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		78 Inch	
	7	Fluid		Raw Sewage	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow		
	10	Nominal Pressure		10 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag		23FE2378-01	
METERING ELEMENT	19	Element Size		78 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		Hard Rubber	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Remote	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range		0 - 250 mgd	
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	LF664	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS** **23FIT2378-01**

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	23FIT2577-01	7701-09-N-031_706370
	2	Loop Title		East Meter Vault Primary Influent Flow Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		54 Inch	
	7	Fluid		Raw Sewage	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow		
	10	Nominal Pressure		10 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag		23FE2577-01	
METERING ELEMENT	19	Element Size		54 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		Hard Rubber	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Remote	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range		0 - 50 mgd	
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	LF664	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS** **23FIT2577-01**

OPPID Reports - F04 Flow Transmitter, Electromagnetic

GENERAL	1	Tag Number	P&ID	23FIT2578-01	7701-09-N-031_706370
	2	Loop Title		East Meter Vault Primary Influent Flow	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size		72 Inch	
	7	Fluid		Raw Sewage	
PROCESS CONDITIONS	8				
	9	Min Flow	Max Flow		
	10	Nominal Pressure		10 psig	
	11	Nominal Temperature		50 degF	
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16	Vacuum Possibility		No	
	17				
	18	Element Tag		23FE2578-01	
METERING ELEMENT	19	Element Size		72 Inch	
	20	Process Connection/Material		ANSI Flange - 316 Stainless Steel	
	21	Electrical Connection		0.5 inch NPT	
	22	Tube Material		Stainless Steel	
	23	Liner Material		Hard Rubber	
	24	Electrode Type		Flush or Bullet Nose	
	25	Electrode Material		316 Stainless Steel	
	26	Range			
	27	Element Cable Length		As required to accommodate device locations	
	28	Grounding Rings	Material	Two	316 Stainless Steel
	29	Enclosure NEMA Rating		NEMA 4X	
	30	Minimum Measurable Velocity		0.033 Feet/Sec	
	31	Minimum Conductivity		5 microS/cm	
	32	Ambient Temperature Limits		-5 degF to 140 degF	
TRANSMITTER	33	Process Temperature Limits		32 degF to 180 degF	
	34	Options			
	35				
	36	Mounting		Remote	
	37	Enclosure NEMA Rating		NEMA 4X	
	38	Power Supply	Voltage	4 - Wire	120 VAC
	39	Output Signal		Isolated 4 to 20 madc	
	40	Communication Protocol		HART	
	41	Calibrated Range		0 - 250 mgd	
	42	Low Flow Cutoff			
	43	Ambient Temperature Limits		-5 degF to 140 degF	
	44				
OPTIONS	45	Accuracy	Repeatability	+/- 0.5 percent of rate	
	46	Vendor Calibration		Factory calibrate with calibration certificate	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Element Mounting Bracket			
PURCHASE	49				
	50	Manufacturer 1	Manufacturer 2	Toshiba	Endress+Hauser
	51	Element Model Num 1	Element Model Num 2	LF664	W400
	52	Xmitter Model Num 1	Xmitter Model Num 2		
	53	Purchase Note		1 year warranty	

F04 **Flow Transmitter, Electromagnetic**	**706370 - SAN JOSE HEADWORKS** **23FIT2578-01**

F16
FLOW ELEMENT, ROTAMETER

GENERAL	1	Tag Number	P&ID	14FI9531-01	7701_09-N-019_706370
	2	Loop Title		Grit Basin 1 Fluidizing Water Flow	
	3	Area Classification			
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule	1.5"	
	7				
PROCESS CONDITIONS	8	Fluid		No. 3 Water	
	9	Min Flow	Max Flow	20 gpm	25 gpm
	10	Nominal Pressure			
	11	Nominal Temperature			
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16				
INDICATOR	17	Type		Direct Reading	
	18				
	19	Process Connection		1.5 inch FNPT	
	20	Process Connection Material		316 Stainless Steel	
	21	Tube Size		13	
	22	Tube Length		16.3"	
	23	Tube Material		Glass	
	24	Float Material		316 Stainless Steel	
	25	Pressure Rating		75 psig	
	26	Seal Material		Buna N	
	27				
	28	Inlet Connection Orientation		Bottom Vertical	
	29	Outlet Connection Orientation		Top Vertical	
	30				
	31	Range		0 - 42 gpm	
	32				
	33				
SWITCH	34	Switch Type		N/A	
	35	Set Point			
	36	Set Point Direction			
	37	Deadband			
	38	Failure State			
	39	Voltage			
	40	Contact Arrangement			
	41	Contact Rating			
	42				
OPTIONS	43	Shield			
	44	Illuminator	Voltage		
	45	Needle Valve			
	46				
	47				
	48				
PURCHASE	49	Manufacturer		Brooks Instrument	
	50	Model Number		1024N	
	51				
	52	Purchase Note		1 year warranty	
	53				

F16

FLOW ELEMENT - ROTAMETER

706370 - SAN JOSE HEADWORKS

14FI9531-01

GENERAL	1	Tag Number	P&ID	14FI9531-02	7701_09-N-019_706370
	2	Loop Title		Grit Basin 2 Fluidizing Water Flow	
	3	Area Classification			
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule	1.5"	
	7				
PROCESS CONDITIONS	8	Fluid		No. 3 Water	
	9	Min Flow	Max Flow	20 gpm	25 gpm
	10	Nominal Pressure			
	11	Nominal Temperature			
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16				
INDICATOR	17	Type		Direct Reading	
	18				
	19	Process Connection		1.5 inch FNPT	
	20	Process Connection Material		316 Stainless Steel	
	21	Tube Size		13	
	22	Tube Length		16.3"	
	23	Tube Material		Glass	
	24	Float Material		316 Stainless Steel	
	25	Pressure Rating		75 psig	
	26	Seal Material		Buna N	
	27				
	28	Inlet Connection Orientation		Bottom Vertical	
	29	Outlet Connection Orientation		Top Vertical	
	30				
	31	Range		0 - 42 gpm	
	32				
	33				
SWITCH	34	Switch Type		N/A	
	35	Set Point			
	36	Set Point Direction			
	37	Deadband			
	38	Failure State			
	39	Voltage			
	40	Contact Arrangement			
	41	Contact Rating			
	42				
OPTIONS	43	Shield			
	44	Illuminator	Voltage		
	45	Needle Valve			
	46				
	47				
	48				
PURCHASE	49	Manufacturer		Brooks Instrument	
	50	Model Number		1024N	
	51				
	52	Purchase Note		1 year warranty	
	53				

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FLOW ELEMENT - ROTAMETER

706370 - SAN JOSE HEADWORKS

14FI9531-02

GENERAL	1	Tag Number	P&ID	14FI9531-03	7701_09-N-020_706370
	2	Loop Title		Grit Basin 3 Fluidizing Water Flow	
	3	Area Classification			
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule	1.5"	
	7				
PROCESS CONDITIONS	8	Fluid		No. 3 Water	
	9	Min Flow	Max Flow	20 gpm	25 gpm
	10	Nominal Pressure			
	11	Nominal Temperature			
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16				
INDICATOR	17	Type		Direct Reading	
	18				
	19	Process Connection		1.5 inch FNPT	
	20	Process Connection Material		316 Stainless Steel	
	21	Tube Size		13	
	22	Tube Length		16.3"	
	23	Tube Material		Glass	
	24	Float Material		316 Stainless Steel	
	25	Pressure Rating		75 psig	
	26	Seal Material		Buna N	
	27				
	28	Inlet Connection Orientation		Bottom Vertical	
	29	Outlet Connection Orientation		Top Vertical	
	30				
	31	Range		0 - 42 gpm	
	32				
	33				
SWITCH	34	Switch Type		N/A	
	35	Set Point			
	36	Set Point Direction			
	37	Deadband			
	38	Failure State			
	39	Voltage			
	40	Contact Arrangement			
	41	Contact Rating			
	42				
OPTIONS	43	Shield			
	44	Illuminator	Voltage		
	45	Needle Valve			
	46				
	47				
	48				
PURCHASE	49	Manufacturer		Brooks Instrument	
	50	Model Number		1024N	
	51				
	52	Purchase Note		1 year warranty	
	53				

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FLOW ELEMENT - ROTAMETER

706370 - SAN JOSE HEADWORKS

14FI9531-03

GENERAL	1	Tag Number	P&ID	14FI9531-04	7701_09-N-020_706370
	2	Loop Title		Grit Basin 4 Fluidizing Water Flow	
	3	Area Classification			
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule	1.5"	
	7				
PROCESS CONDITIONS	8	Fluid		No. 3 Water	
	9	Min Flow	Max Flow	20 gpm	25 gpm
	10	Nominal Pressure			
	11	Nominal Temperature			
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16				
INDICATOR	17	Type		Direct Reading	
	18				
	19	Process Connection		1.5 inch FNPT	
	20	Process Connection Material		316 Stainless Steel	
	21	Tube Size		13	
	22	Tube Length		16.3"	
	23	Tube Material		Glass	
	24	Float Material		316 Stainless Steel	
	25	Pressure Rating		75 psig	
	26	Seal Material		Buna N	
	27				
	28	Inlet Connection Orientation		Bottom Vertical	
	29	Outlet Connection Orientation		Top Vertical	
	30				
	31	Range		0 - 42 gpm	
	32				
	33				
SWITCH	34	Switch Type		N/A	
	35	Set Point			
	36	Set Point Direction			
	37	Deadband			
	38	Failure State			
	39	Voltage			
	40	Contact Arrangement			
	41	Contact Rating			
	42				
OPTIONS	43	Shield			
	44	Illuminator	Voltage		
	45	Needle Valve			
	46				
	47				
	48				
PURCHASE	49	Manufacturer		Brooks Instrument	
	50	Model Number		1024N	
	51				
	52	Purchase Note		1 year warranty	
	53				

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FLOW ELEMENT - ROTAMETER

706370 - SAN JOSE HEADWORKS

14FI9531-04

GENERAL	1	Tag Number	P&ID	14FI9531-05	7701_09-N-021_706370
	2	Loop Title		Grit Basin 5 Fluidizing Water Flow	
	3	Area Classification			
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule	1.5"	
	7				
PROCESS CONDITIONS	8	Fluid		No. 3 Water	
	9	Min Flow	Max Flow	20 gpm	25 gpm
	10	Nominal Pressure			
	11	Nominal Temperature			
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16				
INDICATOR	17	Type		Direct Reading	
	18				
	19	Process Connection		1.5 inch FNPT	
	20	Process Connection Material		316 Stainless Steel	
	21	Tube Size		13	
	22	Tube Length		16.3"	
	23	Tube Material		Glass	
	24	Float Material		316 Stainless Steel	
	25	Pressure Rating		75 psig	
	26	Seal Material		Buna N	
	27				
	28	Inlet Connection Orientation		Bottom Vertical	
	29	Outlet Connection Orientation		Top Vertical	
	30				
	31	Range		0 - 42 gpm	
	32				
	33				
SWITCH	34	Switch Type		N/A	
	35	Set Point			
	36	Set Point Direction			
	37	Deadband			
	38	Failure State			
	39	Voltage			
	40	Contact Arrangement			
	41	Contact Rating			
	42				
OPTIONS	43	Shield			
	44	Illuminator	Voltage		
	45	Needle Valve			
	46				
	47				
	48				
PURCHASE	49	Manufacturer		Brooks Instrument	
	50	Model Number		1024N	
	51				
	52	Purchase Note		1 year warranty	
	53				

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FLOW ELEMENT - ROTAMETER

706370 - SAN JOSE HEADWORKS

14FI9531-05

GENERAL	1	Tag Number	P&ID	14FI9531-06	7701_09-N-021_706370
	2	Loop Title		Grit Basin 6 Fluidizing Water Flow	
	3	Area Classification			
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule	1.5"	
	7				
PROCESS CONDITIONS	8	Fluid		No. 3 Water	
	9	Min Flow	Max Flow	20 gpm	25 gpm
	10	Nominal Pressure			
	11	Nominal Temperature			
	12	Specific Gravity	Viscosity	1.0	
	13	Conductivity	Density		
	14	Vapor Pressure	Critical Pressure		
	15				
	16				
INDICATOR	17	Type		Direct Reading	
	18				
	19	Process Connection		1.5 inch FNPT	
	20	Process Connection Material		316 Stainless Steel	
	21	Tube Size		13	
	22	Tube Length		16.3"	
	23	Tube Material		Glass	
	24	Float Material		316 Stainless Steel	
	25	Pressure Rating		75 psig	
	26	Seal Material		Buna N	
	27				
	28	Inlet Connection Orientation		Bottom Vertical	
	29	Outlet Connection Orientation		Top Vertical	
	30				
	31	Range		0 - 42 gpm	
	32				
	33				
SWITCH	34	Switch Type		N/A	
	35	Set Point			
	36	Set Point Direction			
	37	Deadband			
	38	Failure State			
	39	Voltage			
	40	Contact Arrangement			
	41	Contact Rating			
	42				
OPTIONS	43	Shield			
	44	Illuminator	Voltage		
	45	Needle Valve			
	46				
	47				
	48				
PURCHASE	49	Manufacturer		Brooks Instrument	
	50	Model Number		1024N	
	51				
	52	Purchase Note		1 year warranty	
	53				

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FLOW ELEMENT - ROTAMETER

706370 - SAN JOSE HEADWORKS

14FI9531-06

L29
LEVEL ELEMENT
AND TRANSMITTER, RADAR

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	11LIT9750-01	7701-09-N-030_706370
	2	Loop Title		California Structure Level	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Raw Sewage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range			
	35	Zero Reference			
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **11LIT9750-01**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	12LIT9701-00	7701-09-N-037_706370
	2	Loop Title		Recycle Pump Station 1 Level	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Pumped Drainage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range			
	35	Zero Reference			
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **12LIT9701-00**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9500-01	7701-09-N-005_706370
	2	Loop Title		Influent Screens Influent Channel Level	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Raw Sewage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range		0 - 20 Feet	
	35	Zero Reference		Elevation -8.0 Feet	
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9500-01**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9500-02	7701-09-N-005_706370
	2	Loop Title		Influent Screens Influent Channel Level	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Raw Sewage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range		0 - 20 Feet	
	35	Zero Reference		Elevation -8.0 Feet	
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9500-02**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9506-01	7701-09-N-007_706370
	2	Loop Title		Influent Screens Effluent Channel Level	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Raw Sewage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range		0 - 20 Feet	
	35	Zero Reference		Elevation -8.0 Feet	
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9506-01**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9506-02	7701-09-N-007_706370
	2	Loop Title		Influent Screens Effluent Channel Level	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Raw Sewage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range		0 - 20 Feet	
	35	Zero Reference		Elevation -8.0 Feet	
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9506-02**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9532-01	7701-09-N-019_706370
	2	Loop Title		Grit Basin 1 Flow	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid			
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range			
	35	Zero Reference			
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9532-01**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9532-02	7701-09-N-019_706370
	2	Loop Title		Grit Basin 2 Flow	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid			
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range			
	35	Zero Reference			
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9532-02**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9532-03	7701-09-N-020_706370
	2	Loop Title		Grit Basin 3 Flow	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid			
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range			
	35	Zero Reference			
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9532-03**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9532-04	7701-09-N-020_706370
	2	Loop Title		Grit Basin 4 Flow	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid			
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range			
	35	Zero Reference			
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9532-04**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9532-05	7701-09-N-021_706370
	2	Loop Title		Grit Basin 5 Flow	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid			
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range			
	35	Zero Reference			
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9532-05**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9532-06	7701-09-N-021_706370
	2	Loop Title		Grit Basin 6 Flow	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid			
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range			
	35	Zero Reference			
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9532-06**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9560-00	7701-09-N-001_706370
	2	Loop Title		EBOS - Compartment B Level	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Raw Sewage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range			
	35	Zero Reference			
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9560-00**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9561-00	7701-09-N-002_706370
	2	Loop Title		Emergency Overflow Basin Level	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Raw Sewage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range			
	35	Zero Reference			
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9561-00**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9570-00	7701-09-N-001_706370
	2	Loop Title		EBOS - Compartment B Level	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Raw Sewage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range			
	35	Zero Reference			
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9570-00**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9651-01	7701-09-N-012_706370
	2	Loop Title		Raw Sewage Pump 1 Wet Well Level	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Raw Sewage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range		0 - 20 Feet	
	35	Zero Reference		Elevation -9.0 Feet	
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9651-01**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9651-02	7701-09-N-013_706370
	2	Loop Title		Raw Sewage Pump 2 Wet Well Level	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Raw Sewage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range			
	35	Zero Reference			
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9651-02**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9651-03	7701-09-N-014_706370
	2	Loop Title		Raw Sewage Pump 3 Wet Well Level	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Raw Sewage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range			
	35	Zero Reference			
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9651-03**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9651-04	7701-09-N-015_706370
	2	Loop Title		Raw Sewage Pump 4 Wet Well Level	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Raw Sewage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range			
	35	Zero Reference			
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9651-04**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9651-05	7701-09-N-016_706370
	2	Loop Title		Raw Sewage Pump 5 Wet Well Level	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Raw Sewage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range			
	35	Zero Reference			
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9651-05**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9721-00	7701-09-N-038_706370
	2	Loop Title		HW3 Recycle Pump Station Level	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Pumped Drainage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range			
	35	Zero Reference			
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9721-00**

OPPID Reports - L29 Level Transmitter, Radar

GENERAL	1	Tag Number	P&ID	14LIT9739-00	7701-09-N-039_706370
	2	Loop Title		Grit Pump Room Sump Level	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Pumped Drainage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type			
	16	Element Length			
	17	Extension Length			
	18	Wetted Materials		316 Stainless Steel	
	19	Process Connection		4-inch Class 150 ANSI Flange	
	20	Measurable Limits		65 Feet	
	21	Beam Angle		15 Degrees	
	22	Antenna Enclosure		NEMA 6P/IP68	
	23	Ambient Temperature Limits		-40 degF to 176 degF	
	24	Process Temperature Limits		-40 degF to 176 degF	
	25				
	26				
TRANSMITTER	27	Mounting		Integral	
	28	Enclosure NEMA Rating		NEMA 4X/IP65	
	29	Power Supply	Voltage	2 - Wire	24 VDC
	30	Output Signal		4 to 20 madc	
	31	Communication Protocol		HART	
	32	Range			
	33	Display		Integral	
CALIBRATION	34	Calibrated Range			
	35	Zero Reference			
	36	Vendor Calibration		No	
	37				
	38	Accuracy	Resolution	+/- 0.1 Pct of Range	0.04 inch
	39				
OPTIONS	40	Tagging		Stainless Steel Tag with Tag Number	
	41	Sun Shield		No	
	42				
	43				
	44				
	45				
PURCHASE	46	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	47	Model Number 1	Model Number 2	FMR60	
	48	Antenna Extension			
	49	Sun Shield			
	50	Purchase Note		1 year warranty	
	51				
	52				
	53				

L29 **Level Transmitter, Radar**	**706370 - SAN JOSE HEADWORKS** **14LIT9739-00**

L50
LEVEL SWITCH, TUNING FORK

OPPID Reports - L50 Level Switch, Tuning Fork

GENERAL	1	Tag Number	P&ID	12LSH9702-00	7701-09-N-037_706370
	2	Loop Title		Recycle Pump Station 1 Level	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Pumped Drainage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity		
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type		Tuning Fork	
	16	Insertion Length			
	17	Process Connection		2 inch - Class 150 ANSI Flange	
	18	Wetted Materials		Teflon	
	19				
	20	Enclosure NEMA Rating		NEMA 4X	
	21				
	22	Ambient Temperature Limits		-50 degF to 160 degF	
	23	Process Temperature Limits		-50 degF to 300 degF	
	24				
SWITCH	25	Switch Type		4 - 20 madc	
	26	Set Point			
	27	Set Point Direction		Rising	
	28	Deadband			
	29	Failure State			
	30	Voltage			
	31	Contact Arrangement			
	32	Contact Rating			
	33	Communication Protocol			
	34				
	35				
	36				
	37				
	38				
	39				
	40				
CALIBRATION	41	Vendor Calibration		No	
	42				
	43				
	44	Accuracy	Repeatability	0.04 inches	0.004 inches
	45				
OPTIONS	46	Tagging		Affix paper tag with Tag Number	
	47				
	48				
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	51	Model Number 1	Model Number 2	Liquiphant FLT 51C	
	52	Purchase Note		1 year warranty	
	53				

L50 **Level Switch, Tuning Fork**	**706370 - SAN JOSE HEADWORKS** **12LSH9702-00**

OPPID Reports - L50 Level Switch, Tuning Fork

GENERAL	1	Tag Number	P&ID	14LSH9511-01	7701-09-N-006_706370
	2	Loop Title		Screenings Trough Level	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		No. 3 Water	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity		
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type		Tuning Fork	
	16	Insertion Length			
	17	Process Connection		2 inch - Class 150 ANSI Flange	
	18	Wetted Materials		Teflon	
	19				
	20	Enclosure NEMA Rating		NEMA 4X	
	21				
	22	Ambient Temperature Limits		-50 degF to 160 degF	
	23	Process Temperature Limits		-50 degF to 300 degF	
	24				
SWITCH	25	Switch Type		4 - 20 madc	
	26	Set Point			
	27	Set Point Direction		Rising	
	28	Deadband			
	29	Failure State			
	30	Voltage			
	31	Contact Arrangement			
	32	Contact Rating			
	33	Communication Protocol			
	34				
	35				
	36				
	37				
	38				
	39				
	40				
CALIBRATION	41	Vendor Calibration		No	
	42				
	43				
	44	Accuracy	Repeatability	0.04 inches	0.004 inches
	45				
OPTIONS	46	Tagging		Affix paper tag with Tag Number	
	47				
	48				
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	51	Model Number 1	Model Number 2	Liquiphant FLT 51C	
	52	Purchase Note		1 year warranty	
	53				

L50 **Level Switch, Tuning Fork**	**706370 - SAN JOSE HEADWORKS** **14LSH9511-01**

OPPID Reports - L50 Level Switch, Tuning Fork

GENERAL	1	Tag Number	P&ID	14LSH9534-01	7701-09-N-021_706370
	2	Loop Title		Grit Basins Effluent Channel Level	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Raw Sewage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity		
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type		Tuning Fork	
	16	Insertion Length			
	17	Process Connection		2 inch - Class 150 ANSI Flange	
	18	Wetted Materials		Teflon	
	19				
	20	Enclosure NEMA Rating		NEMA 4X	
	21				
	22	Ambient Temperature Limits		-50 degF to 160 degF	
	23	Process Temperature Limits		-50 degF to 300 degF	
	24				
SWITCH	25	Switch Type		4 - 20 madc	
	26	Set Point			
	27	Set Point Direction		Rising	
	28	Deadband			
	29	Failure State			
	30	Voltage			
	31	Contact Arrangement			
	32	Contact Rating			
	33	Communication Protocol			
	34				
	35				
	36				
	37				
	38				
	39				
	40				
CALIBRATION	41	Vendor Calibration		No	
	42				
	43				
	44	Accuracy	Repeatability	0.04 inches	0.004 inches
	45				
OPTIONS	46	Tagging		Affix paper tag with Tag Number	
	47				
	48				
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	51	Model Number 1	Model Number 2	Liquiphant FLT 51C	
	52	Purchase Note		1 year warranty	
	53				

L50 **Level Switch, Tuning Fork**	**706370 - SAN JOSE HEADWORKS**
	14LSH9534-01

OPPID Reports - L50 Level Switch, Tuning Fork

GENERAL	1	Tag Number	P&ID	14LSH9722-00	7701-09-N-038_706370
	2	Loop Title		HW3 Recycle Pump Station Level	
	3	Area Classification		Class I - Division II	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Pumped Drainage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity		
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type		Tuning Fork	
	16	Insertion Length			
	17	Process Connection		2 inch - Class 150 ANSI Flange	
	18	Wetted Materials		Teflon	
	19				
	20	Enclosure NEMA Rating		NEMA 4X	
	21				
	22	Ambient Temperature Limits		-50 degF to 160 degF	
	23	Process Temperature Limits		-50 degF to 300 degF	
	24				
SWITCH	25	Switch Type		4 - 20 madc	
	26	Set Point			
	27	Set Point Direction		Rising	
	28	Deadband			
	29	Failure State			
	30	Voltage			
	31	Contact Arrangement			
	32	Contact Rating			
	33	Communication Protocol			
	34				
	35				
	36				
	37				
	38				
	39				
	40				
CALIBRATION	41	Vendor Calibration		No	
	42				
	43				
	44	Accuracy	Repeatability	0.04 inches	0.004 inches
	45				
OPTIONS	46	Tagging		Affix paper tag with Tag Number	
	47				
	48				
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	51	Model Number 1	Model Number 2	Liquiphant FLT 51C	
	52	Purchase Note		1 year warranty	
	53				

L50 **Level Switch, Tuning Fork**	**706370 - SAN JOSE HEADWORKS**
	14LSH9722-00

OPPID Reports - L50 Level Switch, Tuning Fork

GENERAL	1	Tag Number	P&ID	14LSH9739-00	7701-09-N-039_706370
	2	Loop Title		Grit Pump Room Sump Level	
	3	Area Classification		Non-Classified	
	4				
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		Pumped Drainage	
	9	Pressure		Atmospheric	
	10	Temperature			
	11	Specific Gravity	Viscosity		
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
ELEMENT	15	Element Type		Tuning Fork	
	16	Insertion Length			
	17	Process Connection		2 inch - Class 150 ANSI Flange	
	18	Wetted Materials		Teflon	
	19				
	20	Enclosure NEMA Rating		NEMA 4X	
	21				
	22	Ambient Temperature Limits		-50 degF to 160 degF	
	23	Process Temperature Limits		-50 degF to 300 degF	
	24				
SWITCH	25	Switch Type		4 - 20 madc	
	26	Set Point			
	27	Set Point Direction		Rising	
	28	Deadband			
	29	Failure State			
	30	Voltage			
	31	Contact Arrangement			
	32	Contact Rating			
	33	Communication Protocol			
	34				
	35				
	36				
	37				
	38				
	39				
	40				
CALIBRATION	41	Vendor Calibration		No	
	42				
	43				
	44	Accuracy	Repeatability	0.04 inches	0.004 inches
	45				
OPTIONS	46	Tagging		Affix paper tag with Tag Number	
	47				
	48				
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Endress+Hauser	
	51	Model Number 1	Model Number 2	Liquiphant FLT 51C	
	52	Purchase Note		1 year warranty	
	53				

L50 **Level Switch, Tuning Fork**	**706370 - SAN JOSE HEADWORKS**
	14LSH9739-00

P03
PRESSURE DIFFERENTIAL TRANSMITTER, ELECTRONIC

OPPID Reports - P03 Pressure Differential Transmitter

GENERAL	1	Tag Number	P&ID	14PDIT9702-01	7701-09-N-033_706370
	2	Loop Title		Odor Control Exhaust Fan 1 Headloss	
	3	Area Classification		Class I - Division II	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
PROCESS CONDITIONS	6	Fluid		Foul Air	
	7	Min Pressure	Max Pressure		12 inwc
	8	Temperature			
	9	Specific Gravity	Viscosity		
	10	Conductivity	Density		
	11	Vapor Pressure	Critical Pressure		
ELEMENT	12	Element Type		Ceramic Diaphragm	
	13	Element Material			
	14	Body Rating			
	15	Instrument Body Material		AISI 316L	
	16	Wetted Materials		AISI 316L	
	17	Process Connection		0.5 inch NPT	
	18	Measurable Limits			
	19	Ambient Temperature Limits		-40 degF to 175 degF	
	20	Process Temperature Limits		-40 degF to 250 degF	
	21	Wetted O-Ring Material			
DIAPHRAGM SEAL	22	Type		NA	
	23	Process Connection		0.75 Inch NPT	
	24	Body Material			
	25	Diaphragm/Sleeve Material			
ANNULAR SEAL	26				
	27	Capillary Material			
	28	Capillary Length			
	29	Fill Fluid		Glycerine	
	30	Flushing Connection		No	
	31				
	32	Manufacturer			
	33	Model Number			
TRANSMITTER	34	Mounting		Wall	
	35	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	36	Power Supply	Voltage	2 - Wire	24 VDC
	37	Output Signal		4 to 20 madc	
	38	Communication Protocol		HART	
	39	Range			
	40				
CALIBRATION	41	Calibrated Range		0 - 16 inwc	
	42	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	43	Zero Elevated or Suppressed			
	44	Zero Reference			
	45	Accuracy	Repeatability	+/- 0.1 Pct of Span	
OPTIONS	46	Multi-Valve Manifold		Yes	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Mounting Bracket		2 inch pipe	
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Rosemount	Endress+Hauser
	51	Model Number 1	Model Number 2	3051	PMD75
	52	3-Valve SS Manifolds Mounted		316 stainless steel	
	53	Purchase Note		1 year warranty	

P03 **Pressure Differential Transmitter**	**706370 - SAN JOSE HEADWORKS** **14PDIT9702-01**

OPPID Reports - P03 Pressure Differential Transmitter

GENERAL	1	Tag Number	P&ID	14PDIT9702-02	7701-09-N-033_706370
	2	Loop Title		Odor Control Exhaust Fan 2 Headloss	
	3	Area Classification		Class I - Division II	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
PROCESS CONDITIONS	6	Fluid			
	7	Min Pressure	Max Pressure		12 inwc
	8	Temperature			
	9	Specific Gravity	Viscosity		
	10	Conductivity	Density		
	11	Vapor Pressure	Critical Pressure		
ELEMENT	12	Element Type		Ceramic Diaphragm	
	13	Element Material			
	14	Body Rating			
	15	Instrument Body Material		AISI 316L	
	16	Wetted Materials		AISI 316L	
	17	Process Connection		0.5 inch NPT	
	18	Measurable Limits			
	19	Ambient Temperature Limits		-40 degF to 175 degF	
	20	Process Temperature Limits		-40 degF to 250 degF	
	21	Wetted O-Ring Material			
DIAPHRAGM SEAL	22	Type		NA	
	23	Process Connection		0.75 Inch NPT	
	24	Body Material			
	25	Diaphragm/Sleeve Material			
ANNULAR SEAL	26				
	27	Capillary Material			
	28	Capillary Length			
	29	Fill Fluid		Glycerine	
	30	Flushing Connection		No	
	31				
	32	Manufacturer			
	33	Model Number			
TRANSMITTER	34	Mounting		Wall	
	35	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	36	Power Supply	Voltage	2 - Wire	24 VDC
	37	Output Signal		4 to 20 madc	
	38	Communication Protocol		HART	
	39	Range			
	40				
CALIBRATION	41	Calibrated Range		0 - 16 inwc	
	42	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	43	Zero Elevated or Suppressed			
	44	Zero Reference			
	45	Accuracy	Repeatability	+/- 0.1 Pct of Span	
OPTIONS	46	Multi-Valve Manifold		Yes	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Mounting Bracket		2 inch pipe	
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Rosemount	Endress+Hauser
	51	Model Number 1	Model Number 2	3051	PMD75
	52	3-Valve SS Manifolds Mounted		316 stainless steel	
	53	Purchase Note		1 year warranty	

P03 **Pressure Differential Transmitter**	**706370 - SAN JOSE HEADWORKS** **14PDIT9702-02**

P04
PRESSURE GAUGE

OPPID Reports - P04 Pressure Gauge

GENERAL	1	Tag Number	P&ID	14PI9509-01	7701-09-N-006_706370
	2	Loop Title		Screenings Sluice Water Pressure	
	3				
	4	Area Classification			
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid			
	9	Min Pressure	Max Pressure		
	10	Temperature		Ambient	
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
INDICATOR	15	Type		Bourdon Tube	
	16	Range		0 - 100 psig	
	17	Dial Size	Dial Color	4.5 Inches	White
	18	Process Connection	Mounting	0.5-inch MNPT	Lower Stem
	19	Movement Dampening		Glycerine	
	20	Case Material	Window Material	Black Thermoplastic	Glass or Acrylic
	21				
	22	Blowout Protection		Case Back	
	23	Wetted Parts	Socket Material	Stainless Steel	Stainless Steel
	24				
	25	Mounting		Wall	
	26	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	27	Power Supply	Voltage	2 - Wire	24 VDC
	28	Output Signal		4 to 20 madc	
	29	Communication Protocol		HART	
	30	Range		0 - 100 psig	
	31				
SEAL	32	Type		NA	
	33	Process Connection			
	34	Body Material			
	35	Diaphragm/Sleeve Material			
	36	Capillary Material			
	37	Capillary Length			
	38	Fill Fluid		Glycerine	
	39	Flushing Connection		No	
	40				
	41	Manufacturer			
	42	Model Number			
CALIBRATION	43	Calibrated Range			
	44	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	45	Accuracy	Repeatability	+/- 0.5 Pct of Range	
	46				
OPTIONS	47	Tagging		Stainless steel tag with Tag Number	
	48				
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Ashcroft	
	51	Model Number 1	Model Number 2	1279	
	52	Purchase Note		1 year warranty	
	53				

P04 **Pressure Gauge**	**706370 - SAN JOSE HEADWORKS** **14PI9509-01**

OPPID Reports - P04 Pressure Gauge

GENERAL	1	Tag Number	P&ID	14PI9524-01	7701-09-N-008_706370
	2	Loop Title		Screenings Compactor Flush Water Pressure	
	3				
	4	Area Classification			
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		No. 3 Water	
	9	Min Pressure	Max Pressure		
	10	Temperature		Ambient	
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
INDICATOR	15	Type		Bourdon Tube	
	16	Range		0 - 100 psig	
	17	Dial Size	Dial Color	4.5 Inches	White
	18	Process Connection	Mounting	0.5-inch MNPT	Lower Stem
	19	Movement Dampening		Glycerine	
	20	Case Material	Window Material	Black Thermoplastic	Glass or Acrylic
	21				
	22	Blowout Protection		Case Back	
	23	Wetted Parts	Socket Material	Stainless Steel	Stainless Steel
	24				
	25	Mounting		Wall	
	26	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	27	Power Supply	Voltage	2 - Wire	24 VDC
	28	Output Signal		4 to 20 madc	
	29	Communication Protocol		HART	
	30	Range		0 - 100 psig	
	31				
SEAL	32	Type		NA	
	33	Process Connection			
	34	Body Material			
	35	Diaphragm/Sleeve Material			
	36	Capillary Material			
	37	Capillary Length			
	38	Fill Fluid		Glycerine	
	39	Flushing Connection		No	
	40				
	41	Manufacturer			
	42	Model Number			
CALIBRATION	43	Calibrated Range			
	44	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	45	Accuracy	Repeatability	+/- 0.5 Pct of Range	
	46				
OPTIONS	47	Tagging		Stainless steel tag with Tag Number	
	48				
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Ashcroft	
	51	Model Number 1	Model Number 2	1279	
	52	Purchase Note		1 year warranty	
	53				

P04 **Pressure Gauge**	**706370 - SAN JOSE HEADWORKS** **14PI9524-01**

OPPID Reports - P04 Pressure Gauge

GENERAL	1	Tag Number	P&ID	14PI9678-01	7701-09-N-012_706370
	2	Loop Title		Raw Sewage Pump 1 Seal Water Pressure	
	3				
	4	Area Classification			
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		No.1 Water	
	9	Min Pressure	Max Pressure	40 psig	60 psig
	10	Temperature		Ambient	
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
INDICATOR	15	Type		Bourdon Tube	
	16	Range		0 - 100 psig	
	17	Dial Size	Dial Color	4.5 Inches	White
	18	Process Connection	Mounting	0.5-inch MNPT	Lower Stem
	19	Movement Dampening		Glycerine	
	20	Case Material	Window Material	Black Thermoplastic	Glass or Acrylic
	21				
	22	Blowout Protection		Case Back	
	23	Wetted Parts	Socket Material	Stainless Steel	Stainless Steel
	24				
	25	Mounting		Wall	
	26	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	27	Power Supply	Voltage	2 - Wire	24 VDC
	28	Output Signal		4 to 20 madc	
	29	Communication Protocol		HART	
	30	Range		0 - 100 psig	
	31				
SEAL	32	Type		NA	
	33	Process Connection			
	34	Body Material			
	35	Diaphragm/Sleeve Material			
	36	Capillary Material			
	37	Capillary Length			
	38	Fill Fluid		Glycerine	
	39	Flushing Connection		No	
	40				
	41	Manufacturer			
	42	Model Number			
CALIBRATION	43	Calibrated Range		0 - 100 psig	
	44	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	45	Accuracy	Repeatability	+/- 0.5 Pct of Range	
	46				
OPTIONS	47	Tagging		Stainless steel tag with Tag Number	
	48				
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Ashcroft	
	51	Model Number 1	Model Number 2	1279	
	52	Purchase Note		1 year warranty	
	53				

P04 **Pressure Gauge**	**706370 - SAN JOSE HEADWORKS**
	14PI9678-01

OPPID Reports - P04 Pressure Gauge

GENERAL	1	Tag Number	P&ID	14PI9678-02	7701-09-N-013_706370
	2	Loop Title		Raw Sewage Pump 2 Seal Water Pressure	
	3				
	4	Area Classification			
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		No.1 Water	
	9	Min Pressure	Max Pressure	40 psig	60 psig
	10	Temperature		Ambient	
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
INDICATOR	15	Type		Bourdon Tube	
	16	Range		0 - 100 psig	
	17	Dial Size	Dial Color	4.5 Inches	White
	18	Process Connection	Mounting	0.5-inch MNPT	Lower Stem
	19	Movement Dampening		Glycerine	
	20	Case Material	Window Material	Black Thermoplastic	Glass or Acrylic
	21				
	22	Blowout Protection		Case Back	
	23	Wetted Parts	Socket Material	Stainless Steel	Stainless Steel
	24				
	25	Mounting		Wall	
	26	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	27	Power Supply	Voltage	2 - Wire	24 VDC
	28	Output Signal		4 to 20 madc	
	29	Communication Protocol		HART	
	30	Range		0 - 100 psig	
	31				
SEAL	32	Type		NA	
	33	Process Connection			
	34	Body Material			
	35	Diaphragm/Sleeve Material			
	36	Capillary Material			
	37	Capillary Length			
	38	Fill Fluid		Glycerine	
	39	Flushing Connection		No	
	40				
	41	Manufacturer			
	42	Model Number			
CALIBRATION	43	Calibrated Range		0 - 100 psig	
	44	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	45	Accuracy	Repeatability	+/- 0.5 Pct of Range	
	46				
OPTIONS	47	Tagging		Stainless steel tag with Tag Number	
	48				
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Ashcroft	
	51	Model Number 1	Model Number 2	1279	
	52	Purchase Note		1 year warranty	
	53				

P04 **Pressure Gauge**	**706370 - SAN JOSE HEADWORKS** **14PI9678-02**

OPPID Reports - P04 Pressure Gauge

GENERAL	1	Tag Number	P&ID	14PI9678-03	7701-09-N-014_706370
	2	Loop Title		Raw Sewage Pump 3 Seal Water Pressure	
	3				
	4	Area Classification			
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		No.1 Water	
	9	Min Pressure	Max Pressure	40 psig	60 psig
	10	Temperature		Ambient	
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
INDICATOR	15	Type		Bourdon Tube	
	16	Range		0 - 100 psig	
	17	Dial Size	Dial Color	4.5 Inches	White
	18	Process Connection	Mounting	0.5-inch MNPT	Lower Stem
	19	Movement Dampening		Glycerine	
	20	Case Material	Window Material	Black Thermoplastic	Glass or Acrylic
	21				
	22	Blowout Protection		Case Back	
	23	Wetted Parts	Socket Material	Stainless Steel	Stainless Steel
	24				
	25	Mounting		Wall	
	26	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	27	Power Supply	Voltage	2 - Wire	24 VDC
	28	Output Signal		4 to 20 madc	
	29	Communication Protocol		HART	
	30	Range		0 - 100 psig	
	31				
SEAL	32	Type		NA	
	33	Process Connection			
	34	Body Material			
	35	Diaphragm/Sleeve Material			
	36	Capillary Material			
	37	Capillary Length			
	38	Fill Fluid		Glycerine	
	39	Flushing Connection		No	
	40				
	41	Manufacturer			
	42	Model Number			
CALIBRATION	43	Calibrated Range		0 - 100 psig	
	44	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	45	Accuracy	Repeatability	+/- 0.5 Pct of Range	
	46				
OPTIONS	47	Tagging		Stainless steel tag with Tag Number	
	48				
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Ashcroft	
	51	Model Number 1	Model Number 2	1279	
	52	Purchase Note		1 year warranty	
	53				

P04 **Pressure Gauge**	**706370 - SAN JOSE HEADWORKS**
	14PI9678-03

OPPID Reports - P04 Pressure Gauge

GENERAL	1	Tag Number	P&ID	14PI9678-04	7701-09-N-015_706370
	2	Loop Title		Raw Sewage Pump 4 Seal Water Pressure	
	3				
	4	Area Classification			
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		No.1 Water	
	9	Min Pressure	Max Pressure	40 psig	60 psig
	10	Temperature		Ambient	
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
INDICATOR	15	Type		Bourdon Tube	
	16	Range		0 - 100 psig	
	17	Dial Size	Dial Color	4.5 Inches	White
	18	Process Connection	Mounting	0.5-inch MNPT	Lower Stem
	19	Movement Dampening		Glycerine	
	20	Case Material	Window Material	Black Thermoplastic	Glass or Acrylic
	21				
	22	Blowout Protection		Case Back	
	23	Wetted Parts	Socket Material	Stainless Steel	Stainless Steel
	24				
	25	Mounting		Wall	
	26	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	27	Power Supply	Voltage	2 - Wire	24 VDC
	28	Output Signal		4 to 20 madc	
	29	Communication Protocol		HART	
	30	Range		0 - 100 psig	
	31				
SEAL	32	Type		NA	
	33	Process Connection			
	34	Body Material			
	35	Diaphragm/Sleeve Material			
	36	Capillary Material			
	37	Capillary Length			
	38	Fill Fluid		Glycerine	
	39	Flushing Connection		No	
	40				
	41	Manufacturer			
	42	Model Number			
CALIBRATION	43	Calibrated Range		0 - 100 psig	
	44	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	45	Accuracy	Repeatability	+/- 0.5 Pct of Range	
	46				
OPTIONS	47	Tagging		Stainless steel tag with Tag Number	
	48				
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Ashcroft	
	51	Model Number 1	Model Number 2	1279	
	52	Purchase Note		1 year warranty	
	53				

P04 **Pressure Gauge**	**706370 - SAN JOSE HEADWORKS** **14PI9678-04**

OPPID Reports - P04 Pressure Gauge

GENERAL	1	Tag Number	P&ID	14PI9678-05	7701-09-N-016_706370
	2	Loop Title		Raw Sewage Pump 5 Seal Water Pressure	
	3				
	4	Area Classification			
	5	Line Number	Equipment Number		
	6	Line Size	Line Schedule		
	7				
PROCESS CONDITIONS	8	Fluid		No.1 Water	
	9	Min Pressure	Max Pressure	40 psig	60 psig
	10	Temperature		Ambient	
	11	Specific Gravity	Viscosity	1.0	
	12	Conductivity	Density		
	13	Vapor Pressure	Critical Pressure		
	14				
INDICATOR	15	Type		Bourdon Tube	
	16	Range		0 - 100 psig	
	17	Dial Size	Dial Color	4.5 Inches	White
	18	Process Connection	Mounting	0.5-inch MNPT	Lower Stem
	19	Movement Dampening		Glycerine	
	20	Case Material	Window Material	Black Thermoplastic	Glass or Acrylic
	21				
	22	Blowout Protection		Case Back	
	23	Wetted Parts	Socket Material	Stainless Steel	Stainless Steel
	24				
	25	Mounting		Wall	
	26	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	27	Power Supply	Voltage	2 - Wire	24 VDC
	28	Output Signal		4 to 20 madc	
	29	Communication Protocol		HART	
	30	Range		0 - 100 psig	
	31				
SEAL	32	Type		NA	
	33	Process Connection			
	34	Body Material			
	35	Diaphragm/Sleeve Material			
	36	Capillary Material			
	37	Capillary Length			
	38	Fill Fluid		Glycerine	
	39	Flushing Connection		No	
	40				
	41	Manufacturer			
	42	Model Number			
CALIBRATION	43	Calibrated Range		0 - 100 psig	
	44	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	45	Accuracy	Repeatability	+/- 0.5 Pct of Range	
	46				
OPTIONS	47	Tagging		Stainless steel tag with Tag Number	
	48				
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Ashcroft	
	51	Model Number 1	Model Number 2	1279	
	52	Purchase Note		1 year warranty	
	53				

P04 **Pressure Gauge**	**706370 - SAN JOSE HEADWORKS** **14PI9678-05**

P09
PRESSURE TRANSMITTER, ELECTRONIC

OPPID Reports - P09 Pressure Transmitter

GENERAL	1	Tag Number	P&ID	12PIT9706-01	7701-09-N-037_706370
	2	Loop Title		Recycle Pump Station 1 - Pump 1 Pressure	
	3	Area Classification		Class I - Division II	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
PROCESS CONDITIONS	6	Fluid		Pumped Drainage	
	7	Min Pressure	Max Pressure		
	8	Temperature			
	9	Specific Gravity	Viscosity		
	10	Conductivity	Density		
	11	Vapor Pressure	Critical Pressure		
ELEMENT	12	Element Type		Ceramic Diaphragm	
	13	Element Material			
	14	Body Rating			
	15	Instrument Body Material		AISI 316L	
	16	Wetted Materials		AISI 316L	
	17	Process Connection		0.5 inch NPT	
	18	Measurable Limits			
	19	Ambient Temperature Limits		-40 degF to 175 degF	
	20	Process Temperature Limits		-40 degF to 250 degF	
	21	Wetted O-Ring Material			
SEAL	22	Type		Annular	
	23	Process Connection		0.75 Inch NPT	
	24	Body Material		Carbon Steel	
	25	Diaphragm/Sleeve Material		Buna-N	
	26				
	27	Capillary Material			
	28	Capillary Length			
	29	Fill Fluid		Glycerine	
	30	Flushing Connection		No	
	31				
	32	Manufacturer			
	33	Model Number			
TRANSMITTER	34	Mounting		Wall	
	35	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	36	Power Supply	Voltage	2 - Wire	24 VDC
	37	Output Signal		4 to 20 madc	
	38	Communication Protocol		HART	
	39	Range			
	40				
CALIBRATION	41	Calibrated Range			
	42	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	43	Zero Elevated or Suppressed			
	44	Zero Reference			
	45	Accuracy	Repeatability	+/- 0.1 Pct of Span	
OPTIONS	46	Multi-Valve Manifold		Yes	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Mounting Bracket		2 inch pipe	
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Rosemount	Endress+Hauser
	51	Model Number 1	Model Number 2	3051	PMP51
	52	3-Valve SS Manifolds Mounted		316 stainless steel	
	53	Purchase Note		1 year warranty	

P09 **Pressure Transmitter**	**706370 - SAN JOSE HEADWORKS**
	12PIT9706-01

GENERAL	1	Tag Number	P&ID	12PIT9706-02	7701-09-N-037_706370
	2	Loop Title		Recycle Pump Station 1 - Pump 2 Pressure	
	3	Area Classification		Class I - Division II	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
PROCESS CONDITIONS	6	Fluid		Pumped Drainage	
	7	Min Pressure	Max Pressure		
	8	Temperature			
	9	Specific Gravity	Viscosity		
	10	Conductivity	Density		
	11	Vapor Pressure	Critical Pressure		
ELEMENT	12	Element Type		Ceramic Diaphragm	
	13	Element Material			
	14	Body Rating			
	15	Instrument Body Material		AISI 316L	
	16	Wetted Materials		AISI 316L	
	17	Process Connection		0.5 inch NPT	
	18	Measurable Limits			
	19	Ambient Temperature Limits		-40 degF to 175 degF	
	20	Process Temperature Limits		-40 degF to 250 degF	
	21	Wetted O-Ring Material			
SEAL	22	Type		Annular	
	23	Process Connection		0.75 Inch NPT	
	24	Body Material		Carbon Steel	
	25	Diaphragm/Sleeve Material		Buna-N	
	26				
	27	Capillary Material			
	28	Capillary Length			
	29	Fill Fluid		Glycerine	
	30	Flushing Connection		No	
	31				
	32	Manufacturer			
	33	Model Number			
TRANSMITTER	34	Mounting		Wall	
	35	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	36	Power Supply	Voltage	2 - Wire	24 VDC
	37	Output Signal		4 to 20 madc	
	38	Communication Protocol		HART	
	39	Range			
	40				
CALIBRATION	41	Calibrated Range			
	42	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	43	Zero Elevated or Suppressed			
	44	Zero Reference			
	45	Accuracy	Repeatability	+/- 0.1 Pct of Span	
OPTIONS	46	Multi-Valve Manifold		Yes	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Mounting Bracket		2 inch pipe	
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Rosemount	Endress+Hauser
	51	Model Number 1	Model Number 2	3051	PMP51
	52	3-Valve SS Manifolds Mounted		316 stainless steel	
	53	Purchase Note		1 year warranty	

P09 **Pressure Transmitter**	**706370 - SAN JOSE HEADWORKS** **12PIT9706-02**

GENERAL	1	Tag Number	P&ID	12PIT9706-03	7701-09-N-037_706370
	2	Loop Title		Recycle Pump Station 1 - Pump 3 Pressure	
	3	Area Classification		Class I - Division II	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
PROCESS CONDITIONS	6	Fluid		Pumped Drainage	
	7	Min Pressure	Max Pressure		
	8	Temperature			
	9	Specific Gravity	Viscosity		
	10	Conductivity	Density		
	11	Vapor Pressure	Critical Pressure		
ELEMENT	12	Element Type		Ceramic Diaphragm	
	13	Element Material			
	14	Body Rating			
	15	Instrument Body Material		AISI 316L	
	16	Wetted Materials		AISI 316L	
	17	Process Connection		0.5 inch NPT	
	18	Measurable Limits			
	19	Ambient Temperature Limits		-40 degF to 175 degF	
	20	Process Temperature Limits		-40 degF to 250 degF	
	21	Wetted O-Ring Material			
SEAL	22	Type		Annular	
	23	Process Connection		0.75 Inch NPT	
	24	Body Material		Carbon Steel	
	25	Diaphragm/Sleeve Material		Buna-N	
	26				
	27	Capillary Material			
	28	Capillary Length			
	29	Fill Fluid		Glycerine	
	30	Flushing Connection		No	
	31				
	32	Manufacturer			
	33	Model Number			
TRANSMITTER	34	Mounting		Wall	
	35	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	36	Power Supply	Voltage	2 - Wire	24 VDC
	37	Output Signal		4 to 20 madc	
	38	Communication Protocol		HART	
	39	Range			
	40				
CALIBRATION	41	Calibrated Range			
	42	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	43	Zero Elevated or Suppressed			
	44	Zero Reference			
	45	Accuracy	Repeatability	+/- 0.1 Pct of Span	
OPTIONS	46	Multi-Valve Manifold		Yes	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Mounting Bracket		2 inch pipe	
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Rosemount	Endress+Hauser
	51	Model Number 1	Model Number 2	3051	PMP51
	52	3-Valve SS Manifolds Mounted		316 stainless steel	
	53	Purchase Note		1 year warranty	

P09 **Pressure Transmitter**	**706370 - SAN JOSE HEADWORKS** **12PIT9706-03**

OPPID Reports - P09 Pressure Transmitter

GENERAL	1	Tag Number	P&ID	12PIT9706-04	7701-09-N-037_706370
	2	Loop Title		Recycle Pump Station 1 - Pump 4 Pressure	
	3	Area Classification		Class I - Division II	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
PROCESS CONDITIONS	6	Fluid		Pumped Drainage	
	7	Min Pressure	Max Pressure		
	8	Temperature			
	9	Specific Gravity	Viscosity		
	10	Conductivity	Density		
	11	Vapor Pressure	Critical Pressure		
ELEMENT	12	Element Type		Ceramic Diaphragm	
	13	Element Material			
	14	Body Rating			
	15	Instrument Body Material		AISI 316L	
	16	Wetted Materials		AISI 316L	
	17	Process Connection		0.5 inch NPT	
	18	Measurable Limits			
	19	Ambient Temperature Limits		-40 degF to 175 degF	
	20	Process Temperature Limits		-40 degF to 250 degF	
	21	Wetted O-Ring Material			
SEAL	22	Type		Annular	
	23	Process Connection		0.75 Inch NPT	
	24	Body Material		Carbon Steel	
	25	Diaphragm/Sleeve Material		Buna-N	
	26				
	27	Capillary Material			
	28	Capillary Length			
	29	Fill Fluid		Glycerine	
	30	Flushing Connection		No	
	31				
	32	Manufacturer			
	33	Model Number			
TRANSMITTER	34	Mounting		Wall	
	35	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	36	Power Supply	Voltage	2 - Wire	24 VDC
	37	Output Signal		4 to 20 madc	
	38	Communication Protocol		HART	
	39	Range			
	40				
CALIBRATION	41	Calibrated Range			
	42	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	43	Zero Elevated or Suppressed			
	44	Zero Reference			
	45	Accuracy	Repeatability	+/- 0.1 Pct of Span	
OPTIONS	46	Multi-Valve Manifold		Yes	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Mounting Bracket		2 inch pipe	
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Rosemount	Endress+Hauser
	51	Model Number 1	Model Number 2	3051	PMP51
	52	3-Valve SS Manifolds Mounted		316 stainless steel	
	53	Purchase Note		1 year warranty	

P09 **Pressure Transmitter**	**706370 - SAN JOSE HEADWORKS** **12PIT9706-04**

OPPID Reports - P09 Pressure Transmitter

GENERAL	1	Tag Number	P&ID	12PIT9726-02	7701-09-N-038_706370
	2	Loop Title		HW3 Recycle Pump Station - Pump 2 Pressure	
	3	Area Classification		Class I - Division II	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
PROCESS CONDITIONS	6	Fluid		Pumped Drainage	
	7	Min Pressure	Max Pressure		
	8	Temperature			
	9	Specific Gravity	Viscosity		
	10	Conductivity	Density		
	11	Vapor Pressure	Critical Pressure		
ELEMENT	12	Element Type		Ceramic Diaphragm	
	13	Element Material			
	14	Body Rating			
	15	Instrument Body Material		AISI 316L	
	16	Wetted Materials		AISI 316L	
	17	Process Connection		0.5 inch NPT	
	18	Measurable Limits			
	19	Ambient Temperature Limits		-40 degF to 175 degF	
	20	Process Temperature Limits		-40 degF to 250 degF	
	21	Wetted O-Ring Material			
SEAL	22	Type		Annular	
	23	Process Connection		0.75 Inch NPT	
	24	Body Material		Carbon Steel	
	25	Diaphragm/Sleeve Material		Buna-N	
	26				
	27	Capillary Material			
	28	Capillary Length			
	29	Fill Fluid		Glycerine	
	30	Flushing Connection		No	
	31				
	32	Manufacturer			
	33	Model Number			
TRANSMITTER	34	Mounting		Wall	
	35	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	36	Power Supply	Voltage	2 - Wire	24 VDC
	37	Output Signal		4 to 20 madc	
	38	Communication Protocol		HART	
	39	Range			
	40				
CALIBRATION	41	Calibrated Range			
	42	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	43	Zero Elevated or Suppressed			
	44	Zero Reference			
	45	Accuracy	Repeatability	+/- 0.1 Pct of Span	
OPTIONS	46	Multi-Valve Manifold		Yes	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Mounting Bracket		2 inch pipe	
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Rosemount	Endress+Hauser
	51	Model Number 1	Model Number 2	3051	PMP51
	52	3-Valve SS Manifolds Mounted		316 stainless steel	
	53	Purchase Note		1 year warranty	

P09 **Pressure Transmitter**	**706370 - SAN JOSE HEADWORKS** **12PIT9726-02**

OPPID Reports - P09 Pressure Transmitter

GENERAL	1	Tag Number	P&ID	14PIT9726-01	7701-09-N-038_706370
	2	Loop Title		TBD	
	3	Area Classification		Class I - Division II	
	4	Line Number	Equipment Number		
	5	Line Size	Line Schedule		
PROCESS CONDITIONS	6	Fluid		Pumped Drainage	
	7	Min Pressure	Max Pressure		
	8	Temperature			
	9	Specific Gravity	Viscosity		
	10	Conductivity	Density		
	11	Vapor Pressure	Critical Pressure		
ELEMENT	12	Element Type		Ceramic Diaphragm	
	13	Element Material			
	14	Body Rating			
	15	Instrument Body Material		AISI 316L	
	16	Wetted Materials		AISI 316L	
	17	Process Connection		0.5 inch NPT	
	18	Measurable Limits			
	19	Ambient Temperature Limits		-40 degF to 175 degF	
	20	Process Temperature Limits		-40 degF to 250 degF	
	21	Wetted O-Ring Material			
SEAL	22	Type		Annular	
	23	Process Connection		0.75 Inch NPT	
	24	Body Material		Carbon Steel	
	25	Diaphragm/Sleeve Material		Buna-N	
	26				
	27	Capillary Material			
	28	Capillary Length			
	29	Fill Fluid		Glycerine	
	30	Flushing Connection		No	
	31				
	32	Manufacturer			
	33	Model Number			
TRANSMITTER	34	Mounting		Wall	
	35	Enclosure NEMA Rating		NEMA 4X; Coated Aluminum	
	36	Power Supply	Voltage	2 - Wire	24 VDC
	37	Output Signal		4 to 20 madc	
	38	Communication Protocol		HART	
	39	Range			
	40				
CALIBRATION	41	Calibrated Range			
	42	Vendor Calibration		Factory calibrate - Provide calibration certificate	
	43	Zero Elevated or Suppressed			
	44	Zero Reference			
	45	Accuracy	Repeatability	+/- 0.1 Pct of Span	
OPTIONS	46	Multi-Valve Manifold		Yes	
	47	Tagging		Stainless steel tag with Tag Number	
	48	Mounting Bracket		2 inch pipe	
	49				
PURCHASE	50	Manufacturer 1	Manufacturer 2	Rosemount	Endress+Hauser
	51	Model Number 1	Model Number 2	3051	PMP51
	52	3-Valve SS Manifolds Mounted		316 stainless steel	
	53	Purchase Note		1 year warranty	

P09 **Pressure Transmitter**	**706370 - SAN JOSE HEADWORKS**
	14PIT9726-01

SECTION 40 91 01
CONTROL STRATEGIES

PART 1 GENERAL

1.01 DESCRIPTION

A. Control strategies will be configured and programmed by the Contractor selected City preapproved Software System Integrator (SSI). The SSI shall coordinate with the Contractor to verify inputs and outputs at each DCU/Marshalling Panel. The Contractor shall provide qualified and experienced electricians to assist loop and wiring continuity check with the SSI. The Contractor shall rectify and correct loop and wire problems as identified by the SSI and Jacobs' Engineer.

B. This section specifies control strategies for the Distributed Control System (DCS system). Control strategies describe sequential and interlocking control functions, analog control functions, color-graphic video display operator interfaces and alarm and event logging. The SSI shall provide all necessary software and applications programming to implement the control strategies. The existing wastewater treatment plant control logic shall be maintained except as modified/expanded in the Contract Documents.

C. On each control strategy, the required functions are described for the DCS console monitoring, display, control, and alarms. See the referenced P&ID and related drawings for the required quantity. For example, if on the reference P&ID, three pumps are shown, then the required functions shall be applicable to three pumps. Each pump related instrument shall have unique tag numbers.

1.02 REFERENCES

A. The following is a list of standards and guidelines which may be referenced in this section:

1. City of San José RWF Automation Guidelines, AG-RWF-004 Distributed Control System Guidelines and AG-RWF-007, CIP Project Execution Guidelines for Automation.
2. National Fire Protection Association (NFPA): 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
3. Drawings:

Drawing	Description
N-001-09	EBOS [Emergency Basin Overflow Structure] P&ID
N-002-09	EOB [Emergency Overflow Basin] P&ID
N-003-09	Plant Influent P&ID
N-005-09	HW3 Influent Channel P&ID
N-006-09	HW3 Screening P&ID

Drawing	Description
N-007-09	HW3 Screenings Effluent Channel P&ID
N-008-09	HW3 Screenings Handling 1-2 P&ID
N-009-09	HW3 Screenings Handling 3-4 P&ID
N-012-09	HW3 Raw Sewage Pump 1 P&ID
N-013-09	HW3 Raw Sewage Pump 2 P&ID
N-014-09	HW3 Raw Sewage Pump 3 P&ID
N-015-09	HW3 Raw Sewage Pump 4 P&ID
N-016-09	HW3 Raw Sewage Pump 5 P&ID
N-019-09	HW3 Grit Basins 1-2 P&ID
N-020-09	HW3 Grit Basins 3-4 P&ID
N-021-09	HW3 Grit Basins 5-6 P&ID
N-022-09	Grit Handling 1 P&ID
N-023-09	Grit Handling 2 P&ID
N-024-09	Grit Handling 3 P&ID
N-025-09	Grit Handling 4 P&ID
N-026-09	Grit Handling 5 P&ID
N-027-09	Grit Handling 6 P&ID
N-028-09	HW3 Grit Conveyance P&ID
N-030-09	California Structure P&ID
N-031-09	Primary Influent Loop P&ID
N-033-09	HW3 Odor Control Collection P&ID
N-034-09	HW3 Odor Control P&ID
N-037-09	Recycle Pump Station 1 P&ID
N-038-09	HW3 Recycle Pump Station P&ID
N-039-09	Miscellaneous P&ID
N-040-09	Switchgear P&ID

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONTROL STRATEGIES

A. The Control Strategies shall be based on the requirements of the City of San José RWF Automation Guidelines, AG-RWF-004, Distributed Control System Guidelines.

B. The following template that is located in City of San José RWF Automation Guidelines; AG-RWF-007, CIP Project Execution Guidelines for Automation; Appendix C – Control Strategy, shall be used for all project Control Strategies.

3.02 SUPPLEMENT

A. The supplement listed below, following "End of Section," is part of this Specification.

1. Process Control Narratives.

END OF SECTION

PROCESS CONTROL NARRATIVES

1.0 PURPOSE

Influent wastewater is delivered from the collection system to the San José-Santa Clara Regional Wastewater Facility (RWF) at the Emergency Basin Overflow Structure (EBOS). The raw sewage enters the EBOS structure either directly from Interceptors 2, 3, and 4, and Spreckles force mains, or indirectly from Milpitas, Santa Clara, and Lamplighter force mains through various onsite junction structures. From EBOS, raw sewage flows to Headworks 3 (HW3) and/or Headworks 2 (HW2) where preliminary treatment is provided. The Headworks facilities regulate the influent flow to the RWF as well as treat the influent wastewater through screening and grit removal. Screening removes large objects from the flow. Grit basins remove sand and gravel which otherwise may cause damage to pumps and other equipment. The Headworks facilities also include raw sewage pumping which pumps the wastewater up to a sufficient grade-line so that it flows by gravity to the primary clarification process. HW3 raw sewage pumps deliver screened wastewater to an elevated Grit Removal facility. The degritted raw sewage then flows by gravity to the California Structure. HW2 raw sewage pumps receive screen and degritted wastewater and pump to the California Structure.

An Odor Control system is located at HW3 which collects and treats odors generated from the processes. The Odor Control System is sized to ensure proper odor containment and prevent fugitive odors.

Two Recycle Pump Stations are included in the project. The Recycle Pump Stations are located near the existing Pie structure and Headworks 3. The pump stations collect storm water and process drainage and pump to the process.

2.0 REFERENCES

Drawing	Description
N-001-09	EBOS [Emergency Basin Overflow Structure] P&ID
N-002-09	EOB [Emergency Overflow Basin] P&ID
N-003-09	Plant Influent P&ID
N-005-09	HW3 Influent Channel P&ID
N-006-09	HW3 Screening P&ID
N-007-09	HW3 Screenings Effluent Channel P&ID
N-008-09	HW3 Screenings Handling 1-2 P&ID
N-009-09	HW3 Screenings Handling 3-4 P&ID
N-012-09	HW3 Raw Sewage Pump 1 P&ID
N-013-09	HW3 Raw Sewage Pump 2 P&ID
N-014-09	HW3 Raw Sewage Pump 3 P&ID
N-015-09	HW3 Raw Sewage Pump 4 P&ID
N-016-09	HW3 Raw Sewage Pump 5 P&ID
N-019-09	HW3 Grit Basins 1-2 P&ID

Drawing	Description
N-020-09	HW3 Grit Basins 3-4 P&ID
N-021-09	HW3 Grit Basins 5-6 P&ID
N-022-09	Grit Handling 1 P&ID
N-023-09	Grit Handling 2 P&ID
N-024-09	Grit Handling 3 P&ID
N-025-09	Grit Handling 4 P&ID
N-026-09	Grit Handling 5 P&ID
N-027-09	Grit Handling 6 P&ID
N-028-09	HW3 Grit Conveyance P&ID
N-030-09	California Structure P&ID
N-031-09	Primary Influent Loop P&ID
N-033-09	HW3 Odor Control Collection P&ID
N-034-09	HW3 Odor Control P&ID
N-037-09	Recycle Pump Station 1 P&ID
N-038-09	HW3 Recycle Pump Station P&ID
N-039-09	Miscellaneous P&ID

4.0 SYSTEM DESCRIPTION

4.1 Overall Flow Management

Raw sewage enters the site at several locations. However, the flows eventually converge at the Emergency Basin Overflow Structure (EBOS). From the EBOS, raw sewage flow is routed to Headworks 3 (HW3) and Headworks 2 (HW2). Flow is normally routed to HW3 until influent flow approaches the capacity of HW3. Operations staff will decide when to bring HW2 online to treat flows exceeding the capacity of Headworks 3. In some cases, all major equipment in HW3 will be available so HW3 would have a capacity of approximately 260 MGD. If a major piece of equipment is out-of-service, then HW3 capacity is at least 209 MGD. There may also be a particular scenario where Operations has decided that the capacity is less than 209 MGD and chooses to start HW2 at lower raw sewage flows.

As HW2 is brought online, the Santa Clara Force Main will be rerouted to discharge into Santa Clara Structure No. 2. To keep water surface elevation low at high flows, a portion of the influent flow can bypass the EBOS and flow directly from Santa Clara Structure No. 1 into HW2.

While HW3 and HW2 are operating at the same time, HW2 Raw Sewage Pumps will be operated at a constant speed to remove a mostly constant flow from EBOS. The remaining diurnal variation in flow will be pumped by the HW3 Raw Sewage Pumps. While both pump stations are operating, the one point of common water level will be in the EBOS. Two new level elements are installed at EBOS to be used to control the pump stations while in parallel operation. Further modeling of the system will occur as the design progresses. The modeling will provide operating ranges and basis of control for the pumps.

4.2 HW3 Screenings Removal

INFLUENT SCREENS:

HW3 includes three front-cleaned multi-rake bar screens which will remove small solids, larger than 3/8-inch, from the raw sewage flow allowing screened effluent to pass to the raw sewage pumps. Redundant upstream and downstream level measurement will be provided for the combined upstream and downstream channel levels.

Operator will select the number of units in operation, or operate the screens in a LEAD/LAG/STANDBY configuration. In the LEAD/LAG/STANDBY configuration, the screen channels will operate based on an operator entered flow setpoint using the totalized flow from the raw sewage pumps. If the totalized flow is less than the influent flow setpoint, then the influent gates for the LEAD screen will be OPEN and the gates for the LAG screen will be CLOSED. If the actual flow rises above the flow setpoint, the LAG screen influent gate will OPEN to accommodate the higher flows. The effluent gate for each screen will remain OPENED during normal operation and only be CLOSED when a screen is out of service for maintenance.

Normal cleaning operation of the IN-SERVICE screens will be based on a repeat cycle timer where the screens will be sequentially progress through each cleaning cycle upon completion of the OFF-TIME. If during the OFF-TIME, a HIGH DIFFERENTIAL LEVEL condition exists, the IN-SERVICE screens will initiate a cleaning cycle.

In addition, the screen cleaning speed can be adjusted from SCADA based on the screens upstream level. When level reaches HIGH LEVEL and the cleaning cycle begins, the screen cleaning will operate at operator-entered minimum speed (initially set at 50 percent) and increased to 100 percent as the level increases to operator-entered maximum level. In the case that a HIGH LEVEL is not cleared, and the cleaning speed has reached its maximum speed, the LAG screen channel will be brought into service, and an alarm at SCADA will be provided to notify Operations.

INFLUENT SCREENINGS HANDLING:

Four screenings compactors will receive wet screenings and carrier water (Service Water) from the screenings sluice trough. The compacted screenings are deposited into dumpsters.

The water for the screenings sluice trough will be run based on operation of the IN-SERVICE screen cleaning status and will remain ON based on an Operator adjustable timer to clear the screenings from the sluice after the screen cleaning cycle is stopped. The screenings trough water and screenings into the washer compactors.

The system is designed so that two of the four Screenings Compactors operate together whenever a screen is IN-SERVICE. Two of the Screenings Compactors will be in a STANDBY condition. A knife gate is included in the sluice to isolate the two downstream Screenings Compactors. The Screenings Compactors operate as an “upstream” pair and a “downstream” pair. Operator will select which pair of Screenings Compactors operate.

The Screenings Compactors will operate in a continuous mode when a Screen is in a cleaning mode (or sluice water is ON) and will continue to operate for an operator-entered period time after the Screen stops to continue processing the material conveyed by the sluice. In continuous mode, the controls will run the screenings washer compactors continuously in the forward direction to immediately discharge the high screenings load from the compactor unit.

When a Screenings Compactor is operating, its respective washwater valve will open to provide supplemental water for cleaning the screenings per the manufacturer's design.

4.3 Raw Sewage Pump Station 3

RAW SEWAGE PUMPING:

HW3 will have five variable-speed vertical turbine solids-handling pumps. Raw Sewage Pump Station 3 pumps raw sewage from five wet wells to the grit basin influent channel. The wet wells are hydraulically connected via a common influent channel and motorized gates. The gates will normally be CLOSED so that material does not accumulate in the bottom of the individual pumps that are not operating. The gates will open as part of the pump start sequence..

The wet well level will be allowed to rise and fall within a preset range or bandwidth by adjusting the speed and number of operating influent pumps. In addition, a periodic cleaning cycle will be implemented to temporarily raise the wet well level to the highest operating setpoint and then temporarily lower the wet well level to the lowest operating setpoint to remove floating debris and sediment from the wet well.

Influent pumps operate at variable speed with flow measured by a flow meter on the discharge of each pump. The flow from each of the five pump flowmeters will be summed and displayed on SCADA.

Four pumps will be operated in a sequential operation, with the fifth pump available as a standby pump. The pumps will operate to maintain the wet well level. If the operating pumps exceed 95 percent for a set period without reaching the level set point, an additional pump will be called to run. Likewise, if the operating pumps' speed are below X percent (to be determined, initially set for 50 percent) for a set period of time without reaching the level set point, a pump will be called to stop. The transition between pumps shall provide a flow surge not to exceed 5 percent as measured by the sum of pump flow meters to create a "bumpless" transition.

4.4 HW3 Grit Removal

GRIT REMOVAL:

The grit separation and handling process will remove inert particulate matter from the screened raw sewage to reduce abrasive wear to downstream equipment and reduce the amount of material that settles in the primary, secondary, and solids processing tanks. Removed solids consist of grit along with some organic materials.

The grit removal system includes six grit basins, each equipped with stacked, conical trays. Grit collects at the bottom of each basin and is pumped by six grit pumps to dedicated grit washer and classifying system. The grit classifiers discharge to grit dumpsters.

Screened raw sewage from the common influent channel will flow into the individual grit basin influent channels. Operators will select the number of and which Grit Basins are IN-SERVICE. Each Grit Basin will have a motor actuated influent gates to bring the grit basin in and out of service. Screened raw sewage will flow into the grit basin where particulate matter (e.g., sand, small rock, etc.) will settle as flow passes through the chamber.

When a Grit Basin is brought online, the dedicated grit pump will be sequenced ON in such a way as to not allow grit accumulation while the gate is opening and the basin filling. And when a Grit Basin is taken offline, the dedicated grit pump will continue to operate for an adjustable period of time after the influent gate is closed to remove as much grit from basin as possible.

When a Grit Basin is online, the flow through the basin will be calculated by level over the effluent weir. The flow value will be used to coarsely balance the flow split through the Grit Basins. If the flow split various by approximately 10 percent, the basins receiving the high flow will have their influent gate throttled closed. Balancing of the flow will be based on long flow averaging to avoid influent gates continuously hunting.

Each Grit Basin includes a supplemental source of water for fluidizing the collected grit and to help flush out some organic material that may have settled with the grit. This flushing water has a motorized valve which shall open when the Grit Basin is in-service as determined by the position of the Grit Basin's influent gate.

Effluent from each Grit Basin will collect in the Grit Basin Effluent Channel. Flow is routed to the primary clarifier system, or to the Emergency Overflow Basin (EOB). Effluent to the EOB can be diverted through a manually controlled sluice gate. But if water level is high enough in the effluent channel, then it will flow over an overflow weir.

GRIT HANDLING:

Grit slurry from the Grit Basin will be pumped to Grit Washers to separate the solids from the water. The conveyance system consists of six constant-speed recessed impeller Grit Pumps; one pump dedicated to each Grit Basin. The pumps discharge to a dedicated Grit Washer, so that a Grit Basin, Grit Pump and Grit Washer operate as a train.

When a Grit Basin is IN-SERVICE, its dedicated Grit Pump will operate continuously to send grit to its respective Grit Washing unit. An automated motorized flushing water valve at each Grit Basin will be provided to discharge flushing and fluidizing water near the bottom of each Grit Basin. The flushing valves will automatically open to fluidize the grit during pump operation.

Grit slurry from each Grit Pump will discharge into a Grit Washer system where grit will be washed, dewatered, and discharged to the grit dumpsters. The Grit Washer is a conical tank where grit slurry enters the top of the tank, the majority of the water overflows an internal weir near the top of the tank, a portion of water is periodically removed from mid-depth by opening a blow-down valve, and the grit is removed from the bottom of the tank. The sequence of operation of the Grit Washer components will be coordinated with the manufacturer.

Each Grit Washer includes a stirring mechanism to help dislodge organics from the grit. Supplemental plant water enters the bottom of the tank creating an upflow which further separates the grit particles from the remaining liquid and settle them to the bottom of the tank. Grit is transported from the tank bottom up an inclined ramp by a screw conveyor, where it will be dewatered and deposited into a dumpster.

The Grit Washer stirrer will automatically start and run continuously while the associated Grit Pump is running. The screw conveyor will also automatically start and stop per manufacturer's instruction. The Grit Washer will remain ON for a fixed preset time once the Grit Pump has turned OFF.

An automated motorized blow-down valve on each Grit Washer will OPEN and CLOSE based on the Grit Washer being ON, and per manufacturer's recommended sequencing. The operator will enter frequency and duration that the valve is OPEN and CLOSED.

Automated solenoid valves will be provided on the flushing plant water supply lines to each grit washer. These valves will OPEN when the associated grit washer is operating and will remain open for a predetermined period after the grit washer is shut off.

A manufacturer supplied level switch will be provided with each grit washer to detect a grit level in the unit. In addition, a LOW SPEED condition on the screw conveyor will shut down that screw conveyor to protect the equipment.

Further coordination with the equipment manufacturer will occur.

4.5 HW3 Odor Control

ODOR CONTAINMENT:

Sources at HW3 considered odorous will be covered or contained. The Raw Sewage Pump Station 3, influent channels, and grit basins will be fully enclosed with concrete lids. Similarly, equipment including grit classifiers, screenings washers, and sluiceway, and screenings will be provided with covers for odor containment. The septage receiving station will be provided with loadout openings in the floor with temporary removal covers. Finally, grit bins and screenings bins will be provided with hinged lids for covering bins when full or not in use. Bins may be provided with permanent covers in the future if deemed necessary from a fugitive odor impact standpoint.

FOUL AIR EXTRACTION:

Foul air will be extracted from all key odor sources at HW3. These sources along with airflows and air changes per hour are summarized in the table below.

Source	Airflow (cfm)	Air Changes per Hour (ACH)
Headworks Channels	1700	> 6
Grit Basins	3230	> 6
Raw Sewage Wet Well	2320	> 6
Grit Classifiers	610	> 20
Screenings Sluiceway and Washers	300	> 20

Source	Airflow (cfm)	Air Changes per Hour (ACH)
Septage Receiving	600	> 6
Grit Dumpsters	710	> 20
Screenings Dumpsters	520	> 20
cfm = cubic feet per minute		

All ductwork connected to key sources will be provided with isolation/balancing dampers to allow for system balancing as well as source isolation when processes are taken down for maintenance.

FOUL AIR TREATMENT:

A biotrickling filter (BTF) odor control system will be provided for removal of all targeted odorants and for meeting both regulatory and plant-specific offsite odor goals. The BTF system will consist of the following components:

- BTF vessel
- Duty and standby foul air exhaust fans
- Water control panel with nutrient feed pump
- Nutrient feed tank
- BTF recirculation pump

Each of these system components are further described below.

BTF Vessel: The BTF vessel will consist of synthetic media bed, spray nozzles, mist eliminator, and vessel access hatches. The odor removal mechanism is biological in which microbes reside on the media substrate within a biofilm layer. Odorants enter the media from the bottom and are absorbed into the biofilm and subsequently biological oxidized to benign non-odorous byproducts. Microbial colonies in the lower portion of the media bed consist of acid resistant types (e.g., autotrophic such as thiobascillus) while the upper portions of the bed consist of heterotrophic (pH neutral) bacteria. Leachate is drained out the bottom and can be acidic in nature.

Exhaust Fans: Duty and standby exhaust fans will be constructed of fiberglass reinforced plastic (FRP) and will deliver foul air to the BTF vessel. Each fan will be equipped with variable frequency drive (VFD) motor.

Water Control Panel: The BTF system will include a water control panel consisting of basket strainer, pressure regulating valve, flow meter, solenoid valve, piping and valving, and nutrient feed pump.

Nutrient Feed Tank: A nutrient feed tank will be provided for ensuring a minimum of 4 weeks of nutrient storage.

BTF Recirculation Pump: A recirculation pump will be provided for allowing recirculation of BTF leachate during start-up and acclimation functions. This pump will remain as a permanent unit to allow the City to utilize this pump in the future in case re-acclimation becomes necessary.

When the BTF system is in-service, its duty exhaust fan will operate continuously to extract foul air from all key sources and deliver this air to the BTF vessel for treatment. The duty and standby exhaust fan modes will alternate automatically to ensure equal run times. VFDs will maintain the required airflow. Airflow will be calculated by measured differential pressure across each fan and the fan speed. If the duty fan fails (as measured by its respective pressure differential transmitter) then the standby fan will automatically start in duty mode and an alarm will be initiated.

Differential pressure transmitters across the BTF vessel will alert operators in case of a high-pressure condition.

The nutrient metering pump located in the Water Control Panel will START and STOP based on the BTF System being ON, and per manufacturer's recommended sequencing. The Operator will enter frequency and duration that the unit is STARTED and STOPPED.

An automated motorized irrigation valve located in the Water Control Panel will OPEN and CLOSE based on the BTF System being ON, and per manufacturer's recommended sequencing. The Operator will enter frequency and duration that the valve is OPEN and CLOSED.

The BTF recirculation pump will START and STOP based on the BTF System being on and the mode of operation (once-through or recirculation modes). The Operator will enter the operation mode.

A low-level switch at the nutrient tank will be provided to detect a low-level condition to warn operators that the nutrient tank is in need to filling.

4.6 Recycle Pump Station 1

Recycle Pump Station 1 will include four variable-speed submersible pumps. The pump station will receive recycle streams from the stormwater system, sanitary sewer drains and process drains.

The pumps will be configured as LEAD/LAG1/LAG2/LAG3. Operations will select the LEAD/LAG1/LAG2/LAG3 pumps. At HIGH LEVEL, the LEAD pump will start and operate at a maximum speed to reduce the level to OFF setpoint. As the level decreases, the speed setpoint of the pump will decrease to a minimum speed at the OFF setpoint. If the LEAD pump is operating, and the level rises, the LAG1 pump will start at HIGH-HIGH LEVEL and operate at a maximum speed. This will be repeated for the LAG2 and LAG3 pumps. As level decreases, the speed setpoint of the LAG pumps will decrease to a minimum speed at the LAG OFF setpoints and will shut off the LAG pumps in sequence until only the LEAD pump remains. The LEAD pump will shut off at a LEAD OFF setpoint.

There is a level switch in the wet well which will send a HIGH-LEVEL alarm to SCADA.

4.7 Headworks 3 Recycle Pump Station

Stormwater, sanitary sewer and occasionally process drainage from the Grit Basins generated at HW3 is collected at the recycle pump station wetwell and is pumped back to EBOS. The HW3 Recycle Pump Station will be located adjacent to the Raw Sewage Pump Station and includes two large variable-speed submersible pumps (Pumps 1 and 2) and one small constant speed submersible pump (Pump 3).

Pump 3 will be installed in a small sump within the wet well. All three pumps will be controlled by a level transmitter with a stilling well located in the small sump. The wet well will contain Pumps 1 and 2 which will be configured as (LEAD/LAG).

Pump 3 will start at a HIGH level and stop on a LOW LEVEL. As the inflow to the sump rises into the wet well due to storm drain inflows above the capacity of Pump 3, the level will continue to rise into the large pump wet well. Pump 3 will continue to run.

For Pumps 1 and 2, Operations will select the LEAD pump. At HIGH LEVEL in the Wet well, the LEAD pump will start and operate at a maximum speed to reduce the level to OFF setpoint. As the level decreases, the speed setpoint of the pump will decrease to a minimum speed at the OFF setpoint. If the LEAD pump is operating, and the level rises, the LAG pump will start at HIGH-HIGH LEVEL and operate at a maximum speed. As level decreases, the speed setpoint of the LAG pump will decrease to a minimum speed at the LAG OFF setpoint. Then the small pump will start and drain the sump.

There is a level switch in the wet well which will send a LEVEL HIGH alarm to SCADA.

SECTION 40 95 80
NETWORK COMMUNICATION SYSTEM

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:
   1. BICSI: Building Industry Consulting Services, International.
   2. Electronic Components, Assemblies, and Materials Association (ECA): 310-E, Cabinets, Racks, Panels, and Associated Equipment.
   3. Institute of Electrical and Electronic Engineers, Inc. (IEEE): 802.3, Telecommunications and Information Exchange Between Systems—Local and Metropolitan Networks.
   4. Insulated Cable Engineers Association (ICEA): S-104-696, Indoor-Outdoor Optical Fiber Cable.
   5. International Organization for Standardization (ISO): 9001, Quality Management Systems—Requirements.
   6. International Telecommunication Union (ITU): T G.652, Characteristics of a Single-mode Optical Fibre and Cable.
   7. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
   8. Telecommunications Industry Association (TIA):
      a. 526-7, OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.
      b. 526-14, OFSTP-14 Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
      c. 568-C.1, Commercial Building Telecommunications Cabling Standards.
      d. 568-C.3, Optical Fiber Cabling Components Standard.
      e. 598, Optical Fiber Cable Color Coding.
      f. 606, Administration Standard for Commercial Telecommunications Infrastructure.
   9. Telecommunications Industry Association/Electronics Industry Association (TIA/EIA):
      a. 492AAAC, Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers.
      b. 604-2, FOCIS-2, Type ST.
      c. 604-3, FOCIS-3, Type SC and SC-APC.
      d. 604-10, FOCIS-10, Type LC and LC Duplex.
   10. UL: 94, Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.02 DEFINITIONS

A. Definitions of abbreviations used:

1. CAT6: Category 6 Network Cable.
2. CCTV: Closed Circuit Television.
3. dB: Decibel.
4. EMB: Effective Modal Bandwidth.
5. FOCS: Fiber Optic Communication System.
6. Hybrid Cable: Cable containing more than one type of fiber.
7. m: Meter.
8. Mbps: Megabits per Second.
9. Mechanical Splice: Connecting ends of two fibers together by means other than fusion.
10. Micron: Micrometer or one millionth meter.
11. MIS: xxxx.
12. n, nano: x 10^{-9}.
13. N: Newton.
14. nm: Nanometer—unit of measure equal to one billionth meter.
15. OFL: Over-filled Launch.
16. OFN: Nonconductive Optical Fiber Cable.
17. OFNP: Nonconductive Optical Fiber Plenum Cable.
18. OFNR: Nonconductive Optical Fiber Riser Cable.
19. OLTS: Optical Loss Test Sets.
20. OTDR: Optical Time Domain Reflectometer.
21. Plant SCADA System: Plant Supervisory Control and Data Acquisition System.
22. PP: Patch Panel.
23. PIC: Process Instrumentation and Control.
24. Plenum: Air return path of central air handling system, such as open space above suspended ceiling.
25. UPS: Uninterruptible Power Supply.
26. V ac: Volts Alternating Current.
27. WAN: Wide Area Network.

1.03 SYSTEM DESCRIPTION

A. This section covers requirements for communications networks.

1. The plant network(s) will be used by several systems including the security system, plant operations, and plant SCADA control system.
    a. FOCS: Function of the FOCS is to transmit digital data between the network nodes over fiber media. Requirements listed identify minimum acceptable system performance.

b. CAT6: Function of the CAT6 is to transmit digital data between the network nodes and devices over copper media. Requirements listed identify minimum acceptable system performance.

c. Refer to Block Diagrams and Electrical Plans on Drawings for illustration of the complete network.

d. Detailed network drawings will be developed by Jacobs during construction and shall be used for installation, testing, and labelling of all network cabling.

2. Subcontractor shall submit, provide, install, label, and test all network cabling. This shall include all FOCS and all CAT6 cabling. Refer to Drawings. Network Block diagrams illustrate the fiber cabling, CAT6 cabling, and network connections to the multiple systems.

3. Subcontractor shall provide network cabling, installation, and testing for the following network components that will be supplied by Jacobs:

a. Section 40 92 05, Programmable Logic Controllers.

b. Section 40 92 06, Network and Computer Components.

c. All network switch cabinets

4. Subcontractor shall provide network cabling, connection, labeling, and testing for the following network components and systems that will be supplied by others:

a. Section 26 13 13, Medium-Voltage Circuit Breaker Switchgear.

b. Section 26 19 23, Medium-Voltage Variable Frequency Drive System.

c. Section 26 24 19, Low-Voltage Motor control.

d. Section 26 29 23, Low-Voltage Variable Frequency Drive Systems.

e. Section 26 33 23, Battery Systems.

f. Section 28 31 00, Fire Detection and Alarm.

g. Section 40 99 90, Package Control Systems.

5. Subcontractor shall be responsible for connecting, labeling, and testing the entire network.

a. Subcontractor shall provide cable connections for the entire network, and all network components, including those as supplied by Jacobs, and as supplied by others.

b. Subcontractor shall be responsible for providing complete testing of the entire network, and all network components, including those provided by Jacobs, and by others.

c. Subcontractor shall provide terminations to, and communications through, components provided by Subcontractor, other systems, and Jacobs. This shall include testing, test documentation, and testing submittals for the entire completed network. The entire completed network is for all fiber optic cabling, all CAT6 cablings, all fiber and CAT6 terminations, and all components contained on the entire network.

d. Subcontractor shall be responsible for labeling every cable per requirements of TIA/EIA 606-A labeling standards.

e. Cabling shall be installed per ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling.

6. Refer to network drawings and site electrical drawings for routing, cabling, terminations, locations, labeling, and all other information required for fiber optic and CAT6 installation and testing. Refer to detailed network drawings that will be developed by Owner during construction.

1.04 SUBMITTALS

A. Action Submittals:

1. Network Site Layout Diagrams showing access holes with identification belowgrade conduit routings, and innerduct routings, between the access holes, and buildings, with conduit identifications. Cable routing through innerducts and to patch panels, fiber centers, or network nodes, with cable and node identifications
2. Cable Schedule Showing:
   a. Cable identification.
   b. Fiber counts for each cable and identification of connected fiber pairs, including port identification.
   c. Cable length and attenuation, with two connector pairs and no splice(s), based on TIA 568-C.3, Annex H.
3. Component Data:
   a. Manufacturer and model number.
   b. General data and description.
   c. Engineering specifications and data sheet.
   d. Scaled drawings and mounting arrangements.

B. Informational Submittals:

1. Manufacturer's statement that installer is certified to perform installation Work.
2. Subcontractor Qualifications:
   a. FOCS Subcontractor: Minimum of 5 years' experience providing, integrating, installing, and commissioning of similar systems.
      1) Statement of Experience: List of at least three fiber optic data communications systems comparable to system specified which have been furnished and placed into operation. For each system, provide following information:
         a) Owner's name, address, telephone number, and name of current operations supervisor or other contact.
         b) Description of system hardware configuration including major equipment items, number of nodes, and communication standards implemented.
         c) System block diagram.
         d) Fiber and termination identification, including spares.

b. FOCS Subcontractor's Site Representative: Minimum of 5 years' experience installing similar systems. Lead cabling installation personnel shall have BICSI Installer 2 or Technician certification.

c. Qualification of Personnel:

1) Resumes identifying management and technical qualifications of supervisory, local service representative, and key personnel.

2) Qualification data of firm and persons to demonstrate capabilities and experience in the following areas:

a) Fiber optic cable handling and placement techniques.

b) Fiber optic splicing and installation of connections.

c) Attenuation testing procedures.

d. Owner acceptance of FOCS Subcontractor does not exempt FOCS Subcontractor from meeting Contract Document requirements nor does it give prior acceptance of subsystems, equipment, materials, or services.

e. Sample of Network Test Report, minimum 10 pages that Contractor generated in a previous project.

3. Testing and acceptance plan, 30 days prior to beginning of testing.

4. Network cable, network components, and network connection Tests:

a. Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.

b. Final Test Procedures: Final test procedures, test forms, and checklists.

5. Test Documentation: Signed test forms for FOCS and CAT6 network, including:

a. All FOCS and CAT6 networks.

b. All FOCS and CAT6 connections.

c. All FOCS and CAT6 components.

d. Fiber test results. Documentation covering fiber facility testing, not later than 2 days after testing, showing:

1) Manufacturer's tag of attenuation per fiber as recorded from OTDR reading before shipment.

2) Attenuation of each fiber plus connector after installation as recorded from OTDR with tracing.

6. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.

7. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Optical Fiber Cable:

1. Outside, Underground/Submerged: Minus 20 degrees C to 40 degrees C.

2. Outside, Overhead: Minus 20 degrees C to 60 degrees C.

3. Outside, Aboveground in Conduit: Minus 30 degrees C to 70 degrees C.

4. Inside: 0 degrees C to 40 degrees C.

B. CAT6 Cable: In accordance with Section 26 05 05, Conductors.

C. Equipment:
   1. Outside, Aboveground: Minus 30 degrees C to 50 degrees C.
   2. Control Rooms, Server Rooms, Electrical Rooms: 30 percent to 55 percent relative humidity, 10 degrees C to 30 degrees C.
   3. Other Interior Areas: 0 percent to 100 percent relative humidity, 5 degrees C to 40 degrees C.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Fiber Optic Cable:
      a. ISO 9001 or QF TL 9000 registered, whichever applies to material.
      b. Minimum of 20 years in manufacturing optical fiber cable in order to demonstrate reliable field performance.
   2. Fiber Optic Housing, Connector, and Jumper Cable: ISO 9001 and QF TL 9000 registered.
   3. CAT6:
      a. Cable: In accordance with Section 26 05 05, Conductors.
      b. RJ-45 Connector: In compliance with ISO-8877 and TIA 568 standards.

B. Installer Qualifications:
   1. Individuals with at least 3 years of experience with projects utilizing fiber optic cable in compliance with TIA 568-C.3.
   2. Lead cabling installation personnel shall have BICSI Installer 2, Optical Fiber certification.
   3. Certified by fiber cable manufacturer.

C. Tester Qualifications: Individuals with at least 3 years of experience with projects utilizing fiber optic cable in compliance with TIA 568-C.3. Qualified to test with an OLTS and an OTDR. BICSI Installer 2, Optical Fiber certification.

D. Provide connectors/coupling, splicing enclosures, mounting hardware, and miscellaneous accessories for fibers by same manufacturer.

1.07 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts:

Item	Quantity
Jumpers of each type and length needed	10

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.01 HYBRID MULTIMODE / SINGLE MODE FIBER OPTIC CABLE

A. A hybrid fiber optic cable meeting the requirements of the ANSI/TIA-568-C specification or latest revision of 62.5 MM OM1 and SM OS2 shall be utilized as the network backbone cable.

B. Multi-mode fiber shall be used for the DCS network and single-mode fiber shall be used for the MIS network.

C. The fiber optic cable shall meet the following minimum criteria:
   1. Hybrid Cable: 48 fibers per cable, including 24 – 62.5 micron multi-mode fiber strands and 24 – 8.3 micron single-mode strands.
   2. Multimode Cable: 12 fibers per cable, 62.5 micron multi-mode strands.
   3. Application: Indoor/outdoor rating.
   4. Tight-buffered.
   5. Nonmetallic, gel-free, dry water blocked, loose-tube fiber core with dielectric strength member enclosed by nonmetallic cross-ply sheath; requires buffer tubing.
   6. 62.5/125 micron core/cladding for multi-mode hybrid fiber.
   7. 6.25 micron core/cladding for multimode fiber.
   8. 385 MHz-km bandwidth at 850 nm wavelength for multi-mode fiber.
   9. 500 MHz-km bandwidth at 1,300 nm wavelength for multi-mode fiber.
   10. Riser-rated (FT4) inner and outer PVC jackets.

D. Manufacturer and Product:
   1. Corning Cable Systems; ALTOS Gel-free cable.
   2. “Or-equal.”

2.02 INNER DUCT

A. Innerduct:
   1. Function: Installs into conduit system to provide smooth, low-friction path through conduit, with only one cable per path to facilitate changing individual cables.

2. Features:
    a. Size and Count, in 4-inch Conduit: 25 mm or 32 mm; three per conduit.
    b. Type: Annular, corrugated innerduct.
    c. Material: HDPE.
    d. Color Code: Orange, blue, green, brown, white, or grey.
    e. Strength: Minimum 600-pound tensile strength, with no more than 5 percent ovalization at 600-pound tension.
    f. Lubrication: Prelubricated.
3. Manufacturers:
    a. Endocor.
    b. Dura-Line.

2.03 MIS SWITCH CABINET

A. Function: Provides secure place to terminate CAT6 cables, mounting of network servers, patch panels, and mounting of other network components.

B. Supplied by Jacobs in accordance with Drawings and Section 40 92 06, Network and Computer Components.

2.04 PATCH PANEL

A. Function: Provides secure place to terminate fiber optic cables, CAT6 cables, mounting of network servers, patch panels, and mounting of other network components.

B. Supplied by Jacobs in accordance with Drawings and Section 40 92 06, Network and Computer Components.

2.05 RACK-MOUNT HOUSINGS

A. Termination Housing:
1. Rack mountable connector housing.
2. Mountable in ECA 310-E compatible 465-mm or 592-mm rack.
    a. Size: 3U.
3. In accordance with design requirements of TIA 568-C.3 and polymer compounds flammability requirements of UL 94.
4. Manufactured using 16-gauge steel or equivalent for structural integrity.
5. Finished with wrinkled black powder coat for durability.
6. Provide black installation fasteners.
7. Add-on patch management tray.
8. Accepts up to 12 adapter plates, single-mode or multimode.

B. Splice Trays:
   1. Mountable in termination housing.
   2. Aluminum tray with clear polycarbonate cover for viewing.
   3. Fiber Count: 12 fibers minimum.

2.06 ADAPTER PLATES

A. Adapter Plates:
   1. Manufactured from 16-gauge cold rolled steel or injection-molded polycarbonate for structural integrity.
   2. Attached with two push-pull latches to allow quick installation and removal.
   3. Use for terminating field cables with connectors.
   4. Sleeves: Zirconia ceramic.
   5. Connector Type: LC unless otherwise shown.
   6. Offered in 6-fiber, 8-fiber, 12-fiber, 16-fiber, and 24-fiber versions.
   7. Mounting: Mountable in rack-mount housing or wall-mount FDU.

2.07 CONNECTORS

A. General:
   1. Comply with TIA/EIA 604-2, TIA/EIA 604-3, TIA/EIA 604-10A, and TIA 568-C.3.
   2. LC for single-mode connectors.
   3. LC for multimode connectors.
   4. Pull Strength: 0.2 N minimum.
   5. Durability: Sustain minimum 500 mating cycles without violating other requirements.
      a. Ferrules: Free-floating low loss zirconia ceramic.
      b. Polarizing key on duplex connector systems.
   6. Attenuation:
      a. In accordance with TIA 568-C.3.
      b. Maximum of 0.3 dB per connector.

2.08 PATCHCORDS

A. General:
   1. In accordance with TIA 568-C.3.
   2. Function: Connect fibers to network nodes, such as Ethernet switches.
   3. Type: Duplex.
   4. Fiber Characteristics: In accordance with requirements for fiber optic cable.
   5. Cable Configuration:
      a. Individual tight-buffer thermoplastic, fibers single or multimode, to match fibers being jumpered on.

b. Protected with Kevlar strength members and enclosed in thermoplastic jacket.

6. Length:
   a. Meet requirements of installation:
      1) 2 meters minimum at network racks.
      2) 3 meters minimum at field FDUs.
7. Connectors:
   a. As required by Article Connectors.
   b. On-axial Pull Strength: 33 N.
   c. Normal-to-Axial Pull Strength: 22 N.
8. Cable Rating: OFNR or OFNP.
9. Color: Per standards or as indicated.
10. Measured for insertion loss with the following values for each connector:
    a. LC typical of 0.1 dB and maximum of 0.3 dB.
    b. OM3 fiber shall be measured for insertion loss with the following values for each connector pair: Typical of 0.15 dB and maximum of 0.25 dB.

2.09 CAT6 CABLE

A. In accordance with Section 26 05 05, Conductors.

2.10 CONDUIT

A. In accordance with Section 26 05 33, Raceway and Boxes.

2.11 DATA AND TELEPHONE OUTLETS

A. CAT6 Outlet/Connector:
   1. Comply with FCC Part 68.5 and TIA/EIA 568-B.2-1 Category 6.
   2. UTP outlet/connector shall be UL 1863 listed, nonkeyed, four-pair, constructed of high impact rated thermoplastic housing, third-party verified, and shall comply with TIA/EIA Category 6 requirements.
   3. Terminate using a 110 style PC board connector, color-coded for both T568A and T568B wiring. Wire each jack T568A or as indicated.
   4. Shall comply with TIA/EIA-568-B.2-4.
   5. Cover Plates: Comply with UL 514C, and TIA/EIA 568-B.1; flush design constructed of high impact thermoplastic material. Provide stenciled lettering for voice and data circuits using thermal ink transfer process.
   6. Color Coding:
      a. Provide data and telephone outlets color coded by network function indicated on Drawings:
         1) SCADA Network: Blue.

2) MIS Network: Green.
3) Telephony: White.

2.12 ACCESSORIES

A. Hardware: Provide cable clamps, strain reliefs, blocking and grommet kits, closures, and fan outs for complete installation.

PART 3 EXECUTION

3.01 PREPARATION

A. Conduit:
   1. Ensure installed conduit system conforms to fiber optic system requirements, including:
      a. Conduits and Innerducts: Size and number.
      b. Access Holes, Handholes, and Pull Boxes: Location and size, to ensure cables and innerducts may be installed without exceeding manufacturer's limitations.
      c. Outlet Boxes: Size to coordinate with outlet cover plates for adequate volume and bend radius.
   2. Ensure duct bank, conduit, and other confined routing is free and clear of debris before cable placement.

B. Innerduct:
   1. In accordance with manufacturer's recommendations.
   2. In spare and installed buried fiber optic conduits.
   3. Install no more than one innerduct of each color in single conduit.
   4. Terminate innerducts in conduit with fabricated termination kits.
   5. Identify innerducts at both ends by methods such as color-coding or waterproof tags.
   6. Sealing:
      a. Cabled Innerducts: Seal cables into innerducts to stop ingress of water and grit with fabricated expansion seals that have separate seals for each cable.
      b. Innerduct to Conduit: Seal gaps between innerducts and conduit with sealing compound such as 3M Ductseal.
      c. Empty Innerducts: After installation, seal with fabricated expansion plugs to stop ingress of water and grit. Remove plugs as required to install cables.

3.02 INSTALLATION

A. General: Cabling shall be installed per ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling.

B. Fiber Optic Cable:
   1. Specified fiber counts, routing, origination, and terminating points are indicated on Drawings.
   2. Installation by manufacturer's certified installer.
   3. Install cables in accordance with manufacturer's requirements.
   4. Install cable directly from shipping reels. Ensure that cable is:
      a. Not dented, nicked, or kinked.
      b. Not subjected to pull stress greater than manufacturer's specification.
      c. Not bent to a radius below manufacturer's minimum bend radius.
      d. Not subjected to treatment that may damage fiber strands during installation.
   5. Cables per Conduit or Innerduct: One cable maximum per innerduct.
   6. Splices: Install fiber optic cables in unspliced lengths between fiber distribution units and network racks.
   7. Connector: Insertion loss on multimode connections exceeding 0.5 dB and 0.4 dB on single-mode connections not permitted.
   8. Identification:
      a. Identify cable on both ends, in access holes, and pull points.
      b. In accordance with TIA 606.
   9. Arrange cable, equipment, and hardware to provide neat appearance and accessibility for servicing.
   10. Access Holes:
      a. Provide supports for cables in access and handholes at minimum 600 mm centers along sides.
      b. While maintaining minimum bend radius, lace cables neatly to supports to keep them out of way of personnel.

C. Housings and FDUs: Install securely in rack panels or on wall as shown on Drawings.
   1. Provide supports for cables at minimum every 2 feet.
   2. While maintaining minimum bend radius, lace cables neatly to supports to keep them out of way of personnel.

D. Cable Terminations:
   1. In accordance with TIA 568-C.3.
   2. Fan out loose tube fiber cable to allow direct connectorization of connectors.
      a. Sleeve over individual fibers with transparent furcation tubes.
      b. At point of convergence of furcation tubes, provide strain relief with metal or high-density plastic fan-out collar.

3. Slack:
    a. Underground: 20-foot minimum at each termination point, in final manhole or hand hole before entering the building.
    b. Rack and FDUs: Minimum, 10-foot slack fiber at each end, coiled neatly in cable management equipment.
4. Connectors:
    a. Terminate 100 percent fibers in each cable to specified connector.
    b. Connect into fiber management system.
5. Lace fiber optics neatly in place, routed through wireways.

E. Switch Cabinets, Fiber Patch Panels: Install securely in field panels or enclosures as shown on Drawings.
1. Provide supports for cables at minimum every 2 feet.
2. While maintaining minimum bend radius, lace cables neatly to supports to keep them out of way of personnel.

F. CAT6 Cable:
1. Cable counts, routing, origination, and terminating points are indicated on Drawings.
2. Installation by certified installer.
3. Install cables and terminate cables in accordance with manufacturer's requirements.

G. Data and Telephone Outlets: Terminate UTP cable in accordance with TIA/EIA 568 B.2 and wiring configuration specified.

H. Patch Cords: Install securely in patch panels per manufacturer's instructions.

I. Conduit: Install in accordance with Section 26 05 33, Raceway and Boxes.

3.03 LABELING CONVENTIONS

A. Conform to TIA/EIA 606-A or to requirements specified by Owner or Owner's representative. At a minimum, every fiber cable and every fiber shall include unique number with label on both ends. All labels shall be included on all fiber drawings, cable schedules, and test reports.

3.04 FIELD QUALITY CONTROL

A. General:
1. Advise Jacobs' Engineer at least 48 hours in advance of each test. Jacobs' Engineer shall have option to witness and participate actively in tests.
2. In accordance with Section 01 91 14, Equipment Testing and Facility Startup.
3. Provide equipment, instrumentation, supplies, and skilled staff necessary to perform testing.

4. Outlets, cables, patch panels, and associated components shall be fully assembled and labeled prior to field testing.
5. Testing performed on incomplete systems shall be redone on completion of the Work.
6. Document Test Results: Confirm each cable has at least specified number of fibers that meet Contract Documents standards.
7. Confirm quantities and sizes of conduit and innerduct, in accordance with Contract Documents.

B. Scope:
1. Multimode Fibers: Test all fibers and terminations, inclusive of connectors and network components.
2. Single-mode Fibers: Test all fibers and terminations, inclusive of connectors and network components.
3. Cat6: Test all connections inclusive of connectors and network components.

C. Test Equipment:
1. Field test instruments shall have latest software and firmware installed.
2. Optical Fiber Cable Testers: Field test instrument shall be within calibration period recommended by manufacturer.
3. Optical Loss Test Set (OLTS):
   a. Single-mode optical fiber light source.
   b. Multimode optical fiber light source.
   c. Power meter.
   d. Length Measurement: Capable of measuring optical length of fiber using time-of-flight techniques.
4. Optical Time Domain Reflectometer (OTDR):
   a. Internal nonvolatile memory and removable memory device with at least 16 MB capacity for results storage.
   b. Serial and USB ports to transfer data to PC.
   c. Single-mode OTDR: 1,310 nm (plus or minus 20 nm) and 1,550 nm (plus or minus 20 nm) wavelengths.
   d. Multimode OTDR: 850 nm (plus or minus 20 nm) and 1,300 nm (plus or minus 20 nm) wavelengths.
5. Fiber Microscope:
   a. Magnification: 250X or 400X for end-face inspection.
6. Integrated OLTS, OTDR, and Fiber Microscope: Test equipment that combines into one instrument such as OLTS, OTDR, and fiber microscope may be used.

D. Conduit Test:
   1. Test and seal spare conduits.
   2. Conduit and Innerduct Testing:
      a. Blow full-diameter mouse through each spare conduit and innerduct to verify they are unrestricted over full length.
      b. If conduit is restricted over full length, advise Jacobs' Engineer.
   3. Documentation: Confirm conduit test As-Built Conduit/Innerduct Installation Form documentation includes details of innerducts.

E. Cable Testing:
   1. Test attenuation and polarity of installed cable plant with OLTS and installed condition of cabling system and its components with OTDR.
   2. Verify condition of fiber end face.
   3. Perform on each cabling link (connector to connector).
   4. Document Tests:
      a. OLTS dual wavelength attenuation measurements for single-mode and multimode links and channels.
      b. OTDR traces and event tables for single-mode and multimode links and channels.

F. Fiber Testing Parameters:
   1. Each cabling link shall be in compliance with the following test limits:
      a. Optical Loss Testing:
         1) Single-mode and Multimode Links:
            a) Calculate link attenuation by the formulas specified in TIA 568-C.1.
            b) Values for Attenuation Coefficient (dB/km) are listed in the table below:

Attenuation Coefficient				
Type of Optical Fiber	Wavelength (nm)	Attenuation Coefficient (dB/km)	Wavelength (nm)	Attenuation Coefficient (dB/km)
Single-mode	1,310	0.5	1,550	0.5
Multimode 62.5/125 µm	850	3.0	1,300	1.0

      b. OTDR Testing:
         1) Reflective Events: Maximum 0.75 dB.
         2) Nonreflective Events: Maximum 0.3 dB.

c. Magnified Endface Inspection:
   1) Visually inspect fiber connections for end-face quality.
   2) Scratched, pitted, or dirty connectors shall be diagnosed and corrected.

G. CAT6 Cable Testing:
   1. Electrical performance as required for TIA-568-B including wiremap, cable length, insertion loss, near end crosstalk, power sum near end crosstalk, equal level far end crosstalk, power sum equal level far end crosstalk, return loss, propagation delay, and delay skew.
   2. Physical installation shall be certified by the installer including location of cabling with respect to electrical noise and environmental conditions, grounding of devices, cable bending radii, cable supports, and terminations.

H. Diagnosis and Correction:
   1. Installed cabling links and channels shall be field tested and pass test requirements and analysis as described herein.
   2. Link or channel that fails these requirements shall be diagnosed and corrected.
   3. Document corrective action and follow with new test to prove corrected link or channel meets performance requirements.
   4. Provide final and passing result of tests for links and channels.

I. Acceptance: Acceptance of test results shall be given in writing after Project is tested and completed in accordance with Contract Documents and satisfaction of Owner.

J. Test Execution:
   1. Optical Fiber Cable Testing:
      a. Tests performed that use laser or LED in test set shall be carried out with safety precautions in accordance with LIA Z136.2.
      b. Link and channel test results from OLTS and OTDR shall be recorded in test instrument upon completion of each test for subsequent uploading to a PC in which administrative documentation may be generated.
         1) Record end-face images in memory of test instrument for subsequent uploading to a PC and reporting.
      c. Perform Testing:
         1) On each cabling segment (connector to connector).
         2) Using high-quality test cords of same fiber type as cabling under test.
            a) Test cords for OLTS testing shall be between 1 meter and 5 meters in length.

b) Test cords for OTDR testing shall be approximately 100 meters for launch cable and at least 25 meters for receive cable.

2. Optical Loss Testing (OLTS):
   a. Links:
      1) Test single-mode at 1,310 nm and 1,550 nm in accordance with TIA 526-7, Method A.1, One Reference Jumper or equivalent method.
      2) Test multimode at 850 nm and 1,300 nm in accordance with TIA 526-14A, Method B, One Reference Jumper or equivalent method.
      3) Perform tests in both directions.
3. OTDR Testing:
   a. Test backbone, horizontal, and centralized links at appropriate operating wavelengths for anomalies and to ensure uniformity of cable attenuation and connector insertion loss.
      1) Single-mode: 1,310 nm and 1,550 nm.
      2) Multimode: 850 nm and 1,300 nm.
   b. Test each fiber link and channel in one direction.
   c. Install launch cable between OTDR and first link connection.
   d. Install receive cable after last link connection.
4. Length Measurement:
   a. Record length of each fiber.
   b. Measure optical length using OLTS or OTDR.
5. Polarity Testing:
   a. Test paired duplex fibers in multifiber cables to verify polarity in accordance with subclause 10.3 of TIA/EIA 568-C.1.
   b. Verify polarity of paired duplex fibers using OLTS.
6. Test Results Documentation:
   a. Test results saved within field-test instrument shall be transferred into Windows-based database utility that allows for maintenance, inspection, and archiving of test records. These test records shall be uploaded to the PC unaltered.
   b. Available for inspection by Owner or Owner's representative during installation period. Submit within 5 working days of completion of tests on cabling served by a telecommunications room or of backbone cabling.
   c. Database for project shall be stored and delivered as electronic file prior to Owner acceptance of building. Provide software tools required to view, inspect, and print test reports.
   d. Circuit IDs reported by test instrument shall match label identification.

e. Provide electronic database for each tested optical fiber with the following information:
   1) Identification of Site.
   2) Name of test limit selected to execute stored test results.
   3) Name of personnel performing test.
   4) Date and time test results were saved in memory of tester.
   5) Manufacturer, model, and serial number of field test instrument.
   6) Version of test software and version of test limit database held within test instrument.
   7) Fiber identification number.
   8) Length for each optical fiber.
   9) Test results to include OLTS attenuation link and channel measurements at appropriate wavelength and margin; difference between measured attenuation and test limit value.
   10) Test results to include OTDR link and channel traces, and event tables at appropriate wavelength.
   11) Overall pass/fail evaluation of link-under-test for OLTS and OTDR measurements.

K. Communication System(s) Functional Tests:
   1. Upon completion of cable and component installation and testing, and upon acceptance of cable and component testing submittals, perform test of the entire network as a functional system.
   2. Test Execution:
      a. Confirm network can operate under load over a time duration using automatic testing equipment.
      b. Testing shall conform to RFC 2544 and RFC 6349.
         1) Throughput.
         2) Burst.
         3) Frame loss.
         4) Latency.

L. Drawings:
   1. Record Copy: Provide at end of Project.
      a. Include notations reflecting as-built conditions of additions and variations from Drawings provided, such as to cable path and termination point.
      b. Drawings are to incorporate test data imported from test instruments.

2. As-built Drawings:
   a. Include, but not limited to block diagrams, cable labeling, cable termination points, and installation details.
   b. Include field changes made up to construction completion.

END OF SECTION

SECTION 40 96 00
APPLICATIONS SOFTWARE

PART 1 GENERAL

1.01 WORK INCLUDED

A. General: Work performed by Systems Integrator Subcontractor includes design, furnishing, testing, documenting, training and starting up the Process Control and Integration (PCI) Applications software, complete.

B. Furnish complete operator workstations including but not limited to:
   1. Workstation Hardware:
      a. Computer.
      b. Monitors.
   2. Operating System software and license(s).
   3. Application Software and license(s).

C. Major applications software work items include:
   1. Work sequence and schedule.
   2. Applications software workshops.
   3. Applications software submittals.
   4. Coordination with Package Systems.
   5. Applications software development.
   6. Software testing.
   7. Software installation.
   8. O&M development.
   9. City training.
   10. Startup.

D. Reference City RWF Automation Guidelines for additional requirements related to RWF DCS hardware and software programming including communications, display and data format, display, and pop-up colors and controls, display navigation, tag point numbering and descriptions, and DCS and Programmable Logic Controllers (PLCs) functionality. RWF Automation Guidelines will be provided as part of the Project Bid Process. In the event of a contradiction between items in this Section and the RWF Automation Guidelines, the RWF Automation Guidelines take precedence.

1.02 DIVISION OF WORK

A. Systems Integrator Subcontractor: Employ a Software Supplier as indicated in Section 40 90 00, Instrumentation and Control for Process Systems, to implement the applications software specified herein.

B. Design-Builder: The Design-Builder shall have overall system responsibility.

1.03 DEFINITIONS

A. Abbreviations:
   1. ABB: ASEA Brown Boveri.
   2. DCS: ABB Distributed Control System.
   3. FT: Functional Test.
   4. I&C: Instrumentation and Control.
   5. I/O: Inputs and Outputs.
   6. O&M: Operation and Maintenance.
   7. P&ID: Process and Instrument Diagram.
   8. PC: Personal Computer.
   9. PCI: Process Control and Integration.
   10. PLC: Programmable Logic Controller.
   11. PMCS: Process Monitoring and Control Software.
   12. PT: Performance Testing.
   13. SCADA: Supervisory Control and Data Acquisition.
   14. SDT: Software Demonstration Test.
   15. SLC: Single Loop Controller.

B. Instructor Day: 8 hours of actual instruction time.

C. Loop Specifications: Lists and descriptions in Section 40 90 00, Instrumentation and Control for Process Systems, giving additional requirements for individual control loops.

D. Software:
   1. Programming of digital devices using all types of programming language.
   2. Configuring of digital devices using all types of configuring process.
   3. Programs or configuration data stored in read only memory, programmable read only memory, read/write memory, disk, tape, or other storage device.

E. Types of Software:

1. Standard Software: Software packages that are independent of project on which they are used. Standard software includes system software and process monitoring and control software.
    a. System Software: Application independent software developed by Microsoft. Includes, but is not limited to, Microsoft's NT operating system; file management utilities; text editors; debugging aids; and diagnostics.
    b. Process Monitoring and Control Software (PMCS): Software packages independent of specific process control project on which they are used. Includes, but is not limited to, providing capability for, data acquisition, monitoring, alarming, man-machine interface, data collection, data retrieval, trending, report generation, control, and diagnostics.
2. Application Software:
    a. Software to provide functions unique to this Project and that are not provided by standard software alone.
    b. Configuring databases, tables, displays, reports, parameter lists ladder logic, and control strategies required to implement functions unique to this Project.

1.04 WORK SEQUENCE AND SCHEDULE

A. General: All work provided under this section shall be in accordance with a Milestone Breakdown and System Delivery Plan.

B. Milestone Breakdown (MB): Summarize the major milestones for work provided along with the major milestones of the San José Cogeneration Project.

C. System Delivery Plan (SDP):

1. The intent of the SDP is to:
    a. Coordinate and communicate applications software design and testing activities.
    b. Coordinate interactions with the City regarding workshops, submittal reviews, Design-Builder(s) progress, test witnessing, training, etc.
    c. Communicate and clarify required work sequences and major milestone.
2. Minimum Content:
    a. Work sequence and schedule.
    b. Applications software workshops.
    c. Applications software submittals.

d. Applications software development.
e. Software testing.
f. Software installation.
g. O&M development.
h. City training.
i. Startup.

1.05 SOFTWARE DESIGN WORKSHOPS

A. Location: City's facility during the course of the Project.

B. Objective: To provide a vehicle for the City to oversee the applications software development.

C. Documentation: Software Supplier summarize resolutions reached in each workshop, including cost and schedule impacts and distribute copies to City and Design-Builder.

D. Order and minimum topics to be covered in each Software Design Workshop.
1. Applications Software Design Workshop (kick off) that establishes project processes, including:
a. Software Supplier and Design-Builder organization and reporting procedures.
b. Workshop objectives.
c. Submittal process.
d. Review work sequence and schedule.
2. Loop Specifications, P&ID Review Workshop:
a. Software Supplier use P&IDs and Loop Specifications to present how the proposed control system design and Applications Software will meet the functional requirements specified herein and the City's standards.
b. At the completion of workshop Applications Software Supplier updates Loop Specifications with changes, additions and clarifications, using revision mode, that document the changes.
c. Submit finalized Loop Specification along with an outline of any application software cost and schedule impacts.
3. SCADA Network Configuration Workshop:
a. Coordination of network address assignments with existing SCADA network.
b. Identify all new network nodes. Include PCI elements as well as non-PCI elements such as vendor package control PLCs and HMIs.

c. Coordinate requirements for separate network used for PLC I/O and intelligent MCC.

4. Presoftware Development Workshops:

a. Objective: To present to Design-Builder and City how Applications Software Supplier will implement functional requirements of this Section.

b. Present Information on:

1) DCS I/O Database listing.

2) DCS Screen previews that illustrate dynamic objects, how control functions are controlled and monitored, how equipment is controlled and DCS screen navigation.

3) Program Flow Diagram(s) showing all software sections, sub sections, function blocks, subprograms, and their interrelationships.

a) Function Block standards for commonly used functions, including the following:

(1) Objective: Develop DCS Software Function Standards. Standards for commonly used functions, including, but not limited to, the following:

(a) User-Defined Tag structures and plant standards.
(b) Function Block Templates.
(c) Software tag format.
(d) High and low process variable alarm checking.
(e) Instrument failure alarm detection.
(f) Equipment control.
(g) On/Off pump control.
(h) Start/Stop pump control.
(i) Open/Close Valve and Gate control.
(j) Modulating Valve control.
(k) Equipment failure detection.
(l) Equipment run time.
(m) Signal filtering.
(n) Flow totalization.
(o) Process Values.
(p) Setpoint ramping.
(q) Discrete alarm.
(r) Interface with plant DCS.

5. DCS Standards Workshop:
    a. Objective: To review and develop DCS standards in a participative workshop with City.
    b. Design products and topics to be finalized:
        1) Plant DCS integration.
        2) Tag Group naming convention.
        3) DCS Tag naming conventions.
        4) Overview display design.
        5) Process graphics.
        6) Display paging and navigation.
        7) Dynamic Objects: Pumps, valves, gates, compressors, etc.
        8) Equipment control through pop-up windows.
        9) Loop control through pop-up windows.
        10) Display philosophy, organization and operation.
        11) General data entry through the DCS.
        12) Use of tool tips.
        13) Color graphic standards, symbol standards, etc.
        14) Dynamic Objects: Pumps, compressors, valves, gates, controller faceplates, process indicators, indicators with alarms, data entry, controller face plate, damplers, aerator, chemical feed pump, mixers.
        15) Security.
        16) Alarm Management: Operation of the alarms, alarm areas, alarm filtering.
        17) Trending.
        18) Historical data storage and retrieval.
        19) Variable naming conventions.
        20) Scripting.
        21) Tag Group file naming convention.
        22) Display file naming convention.
6. Plant Process Reporting Workshop:
    a. Objective: Developed and document number and types of reports.
    b. Identify and define each type of Process report including:
        1) Daily flow and energy totals.
        2) Weekly flow and energy totals.
        3) Monthly flow and energy totals.
        4) Yearly flow and energy totals.

1.06 SUBMITTALS

A. Action Submittals:

1. Application Software Standards:
    a. Submittal Objective(s): Provide standard used for control system software. This should align with the City's.
    b. Provide for each of the following: All software being supplied.
    c. Special Submittal Instruction(s):
        1) Submit in PDF.
        2) Complete configuration documentation.
        3) Submit standard used and how it aligns with the City's standard for all created function blocks and graphical objects.
        4) Submit any deviations to the City's Standard.
            a) Submit details of changes required to DCS monitoring and control resulting from installation of alternative or upgraded process equipment and instrumentation, and other causes.
            b) Submit changes at 30 day intervals.
        5) Provide function block programing and operator interface graphics for basic objects but not limited to: motor/pumps, valves, alarming, process values, and navigation.
        6) Complete configuration documentation for microprocessor based programmable devices.
            a) For each device, include program listings and function block diagrams, as appropriate, showing:
                (1) Functional blocks or modules used.
                (2) Configuration, calibration, and tuning parameters.
                (3) Descriptive annotations.
2. Application Workshops:
    a. Submittal Objective(s): Provide a means for Design-Builder and City to participate in discussions of how control system should be built and standards applied.
    b. Provide for each of the following: All software being supplied.
    c. Special Submittal Instruction(s):
        1) Submit schedule and agenda for the two main software workshops.
            a) Pre-software Development Workshop:
                (1) Review Standards.
                (2) Show how City standard is applied.
            b) Software Design Workshop:
                (1) Review of Application Software.

(2) Review Loop Descriptions.
(3) Update and details to Loop Specifications.
(4) Document and submit reporting criteria and functional requirements.

B. Informational Submittals:
1. Factory Demonstration Plan:
a. Submittal Objective(s): Provide overview of factory test procedures and results, prior to and after successful factory testing.
b. Provide for each of the following:
1) Factory Demonstration Test.
c. Special Submittal Instructions:
1) Submit Procedures, Forms, Checklists, and Results in PDF file format.
2) Submit Preliminary Test Procedures: Provide outline of proposed tests, forms, and checklists.
3) Submit Final Test Procedures:
a) Provide outline of proposed tests, forms, and checklists.
b) Describe simulation and monitoring methods used to demonstrate compliance with capacity and timing requirements.
4) Submit copy of signed-off test results.
2. Software Application:
a. Submittal Objective(s): Provide an overview of software development.
b. Provide for each of the following: All configurable hardware and software being supplied.
c. Special Submittal Instruction(s):
1) Submit in PDF.
2) Submit within 30 days after first Preconstruction Conference: schedule of work with milestones including but not limited to software workshops, testing, Design-Builder witness testing, start-up.
3) City Training Plan: In accordance with Section 01 43 33, Manufacturers' Field Services.
4) Testing Related Submittals:
a) Test Forms:
(1) Proposed test procedures, forms, and check lists:
(a) Software Demonstration Tests (SDT).
(b) Functional Test 1 (FT1).

(c) Functional Test 2 (FT2).

(d) Software Performance Test (PT).

b) Test Procedures: Conduct tests using Design-Builder accepted test procedures, forms, and checklists.

c) Test Documentation: Copy of signed of test procedures when tests are completed.

5) Operations and Maintenance Manuals:

a) In accordance with Section 01 78 23, Operation and Maintenance Data, unless otherwise specified in this section.

(1) User's manuals for Standard Software packages.

(2) Licensed copies of Standard Software packages.

(3) Updated versions of material provided under Shop Drawing Submittals for Applications Software Design and Development.

(4) Applications software source files.

PART 2 PRODUCTS

2.01 DCS APPLICATION SOFTWARE DESIGN REQUIREMENTS

A. General:

1. The Applications Software Supplier shall develop the DCS design to convey accurate information to the plant operations staff so they can make informed process control decisions and provide the platform to execute the control decisions.
2. Refer to RWF-004, Distributed Control System Guideline for City standard on how to design interface.
3. The following outlines key objectives in designing the DCS graphics displays:
   a. Easily navigated menus.
   b. Provide no more than three mouse actions to navigate to any control display.
   c. Maintain consistency in graphic display and controls design. (Consistency reduces the chances of misunderstanding, significantly reduces learning time, anxiety and stress.)
   d. Maintain consistent and predictable window operations.
   e. Accurate representation of the plant and its operations.
   f. Represent control options in an easily understood fashion.

g. Develop help screens to provide additional information to help the operations staff understand the control options where complex operations are required.

h. A pleasant and engaging interface that conforms to the operators "Mental Model".

i. Where possible, design overview displays similar to the physical layout of the facility. The perspective to the physical layout should be from the local main control room.

j. Provide operator access to process and alarm setpoints, including the following:

1) Process alarms (High-High, High, Low, and Low-Low).

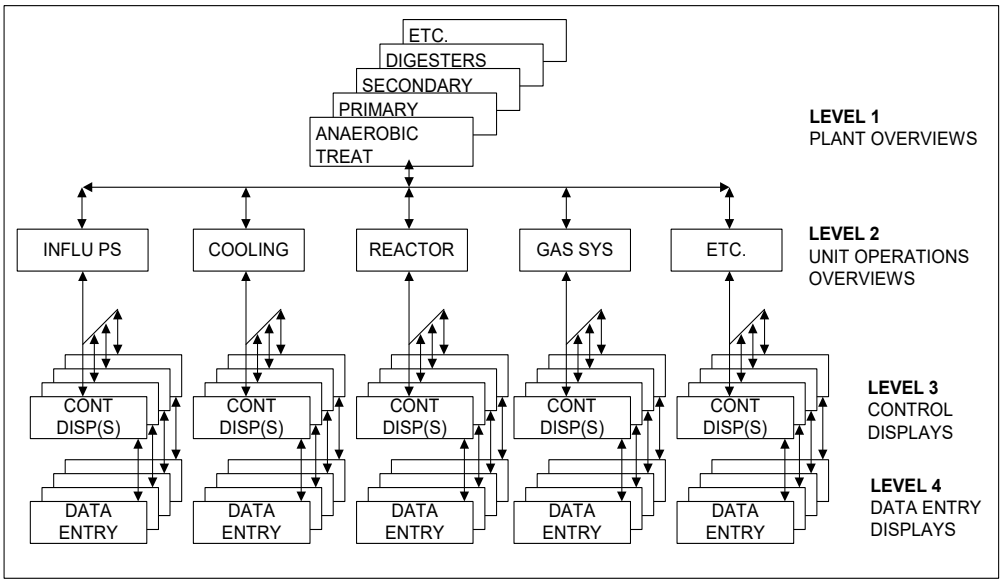
2) Pump and equipment control setpoints.

3) Process timer setpoints.

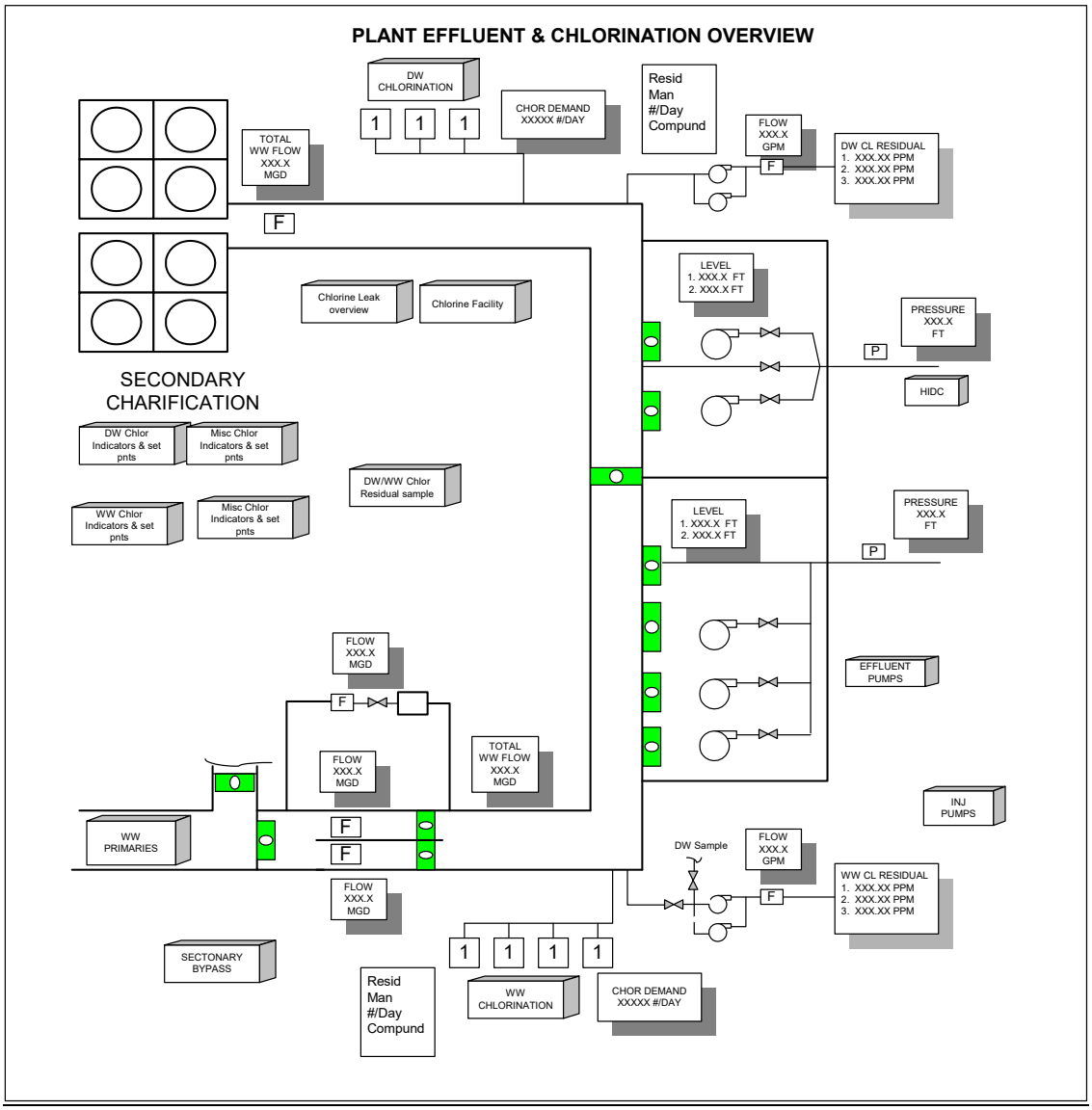
4) Sequence setpoints for volume, level, time etc.

B. General Display Organizational Philosophy:

1. Graphic displays provide the vehicle for the operations to accomplish supervisory control over the entire treatment process. Organization of these graphics displays into a consistent homogeneous hierarchy that permits fast, easy and intuitive navigation between the displays is essential for plan operations. The following figure illustrates an overview of a typical graphic display hierarchy.



2. As shown, the process and control graphic display hierarchy consists of four levels of displays. The following briefly describes the intent of each of the four levels of displays:
   a. Level 1—Plant Overview(s):
      1) The Plant Overview(s) show major processes such as Primary, Secondary, Anaerobic Treatment, etc. These overview displays show the most important (essential) process data and major equipment status on a plant wide basis, but provide no equipment or system control.
      2) The Plant Overview(s) display provide the means to page (i.e., go to) to other Plant Overviews or Unit Process overviews, or in some cases directly to Control Displays.
      3) As a general rule, the Plant overviews show the most critical status and system data that give the operations staff a good general feel on how the plant, is currently operating. A Plant Overview is going to be the opening display whenever the DCS is started.
   b. Level 2—Unit Process Overviews:
      1) Unit Process Overviews are full sized screens.
      2) The Unit Process Overviews show primary process data on unit processes, unit operations, equipment status, or system status, etc. As a general rule no control strategies are implemented through the Unit Operations Overviews. The unit operations overview provides the means to page to Control Displays.
      3) The general rule is to show enough status and system data information that gives operations staff a good general feel on how the individual processes are currently operating. It also provides a launching pad to access control information associated with the individual processes.
      4) Examples of Unit Process Overviews are Influent Pump Station, Influent Cooling, Reactor and associated Chemical system, Bio Gas System, Sulfide Oxidation, Odor Control, Utilities. The following illustrate the level of detail on a Unit Process Overview display.

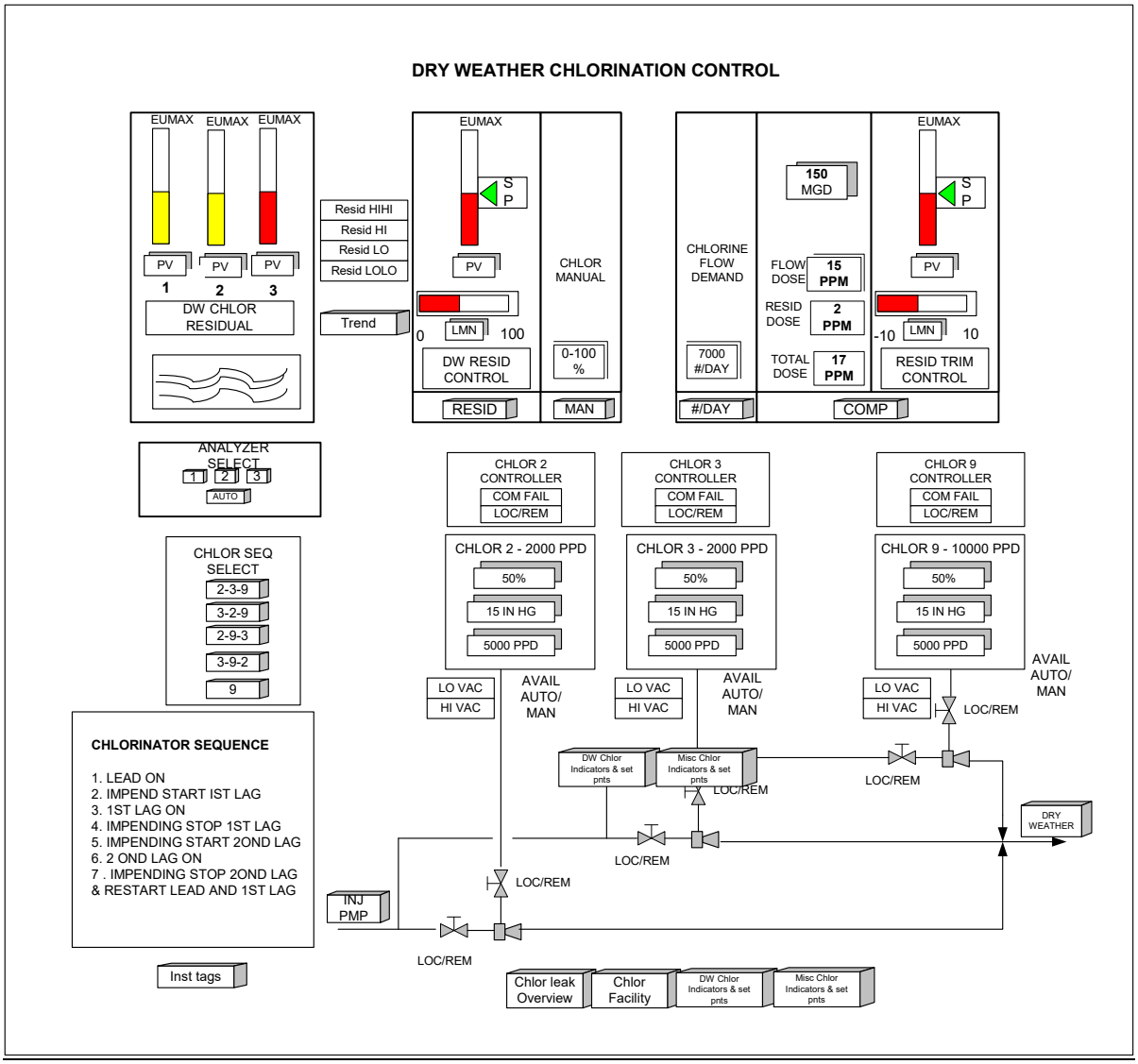


Example Level 2 Display Graphic for " Plant Effluent and Chlorination"

c. Level 3—Control Displays:

1) Control Displays can be Full screen or popup windows.

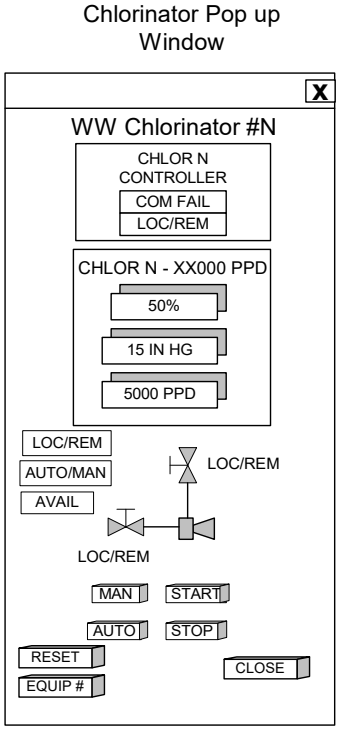
2) Control Displays provide the means to monitor and provide Supervisory Control of specific process operations such as pump stations, specific pumps, heat exchangers, pH control, Pre-Acidification, chemical systems, etc. Depending on the complexity of the specific process there may be several levels of displays. For example, some unit operations will have a special display for each phase of a startup sequence. Control of each piece of equipment on individual unit operation control displays is possible. The following figure illustrates a typical control Display.



Example Level 3 Display of the " Dry Weather Chlorination Control"

a) The Level display provides the capability to control specific equipment, system and to navigate directly to related displays.

3) Supervisory Control:
   a) The objective of the DCS design approach is to implement all Supervisory Control of the plant and its process and control strategies from the control displays. The control strategies include the following functions:
      (1) System level control, such as control loops, and sequences, etc.
      (2) Equipment level control, such as a pump start/stop control.
      (3) Detailed monitoring of sequence steps and general information messages for status.
      (4) Important alarm messages.
      (5) Paging between related displays.
      (6) Paging between related processes.
4) Pop-Up Windows:
   a) Pop-up windows provide the capability to control systems and equipment without cluttering the overview or control display. The following illustrates the configuration of a typical pop-up window.



Typical Pop-up Window

b) The typical pop-up window provides the following functions:

(1) Status monitoring of equipment being controlled.

(2) Operating mode.

(3) Manual mode selection.

(4) Start/Stop Control in Manual.

(5) Auto mode selection.

(6) Failure Reset.

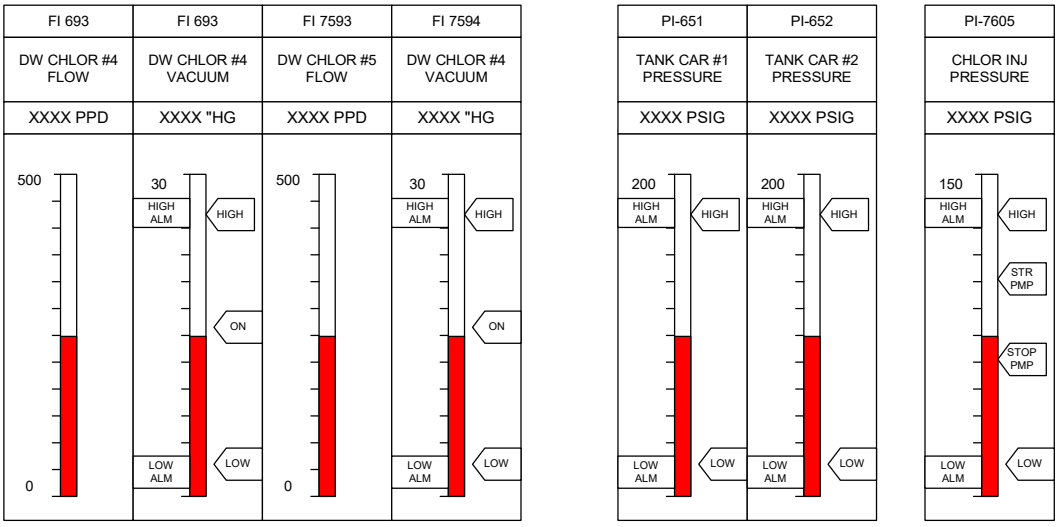
(7) Equipment description.

(8) Control for displaying the equipment number.

d. Level 4—Data Entry and Trend Displays:

1) Data Entry displays are designed especially for data entry purpose. Operators enter process setpoints, equipment control setpoints (such as lead-lag pump start/stop setpoints), alarm setpoints, etc. The following figure illustrates a typical data entry display.

CHLORINATION MISCELLANEOUS INDICATORS AND SETPOINTS



Example Data Entry Display. The operator clicks on a setpoint pointer then enters the setpoint. The pointer is then scaled the same as the process variable.

e. Display Navigation: To provide fast and effective screen navigation shall be provided. The following outlines the type of screen navigation functionality to be provided. The final display navigation process shall be developed in the software workshops.

f. Main Directory:

1) A Main Directory can be a list of Displays that shows the hierarchy of Plant Overviews, Unit Process Overviews, Control Displays and Data Entry Displays.

2) The Main Directory provides a way to catalog and access all displays, however, is does not provide an effective navigation tool for plant operations.

3) The Plant Overview Display is another type of Main Directory Display that has active areas (poke points) to call up Unit Process Displays based on physical location in the plant.

a) The Main Directory Display lends itself to fast navigation from display to display.

g. Main Navigation Menu Bar: The Main Navigation Menu Bar is series of buttons on the bottom of each display that provides the user with the capability to go to (navigate to) any unit operation.

1) The Main Navigation Menu Bar takes up graphic screen area on each full size screen but does provide a consistent, fast way to navigate between unit operation screens.

h. Previous and Next Display Controls:

1) Previous and Next display configurations shall be provided.

2) The Next and Previous displays will be configured to operate within the same level. For example, if an operator is on a Level 2 unit process overview, the previous and next displays configuration will be set up to cycle between all the Level 2 unit process overview displays.

3) If the user was in the Level 3 displays for a specific unit process the next and previous displays will be configured to cycle between all the Level 3 and Level 4 displays associated with the unit process overview.

i. System/Control Displays:

1) Each Unit Process Display will have soft keys that call up System/Control displays. If possible, develop soft keys that call up system/control displays that use a transparent button over the unit. For example on the Thickening overview a transparent button over a specific gravity belt will call up the respective gravity belt control display.

2) A transparent button is a control that has an outline of a button but is transparent. When placed over an object on a display, the object is still visible by clearly identifies navigation to another display or access to a pop-up window.

C. Alarm Group Display: The alarm group window gives operators a first-level indication of an alarm occurrence by group and allows operators to filter the alarm list. It indicates by solid color that an active (acknowledged) alarm exists in the alarm group and by blinking that an unacknowledged alarm exists in the alarm group.

D. Alarm Summary (Filtered): The Filtered Alarm summary window is dedicated to the presentation and acknowledgment of alarms. It provides alarm details, such as date and time of alarm, recurring alarm signal, alarm group, description of the alarm, alarm priority, current value, engineering unit, etc., for all alarms, acknowledged or unacknowledged. Once the alarms occur, they can be taken off the alarm list only if they have been acknowledged and the alarm conditions are no longer true.

2.02 DCS I/O DATABASE

A. DCS I/O Database:

1. The Software Supplier shall provide a Database tool that has the following functions:
    a. Coordinate, manage and document all points DCS database points including those communicated between vendor PLCs and DCS.
    b. The database shall contain all the field necessary to configure the various points including the following per point type:
        1) Discrete Point configuration: The Software Supplier shall provide a DCS Discrete Input/Output (I/O) database of all discrete points that are communicated to and from the DCS. The list shall be configured on a Microsoft Excel or Access database. The I/O list includes the following fields.
            a) Loop Number.
            b) FIX Block Tag Number.
            c) FIX Block type.
            d) FIX SCADA node the point is assigned to.
            e) Attribute: Further definition of the function of the point. The follow list the definitions:
                (1) A(X): DCS alarm read, where X designates the alarm priority: 1,2,3.
                (2) W: DCS write.
                (3) R: DCS read.
                (4) RW: SCC read and write.
            f) Point description.
            g) Alarm Description 1.
            h) Alarm Description 2.

i) Closed Condition (INPUT): Description of the state of the input parameter of device when the field or internal contacts are in the CLOSED position.
j) Open Condition.
k) Closed Condition (OUTPUT): Description of the output signal in the energized position.
l) Alarm area.
m) DCU number.
n) DCS I/O address.

2) Analog Point Configuration: The Software Supplier shall provide a DCS Input/Output (I/O) Database of all analog points that are communicated to and from the DCS. The list shall be configured on a Microsoft Excel or Access database. The Analog I/O database includes the following fields:
a) Loop Number.
b) FIX Block Tag Number.
c) FIX Block Type.
d) FIX SCADA node the point is assigned to.
e) Attribute that further defines of the function of the point. The following list the definitions: Note the attributes will be used of sorting and development of the I/O driver configuration.
(1) SPR: Setpoint read (floating point).
(2) SPW: Setpoint write (floating point).
(3) MNR: Output read (floating point).
(4) MNW: Output write (floating point).
(5) PVR: Process variable read (floating point).
(6) FPR: Floating Point Read (floating point).
(7) FPW: Floating Point Write (floating point).
(8) FQR: Flow totalizer read (Integer).
(9) KTR: Equipment run time read (Integer).
(10) IPR: Integer read (Integer).
(11) IRW: Integer write (Integer).
f) Point description.
g) Alarm Description 1.
h) Alarm Description 2.
i) Engineering units.
j) Scale range.
k) Alarms functions to be configured in FIX analog block configuration.
(1) High-High.
(2) High.
(3) Low.
(4) Low-Low.

(5) Signal fail.
(6) Other.

l) DCU number.
m) DCS I/O address.

3) DCS Database: The Software Supplier shall provide a database of all DCS database points that are not included in the analog or discrete I/O Databases in the that are communicated to and from the DCS. The database shall be configured in a Microsoft EXCEL or ACCESS database. DCS database includes the following fields:
a) Loop number.
b) FIX block tag number.
c) FIX block type.
d) FIX SCADA node the point is assigned to.
e) Point description.
f) Alarm Description 1.
g) Alarm Description 2.
h) Engineering units.
i) Scale range.
j) Alarms functions to be configured in FIX block configuration:
(1) High-High.
(2) High.
(3) Low.
(4) Low-Low.
(5) Signal fail.
(6) Other.

2.03 STANDARD DCS FUNCTIONS BLOCKS

A. General: The following Standard functions blocks specify the standard DCS functions block to be developed and used to implement the DCS requirements specified in the Loop Specifications.

B. Discrete DCS Mode Command And Feed Back Status: When the DCS commands a specific mode such as Auto or Manual, the DCS shall be configured with an Auto write command database point and a in Auto mode database status.

C. Analog DCS Read-Write Process: When an analog value such as setpoint or controller output is specified to be accessible to the operator, the DCS shall be configured to write to a register through one database tag and then read back the variable written through a second database tag.

D. Discrete Equipment Control:

1. Controlled equipment to have ON-OFF-REMOTE (HOR) switch or a LOCAL/COMPUTER switch REMOTE/COMPUTER input to the DCS. The Controlled equipment shall include ON running status. DCS outputs include a RUN signal (or separate START and STOP signals) to start the equipment. The Applications Software shall prevent Start/Stop control of equipment by the DCS unless the HOR switch is in the REMOTE (COMPUTER) position.
2. When the controlled Equipment is in REMOTE or COMPUTER the DCS shall be enabled to set the Equipment mode to DCS AUTO or DCS MANUAL. When the controlled Equipment is in DCS Manual the DCS shall be configured to Start and Stop the Equipment from the DCS. When the Controlled Equipment is in DCS Auto the automatic routine shall control the ON/OFF status of the Equipment.
3. Monitor the ON status of equipment in the REMOTE or COMPUTER mode. If the DCS calls for the equipment to RUN and does not receive an ON signal after a suitable time delay, lock out the equipment and generate an alarm to the DCS.
4. If the equipment is not in REMOTE or COMPUTER mode the logic shall set the mode Manual.
5. Equipment Available Status: Provide equipment available status that is logically true when equipment is in REMOTE, DCS AUTO and not FAILED.
6. If the DCS calls for the equipment not to RUN (STOP) and the ON signal is true after a suitable time delay, lock out the equipment and generate equipment failure alarm to the DCS.
7. The equipment failure alarm condition and the equipment lock out shall be cleared by the loss of the REMOTE signal or DCS initiated Reset.
8. Provide a test input that to be used for system testing. When the TEST input is true the RUN (or START/STOP) output shall be prohibited from energizing. When in this mode, the ON status points read and used by the DCS logic will follow the command to run, instead of the field ON inputs.
9. Provide a bumpless transfer from LOCAL to REMOTE or COMPUTER mode. If the Pump is running in the LOCAL mode it shall continue running when transferred to REMOTE or COMPUTER.

E. Lead/Standby Pump Control:

1. The lead/standby provides control over two redundant pumps.
2. The lead pump can run continuously or when called to run.
3. The lag pump runs when the lead pump is not available or is not ON.
4. Provide a FAIL output that goes true if there is no sequence selected or no pumps are available.
5. Provide a 1-2 and 2-1 lead/lag sequence selection from the DCS.

F. Discrete Valve (or Gate) Control:

1. Controlled valves have OPEN-CLOSED-REMOTE (OCR) switches with OPEN, CLOSED and REMOTE inputs to the DCS. DCS outputs include an OPEN signal (or separate OPEN and CLOSE signals) to open the valve. The applications software shall prevent control of valve by the DCS unless the OCR switch is in the REMOTE (COMPUTER) position.
2. Equipment Available Status: Provide equipment available status that is logically true when equipment is in REMOTE, DCS AUTO and not FAILED.
3. When the controlled valve is in REMOTE the DCS shall be configured to set the valve mode to DCS AUTO or DCS MANUAL. When the controlled valve is in DCS Manual the DCS shall be configured to Open and Close the valve from the DCS. When the Controlled valve is in DCS Auto the automatic routine shall control the Open/Close position of the valve.
4. Monitor the OPEN/CLOSED status of valve in the REMOTE position. If the DCS calls for the valve to OPEN and does not receive an OPEN signal after a suitable time delay, lock out the valve and generate an alarm to the DCS.
5. If the DCS calls for the valve to CLOSE and continues to receive an OPEN signal or does not receive a CLOSED signal after a suitable time delay. Generate a valve failed alarm to the DCS.
6. The alarm condition and the valve shall be cleared when the valve is noted to be in the correct position.
7. Provide a test input that to be used for System Testing. When the TEST input is true the OPEN (or OPEN/CLOSE) output shall be prohibited from energizing. When in this mode, the OPEN/CLOSE status points read and used by the DCS to follow the command to OPEN/CLOSE, instead of the field OPEN/CLOSE inputs.

G. Analog Inputs:

1. Provide sample times for analog inputs of no slower than one sample every 2 seconds. For inputs that are used for control purposes, use sample times no slower than once every 1 second.
2. Provide a first order digital filter on all analog inputs. Use the DCSs built-in lag filter and set the time constants to no greater than four times the input sample time.
3. All analog inputs shall be configured into a floating point variable and scaled in engineering units.
4. Provide analog switches on each analog input. Analog switches to provide High and Low alarms, or as shown or as described in the loop specifications. The setpoints for the analog switches shall be accessible and changeable through the DCS.

5. Monitor signal failure (out of normal range) on all analog inputs and alarm on the DCS.

H. Analog Switches:

1. All analog switches used for Process alarms, to START and STOP pumps, sequences, etc., shall be configured through analog switches. Two types of analog switches shall be provided one for rising signal and one for falling signal. Each analog switch shall be configured with a 1 percent dead band to prevent nuisance tripping. Provide operator access through the DCS to the analog switch setpoints.
2. Each analog alarm shall be configured with four inputs and one output.
    a. Inputs:
        1) Process variable scaled in engineering units.
        2) Setpoint.
        3) Minimum and Maximum engineering units.
    b. Outputs: Discrete output that switches when the process variable is above or below the setpoint.

I. Analog Control:

1. Unless otherwise noted, controllers shall be configured as Proportional-Integral (PI) type. Unless specifically noted do not use derivative mode.
2. Provide access through the DCS for discrete mode changes, Setpoint and controller output when the controller is in manual.
3. Controller gain and integral time constant shall be adjusted to provide stable operation normal operating conditions.
4. Use the position from of the PI equation unless otherwise noted.
5. Freeze the controller bias to prevent reset wind up, if the output is out of range.
6. Controller sample times shall be no slower than once every 2 seconds.
7. Provide bumpless transfer between operating modes, Auto to manual, and manual to auto.
8. Provide a DCS Controller tuning display for each loop. The tuning display shall have a trend that trends the Process Variable, Setpoint and Output.
9. Provide a setpoint initialization routine that initializes the setpoint to the value of process variable when the loop in set to Automatic.
10. Unless otherwise noted, the Analog control shall be one shot into Manual when signal failure is detected on the Process variable. Provide a DCS alarm that indicates that the loop was set to MANUAL.

11. Each Controller shall be configured with a Manual Loading Station that has the follow functions:
    a. The Output of the Manual Loading Station to the Manipulated Device is input back to the DCS.
    b. The Manual Loading Station also has a Remote Status that is input into the DCS.
12. When the Manual Loading Station in Not in Remote, the Loop Controller shall be forced into manual and the manual output shall track the input from the Manual Loading Station.
13. Indicate the Manual Loading Station Local/Remote Status on the DCS.

J. Alarm Processing:
1. Provide alarms as noted or shown.
2. All alarms shall be configured into Alarm Areas as specified by the City in the Workshops.
3. Discrete type alarms shall be provided with an adjustable delay timer so that they do not become nuisance alarms.

K. Feed Forward Flow Pacing:
1. The Feed Forward Flow.
2. The Flow Ratio control routine shall be configured to calculate the chemical flow demand in GPM, based on a DCS entered Flow ratio in PPM and the flow that the chemical is to be ratioed to.
3. The flow demand is passed to a scaling routine that calculates the desired pump flow based on the flow demand and operator entered calibration constant. The desired pump flow is scaled to 0 percent to 100 percent pump speed.
4. The pump calibration constant is entered into the DCS and constitutes the pump flow at maximum flow.
5. Totalize the flow based on the calculated flow demand when the pump ON status shows the pump is on. Display the flow total on the DCS.

L. Manual Equipment Control from the DCS:
1. Provide a DCS AUTO/MANUAL mode for DCS-controlled devices. In the DCS AUTO mode, the device shall operate as described in the Loop Specifications. In the DCS MANUAL mode, the operator shall control the device through Start/Stop or Open/Close commands from the DCS.
2. The software AUTO/MANUAL selection shall be allowed only when the device's panel switch is in the REMOTE or COMPUTER position.

3. Provide MANUAL mode start and stop capability on all equipment, valves, and packaged systems (devices) that are controlled from the DCS, unless otherwise noted.
4. Receive a discrete variable from the DCS in the MANUAL mode, indicating that the device should start or stop (open or close).
5. When the device is in MANUAL, disable normal sequence of operations from controlling the device. Do not override shut-down interlocks.

M. Run-Time Counters:

1. Provide a run-time counter for all motorized equipment that has an ON signal to the DCS.
2. Accumulate run times in hours with a minimum resolution of 0.1 hour. Counters shall roll over automatically when the accumulator is full.
3. Provide for a contact from the DCS to reset all run-time counters, on demand or by reaching a preset of 30,000 hours
4. Store all run-time counters in a linear block of DCS memory.

N. Sequences:

1. Sequences specified in the loop descriptions shall have the following general requirements:
   a. All sequences shall be divided into individual steps and be a command report-back type sequence. For example, the DCS shall issue a command for a valve to open (or pump to start) and the it will monitor the valve limit switches (or motor starter auxiliary contact or flow switch) to verify that it did open (or pump start). If the correct feedback status is not received within a preset time limit an individual failed alarm shall be initiated.
   b. Once a sequence has been started, it shall advance from one step to the next when all of the previous steps commanded by the DCS have been verified by the “report-back” portion of the program.
   c. Each sequence shall have a systems level MANUAL/OFF/AUTOMATIC control from the DCS. In the OFF mode the sequence shall be reset to the home, step 0. In the manual mode the sequence shall be started by a DCS START/STOP control. In the AUTOMATIC mode the sequence shall be started by the specified automatic control functions.
   d. If in any sequence step, a device fails to respond to the control of the DCS the sequence shall stop and remain in the current step. The sequence shall remain in the failed step until the DCS start function is initiated. The sequence will then retest the current step and advance to the next step if the device has responded to the control action.

e. Each sequence shall have a DCS JOG function. The JOG function shall advance the step by one, independent of the normal step advance conditionals and timers.

f. Each sequence shall transmit bit variable indicating the active step to the DCS.

O. Totalization: All Flow, weight, and power signals shall be totalized in the DCS. All totalizers shall be calculated at least every 3 seconds. DCS special function programs shall be configured to scale the process variable to be totalized into gallons, pounds, or KWH in three seconds. These scaled variables shall be accumulated every 3 seconds until an accumulated value is greater than the a unit digit value. When the accumulated value is greater than the unit digit value, a totalizing counter shall incremented by one and the accumulated value subtracted from the unit digit value, and the accumulated value set equal to the result. A threshold detector shall be developed to inhibit the totalizer from totalizing until the process value is greater than a preset percentage of the scale range. Each totalizer shall reset to 0 at 30,000 counts or from a single reset coil shall reset all DCS totalizer counters.

P. Sampler:

1. Sampler Function:

a. Receive at the DCS a contact closure denoting trouble (TRBL) with the sampler. Store this contact state for use in the DCS.

b. When the sampler is required to start transmit a RUN contact closure from the DCS to panel.

c. Provide Manual/Auto control of the sampler from the DCS. When the control is in the manual mode the sampler sequence shall be controlled through a start control. When the control is in the AUTO mode the sampler shall be controlled by either flow or time. In the Time mode the sampler shall be controlled by repeat cycle timer that is controlled and monitored through the DCS. In the flow mode the sampler shall be controlled by a flow totalizer. The flow totalizer shall be monitored and controlled through the DCS.

Q. Process Control Functions Timing:

1. The objective of the process control function timing function is to reduce processor loading on any one scan by distributing over four time slots.

2. Provide a timing sequence that is designed to distribute processing of functions in one of four time slots. The duration of each time slot shall be controlled to one scan, approximately 0.25 second.

PART 3 EXECUTION

3.01 TESTING

A. General:

1. Test software to demonstrate that the applications software satisfies requirements outlined in the Loop specifications, and described in submittals, and workshops.
2. Test Format:
   a. Cause and Effect:
      1) Person conducting test initiates input (cause).
      2) Specific test requirement is satisfied if correct result (effect), occurs.
3. Procedures, Forms, and Checklists:
   a. The Test will be completed on a unit operation and loop basis that is design to coordinate with the PCI testing and startup.
   b. The Software Supplier shall generate testing forms, and checklists from the DCS database.
   c. Have space after each test item description for sign off by appropriate party after satisfactory completion.

B. Software Demonstration Tests (SDT):

1. Scope: Test entire PLC and DCS to demonstrate that it is operational. The SDT shall be successfully completed to the satisfaction of the Design-Builder and City before the software is loaded on to the Plant DCS.
2. Location: Software Supplier's facility.
3. Prerequisites: PCI shall complete an unwitnessed SDT on the entire system and submit results as part of the Pre-software Design Submittal.
4. DCS Display Tests: The Object of the test is to verify all DCS database points and points communicated between the DCS and vendor PLCs. Each DCS display and dynamic object on that display and control will be tested and verified. The Applications Software Supplier shall provide a test form for each display that lists all of dynamic objects, controls, pop-up windows and their associated database tags and corresponding PLC address. The test form shall provide a place for a sign off for the Software Supplier and Design-Builder.
5. DCS Display Navigation Test: The Objective of the test is to verify all the display navigation controls.
6. Loop-Specific Functions: Demonstrate functions shown on P&IDs, specified in the Loop Specifications, described in submittals, and workshops. This test shall not be started until the Display and Display navigation tests have

been successfully completed. This test shall verify all DCS functions through indications on the DCS programming software. The Applications Software Supplier shall develop a test form on and unit Operation and loop basis. The form shall list all controlled equipment, control routines, alarm points, status points, setpoints, controllers, sequences that are specified in the Loop Specifications. The test shall demonstrate all manual and automatic functions are operating as specified and verify that the outputs and inputs are configured to the correct DCS I/O point.

7. Make following documentation available to City at Test Site both before and during SDT:
    a. Loop specifications.
    b. Pre-software design submittal.
    c. Software design submittal.
    d. O&M material.
    e. Master copy of SDT sign off sheets.
    f. Applications software documentation.

C. Functional Test 1 (FT1). Performed by the Systems Integrator Subcontractor: Prior to FT2, startup test period and PT, inspect, test, and document that entire PCI is ready for operation; excluding Software Supplier provided DCS applications software.

D. Functional Test 2 (FT2): Combined effort between Systems Integrator Subcontractor, DESIGN-BUILDER, and Software Supplier to confirm that PCI, including applications software, is ready for operation.
    1. Prerequisite: Completion of FT1.
    2. Joint test with Software Supplier. Repeat of Software Supplier's SDT, except using real field sensors and equipment. Plant interlocking and communications with the DCS shall be tested on loop-by-loop basis.
    3. Test procedures provided by Software Supplier based on Loop specifications.

E. Software Performance Tests (PT): These are the activities that Section 01 91 14, Equipment Testing and Facility Startup, refers to as performance testing.
    1. Once FT1 and FT2 has been completed and facility has been started up, perform a witnessed PT on complete PCI and software to demonstrate that it is operating as required by the Contract Documents and software loop descriptions. Demonstrate each required function on a paragraph-by-paragraph, loop-by-loop basis.
    2. Loop-specific and non-loop-specific tests same as required for SDT except that entire installed PCI tested using actual process variables and all functions demonstrated.

3. Perform local and manual tests for each loop before proceeding to remote and automatic modes.
4. Where possible, verify test results using visual confirmation of process equipment and actual process variable. Unless otherwise directed, exercise and observe devices supplied by others, as needed to verify correct signals to and from such devices and to confirm overall system functionality. Test verification by means of disconnecting wires or measuring signal levels is acceptable only where direct operation of plant equipment is not possible.
5. Make updated versions of documentation required for PT available to City at Site, both before and during tests.
6. Make one copy of all software O&M manuals available to the City at the Site both before and during testing.

3.02 CITY TRAINING

A. General:
   1. Provide an integrated training program for City's personnel.
   2. Perform training to meet specific needs of City's personnel.
   3. Include training sessions, classroom and field, for managers, engineers, operators, and maintenance personnel.
   4. Provide instruction on all working shift(s) as needed to accommodate the City's personnel schedule.
   5. City reserves the right to make and reuse videotapes of all training sessions.

B. Management Seminar:
   1. Length: 1 day.
   2. Location: City's facility.
   3. Objective: Provide an overview for non-operations and maintenance personnel for understanding the applications software.
   4. Attended by management, engineering, and other non-operations and nonmaintenance personnel.
   5. Primary Topics:
      a. Applications Software Overview: How software is used for operation and control of facilities.
      b. Block Diagram Presentation of the DCS: How and what information flows within system and what is done by each functional unit.
      c. Process/Operator Interface: Explanation and demonstration of how to use an operator's CRT to access displays, reports, and controls.

d. Management-oriented explanation of data management displays and printouts.

e. Walk-through of installed systems.

C. Operations:

1. Provide a minimum of 10 days of training at the Site indicated by the City for City's personnel in the operation of the DCS. Training shall include:

a. Standard operational features of DCS equipment provided.

b. Specific features provided for this project including:

1) General Loop functions.

2) Operation of Each Loop: For example, AUTO/MANUAL control, control setpoint settings, control mode selection, alarm acknowledgment.

3) Operation of Each DCS display, dynamic objects, and controls on that display.

a) The information shall be presented in an electronic format similar to the following Microsoft Power Point slide that illustrates the function of a compound mode in a chlorination control routine.

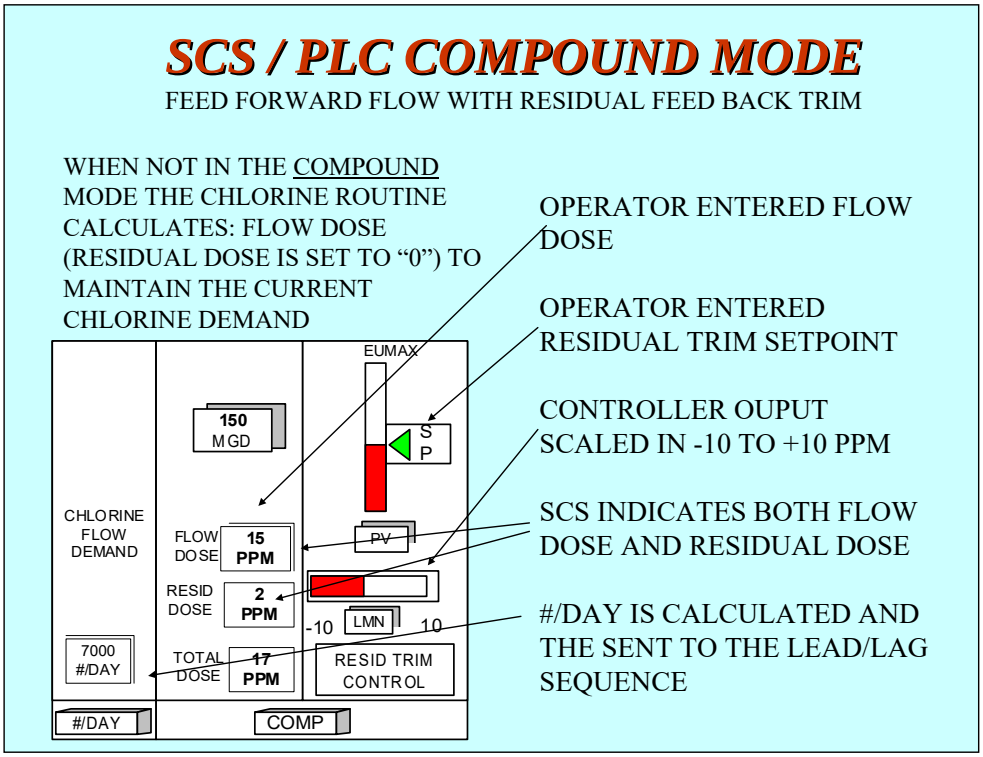


Figure Illustrating a specific control section on a graphic display

2. Operations Startup Suggestions:
    a. Suggested unit operations startup suggestions shall be developed and presented to the operations staff. The suggested unit operation shall consist of two sections, field setup and Startup through the DCS.
        1) The Field Setup shall list the field devices such as pumps, valves, chemical feeders, etc., and the position of their local control switches to transfer control to the DCS.
        2) The Startup Sequence through the DCS shall list each equipment control, its display where located and the control action to be taken and the expected response to be seen on the DCS.
    b. The following is a list of Unit Operations to be developed:
        1) Influent cooling.
        2) Pre-acidification and associated chemical systems.
        3) Reactors and associated chemical systems.
        4) Solids transfer.
        5) Gas system.
        6) Sulfide oxidation.
        7) Utilities.
3. Alarm Summary:
    a. Describe each DCS alarm, including DCS tag name, detailed description of the alarm, probable cause, suggested operator action(s).
    b. The Alarm summary shall be configured in Microsoft Excel.

D. Software Maintenance:
1. Provide a minimum of 5 days of training at the Site indicated by the City's for personnel in the maintenance of the DCS software.
2. Software functional Block diagrams.
3. Documented ladder diagrams.
4. DCS I/O Database.

3.03 O&M MANUALS

A. General:
1. Provide the following:
    a. Suggested startup procedures.
    b. Training material.
    c. Alarm summaries.

B. Software:

1. Provide the following:

a. Finalized loop specifications.

b. Program flow diagrams.

c. Documented ladder programs.

d. PLC I/O database, forms, queries, and reports.

END OF SECTION

SECTION 40 99 90
PACKAGE CONTROL SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. The Institute of Electrical and Electronics Engineers, Inc. (IEEE): C62.41, IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
   2. International Society of Automation (ISA): S50.1, Compatibility of Analog Signals for Electronic Process Instruments.
   3. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. AB 1, Molded Case Circuit Breakers and Molded Case Switches.
      c. ICS 2, Industrial Control Devices, Controllers and Assemblies.
   4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
   5. UL: 508A, Standards for Safety, Industrial Control Panels.

1.02 SYSTEM DESCRIPTION

A. Assemble panels and install instruments, plumbing, and wiring in equipment manufacturer's factories.

B. Test panels and panel assemblies for proper operation prior to shipment from equipment manufacturer's factory.

1.03 SUBMITTALS

A. Action Submittals:
   1. Complete specifications, descriptive drawings, catalog cuts, and descriptive literature which shall include make and model of instrumentation and components of control system.
   2. Complete process and instrumentation diagrams (P&IDs), network interface drawings, electrical schematic and wiring diagrams, electrical ladder diagrams, interconnection diagram showing power and control interfaces among all system components, and instrument settings.
   3. Control panel arrangement drawings. Include wiring and schematic diagrams, network equipment, mounting, location, and communication layout Drawings.
   4. Panel heat load and dissipation calculations.
   5. Panel elementary diagrams of prewired panels. Include in diagrams control devices and auxiliary devices, for example, relays, alarms, fuses, lights, fans, and heaters.
   6. Plumbing diagrams of preplumbed panels and interconnecting plumbing diagrams.
   7. Interconnection wiring diagrams that include numbered terminal designations showing external interfaces.

8. Submit anchorage and bracing data sheets and drawings as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:
   1. Submit anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
   2. Component and attachment testing seismic certificate of compliance as required by Section 01 45 36, Equipment Seismic Certification.
   3. Manufacturer's list of proposed spares, expendables, and test equipment.
   4. Manufacturer's Certificate of Proper Installation in accordance with Section 01 91 14, Equipment Testing and Facility Startup.

C. Software Submittals:
   1. Software program code and software configuration information shall be non-proprietary and fully documented, to interface with and to operate, configure, and maintain the software. Key code may be password-protected to maintain intellectual property, if necessary. All portions of the software which involve interface with the plant SCADA system must be accessible for review and troubleshooting.
   2. Provide licensing as required for functionality of software.
   3. This includes but is not limited to anything that needs be configured to operate:
      a. Programmable Logic Controller (PLC).
      b. Operator Interface Unit (OIU).
      c. Human Machine Interface (HMI).
      d. Workstation.
      e. Network switches.
      f. Woodward's Digital Synchronizer and Load Controller (DSLC) where applicable.
   4. Include in PLC and OIU Submittals:
      a. Complete set of user manuals.
      b. Input/Output list.
      c. Cross-reference listing.
      d. Fully-documented electronic copy of the as-built programmable controller software configuration for the package control system that was developed using the programmable controller's software development tools.
      e. PLC network communication data exchange documentation
      f. Actual PLC files.
      g. OIU graphics.
      h. Software Licensing for software that needs license to operate.
      i. Actual OIU files.

1.04 APPLICATION SOFTWARE INTEGRATION

A. Work with the Plant Integrator to integrate the application software functionality into the Plant SCADA system.

1.05 EXTRA MATERIALS

A. Spares, Expendables, and Test Equipment:
   1. Selector Switch, Pushbutton, and Indicating Light: 20 percent, one minimum, of each type used.
   2. Light Bulb: 100 percent, 2 minimum, of each type used.
   3. Fuse: 100 percent, 5 minimum, of each type used.
   4. Surge Suppressors: 20 percent, one minimum, of each type used.

PART 2 PRODUCTS

2.01 SIGNAL CHARACTERISTICS

A. Analog Signals:
   1. 4 mA dc to 20 mA dc, in accordance with compatibility requirements of ISA S50.1.
   2. Unless otherwise specified or shown, use Type 2, two-wire circuits.
   3. Transmitters: Load resistance capability conforming to Class L.
   4. Fully isolate input and output signals of transmitters and receivers.

B. Pulse Frequency Signals: dc pulses whose repetition rate is linearly proportional to process variable over 10:1 range. Generate pulses by contact closures or solid-state switches.
   1. Power Source: Less than 30V dc.

C. Discrete Signals:
   1. Two-state logic signals.
   2. Utilize 120V ac sources for control and alarm signals.
   3. Alarm signals shall be normally open, close to alarm isolated contacts rated for 5-ampere at 120V ac and 2-ampere at 30V dc.

2.02 CORROSION PROTECTION

A. Corrosion-Inhibiting Vapor Capsule Manufacturers and Products:
   1. Northern Instruments; Model Zerust VC.
   2. Hoffmann Engineering; Model A-HCI.

2.03 CONTROL PANEL

A. Panel Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), UL 508, state and local codes, and applicable sections of NEMA, ANSI, and ICECA.

B. Conform to NEMA ratings as specified in individual equipment sections.

C. Minimum Metal Thickness: 14 gauge.

D. Refer to Material and Area Classification Table in Contract Drawings for panel construction material and NEMA rating.

E. Doors:
   1. Doors higher than 30 inches:
      a. Three-point latching mechanisms.
      b. Fold-up shelf of sufficient size and weight capacity for supporting a laptop computer.
   2. For other doors, stainless steel quick release clamps.
   3. Doors shall be full-length continuous hinge.

F. Cutouts shall be cut, punched, or drilled and finished smoothly with rounded edges.

G. Access: Front, suitable for installation with back and sides adjacent to or in contact with other surfaces, unless otherwise specified.

H. Temperature Control:
   1. Size panels to adequately dissipate heat generated by equipment mounted on or in the panel.
   2. For panels outdoors or in unheated areas, furnish thermostatically controlled heaters to maintain temperature above 40 degrees F.
   3. Calculate panel heat load and heat dissipation. For panels mounted outdoors in direct sun, include solar gain in heat load calculation. If temperature rise caused by heat load exceeds 10 degrees less than rating of any interior component, then provide means to dissipate heat:
      a. Ventilation Requirements: Indoor, dry, and conditioned environment.
         1) Where panel ventilation will adequately dissipate heat furnish cooling fans with filters near bottom of panel and louvers near top.
         2) When an Uninterruptable Power Supply (UPS) is installed inside the panel, panel ventilation is required with cooling fan(s) positioned to blow across the UPS.
      b. Air Conditioning: Where panel ventilation will not adequately dissipate heat, or in outdoor spaces, furnish panel-mounted air conditioner. Air conditioner to match material and rating of panel enclosure, e.g.; Type 316 stainless steel NEMA 4X air conditioner in Type 316 stainless steel NEMA 4X panels. Provide air conditioners designed for side-panel mounting.

I. Push-to-Test Circuitry: For each push-to-test indicating light, provide a fused push-to-test circuit.

J. Lighting, Internal:
   1. Minimum of one for panels 12 cubic feet and larger.
   2. Provide minimum one for every 3 feet of panel width.

3. Motion controlled 5-watt LED light.

K. Provide 25 percent internal free space inside panel.

L. Minimum of one 120-volt GFCI duplex receptacle for panels 12 cubic feet and larger.

M. Finish:
1. Metallic External Surfaces (Excluding Aluminum and Stainless Steel): Manufacturer's standard gray unless otherwise specified.
2. Internal Surfaces: White enamel.

N. Panel Manufacturers:
1. Hoffman.
2. Saginaw Control & Engineering.

O. Breather and Drains: Furnish with NEMA 250, Type 4 and Type 4X panels.
1. Manufacturer and Product: Cooper Crouse-Hinds; ECD Type 4X Drain and Breather; Drain Model ECD1-N4D, Breather Model ECD1-N4B.

2.04 CONTROL PANEL ELECTRICAL

A. UL Listing Mark for Enclosures: Mark stating "Listed Enclosed Industrial Control Panel" per UL 508A.

B. I&C and electrical components, terminals, wires, and enclosures UL recognized or UL listed.

C. Control Panels without Motor Starters:
1. Furnish main circuit breaker and a circuit breaker on each individual branch circuit distributed from power panel. Main circuit breaker shall have auxiliary contact for breaker position status.
2. Locate to provide clear view of and access to breakers when door is open. Group on single subpanel. Provide typed directory.
3. Circuit Breakers:
a. Coordinate for fault in branch circuit trips, branch breaker, and not main breaker.
b. Branch Circuit Breakers: 15 amps at 250V ac.
c. Breaker Manufacturers and Products:
1) Eaton; Heineman Series AM.
2) Airpax; IULP Series 214.

D. Control Panels with Three-Phase Power Supplies and Motor Starters:
1. Interlock main circuit breaker with panel door.
a. Mount logic controls, branch circuit breakers, overload reset switches, and other control circuit devices.
b. Mount operator controls and indications on front access door.

2. Separation of Power and PLC Control Components:
    a. Separate 480V ac and higher power components and wiring terminations from PLC control components and terminations.
    b. Provide isolation compartment behind separate doors, or interior enclosures to provide this separation.
    c. Access to PLC must be possible without exposure to 480V ac and higher power components.
3. Circuit Breakers:
    a. In accordance with NEMA AB 1.
    b. Breakers, except Motor Branch Breakers: Molded case thermal magnetic.
    c. 42,000-ampere RMS symmetrical rating, minimum at 480 volts, unless otherwise specified in package system equipment specification sections.
    d. Tripping: Indicate with operator handle position.
4. Magnetic Motor Starters:
    a. Full voltage, NEMA ICS 2, Class A, Size 0 minimum.
    b. Include three-pole bimetallic or eutectic alloy thermal overload relays sized for each motor.
    c. Manual reset type with reset button mounted on panel door.
5. Motor Control: 120V ac (except intrinsically safe circuits where applicable).
    a. Power Control Transformer:
        1) Sufficient capacity to serve connected load, including 200VA for duplex outlet plus 100VA (minimum).
        2) Limit voltage variation to 15 percent during contact pickup.
        3) Fuse one side of secondary winding and ground the other.
        4) Furnish primary winding fuses in ungrounded conductors.
6. Phase Monitoring Relay:
    a. Protect three-phase equipment from single phasing, phase imbalance, or phase reversal.
    b. Separate, isolated contact outputs to stop motors and activate alarm light during abnormal conditions.
    c. Transient Voltage Protection: 10,000 volts.
    d. Manufacturer and Product: Eaton; D65 Series.
7. Power Distribution Blocks: Furnish to parallel feed tap on branch circuit protective devices. Do not “leap frog” power conductors.
8. Terminations for Power Conductors: Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

E. Power:
1. Power Supplies:
    a. All power supplies shall be redundant.
    b. Capacity rating 200 percent of calculated load.

2. Panel: All panels shall be built to handle two separate power feeds for power redundancy - primary power feed being 120V ac powered from a battery backed panelboard (included as part of the facility distribution system), and secondary 120V ac utility feed.

F. Wiring:
   1. ac Circuits:
      a. Type: 600-volt, Type MTW stranded copper.
      b. Size: For current to be carried, but not less than 14 AWG.
   2. Analog Signal Circuits:
      a. Type: 300-volt, Type 2 stranded copper, twisted shielded pairs.
      b. Size: 18 AWG, minimum.
   3. Other dc Circuits.
      a. Type: 600-volt, Type MTW stranded copper.
      b. Size: 18 AWG, minimum.
   4. Separate analog and other dc circuits by at least 6 inches from ac power and control wiring, except at unavoidable crossover points and at device terminations.
   5. Enclose wiring in sheet metal raceways or plastic wiring ducts.
   6. Wire Identification: Numbered and tagged at each termination.
      a. Wire Tags: Machine printed, heat shrink.
      b. Manufacturers:
         1) Brady PermaSleeve.
         2) Tyco Electronics.

G. Wiring Interface:
   1. For analog and discrete signal, terminate at numbered terminal blocks.
   2. For special signals, terminate power (240 volts or greater) at manufacturer's standard connectors.
   3. For panel, terminate at equipment on/with which it is mounted.

H. Terminal Blocks:
   1. Quantity:
      a. For external connections.
      b. Wire spare or unused panel mounted elements to their panels' terminal blocks.
      c. Spare Terminals: 20 percent of connected terminals, but not less than 10.
   2. General:
      a. Group to keep 120V ac circuits separate from 24V dc circuits.
      b. Connection Type: Screw connection clamp.
      c. Compression Clamp:
         1) Hardened steel clamp with transversal grooves penetrating wire strands providing a vibration-proof connection.

2) Guides strands of wire into terminal.

d. Screws: Hardened steel, captive, and self-locking.

e. Current Bar: Copper or treated brass.

f. Insulation:

1) Thermoplastic rated for minus 55 degrees C to plus 110 degrees C.

2) Two funnel shaped inputs to facilitate wire entry.

g. Mounting:

1) Rail.

2) Terminal block can be extracted from an assembly without displacing adjacent blocks.

3) End Stops: One at each end of rail, minimum.

h. Wire Preparation: Stripping only.

i. Jumpers: Allow jumper installation without loss of space on terminal or rail.

j. Marking System:

1) Terminal number shown on both sides of terminal block.

2) Allow use of preprinted and field marked tags.

3) Terminal strip numbers shown on end stops.

4) Mark terminal block and terminal strip numbers to match panel construction and wiring drawings.

k. Wire Size: 22 AWG through 12 AWG.

l. Rated Wire Size: 12 AWG.

m. Spacing:

1) Unfused: 0.25 inch, maximum.

2) Fused: 0.32 inch, maximum.

3. Terminal Block, 120-Volt Power:

a. Rated Voltage: 600V ac.

b. Rated Current: 30-amp.

c. Rated Wire Size: 10 AWG.

d. Color: Gray body.

e. Spacing: 0.25 inch, maximum.

4. Terminal Block, Ground:

a. Color: Green and yellow body.

b. Grounding: Ground terminal blocks electrically grounded to the mounting rail.

5. Terminal Block, Blade Disconnect Switch:

a. Use: Provide one for each discrete input and output field interface wire.

b. Rated Voltage: 600V ac.

c. Rated Current: 10-amp.

d. Color: Gray body, orange switch.

6. Terminal Block, Fused, 24V dc:
    a. Rated Voltage: 600V dc.
    b. Rated Current: 6.3-amp.
    c. Color: Gray or beige body.
    d. Fuse: 5 by 20 GMA fuses.
    e. Fuse Marking: Fuse amperage rating shown on top of terminal block.
    f. Indication: LED diode 24V dc.
    g. Leakage Current: 5.2 mA, maximum.
7. Terminal Block, Fused, 120V ac:
    a. Rated Voltage: 600V ac.
    b. Rated Current: 6.3-amp.
    c. Color: Gray or beige body.
    d. Fuse: 5 by 20 GMA fuses.
    e. Fuse Marking: Fuse amperage rating shown on top of terminal block.
    f. Indication: Neon lamp 110V ac.
    g. Leakage Current: 1.8 mA, maximum.
    h. Spacing: 0.32 inch, maximum.

I. Grounding: Internal copper grounding bus for ground connections on panels, consoles, racks, and cabinets.

J. Relays:
1. General:
    a. Relay Mounting: Plug-in type socket.
    b. Relay Enclosure: Provide dust cover.
    c. Socket Type: Screw terminal interface with wiring.
    d. Socket Mounting: Rail.
    e. Furnish holddown clips.
2. PLC Interface Relay:
    a. Type: Narrow design for high density and direct connection of field wiring to relay terminals.
    b. Function: Convert PLC output voltage to dry contact for isolated discrete signal interface.
    c. Relay Mounting: Plug into terminal block style socket.
    d. Socket Mounting: DIN rail.
    e. Socket Width: 0.25 inch nominal.
    f. Coil Voltage: 120V ac.
    g. Coil Power: 0.5 VA.
    h. Expected Mechanical Life: 10,000,000 operations.
    i. Operating Indicator: LED lights when coil is energized.
    j. Contact Arrangement: One Form C, SPDT contact.
    k. Contact Rating: 5A at 24V dc or 250V ac.
    l. Connection Type: Scree compression clamp.

m. Terminal Marking: Numbered with preprinted or field-marked tags.
n. Manufacturers and Products:
1) Phoenix Contact; PLC-RSC-120UC.
2) Allen-Bradley; Bulletin 700-HL Terminal Block Relays.
3) Idec; RV8H series.

3. Control Circuit Switching Relay, Nonlatching:
a. Type: Compact general purpose plug-in.
b. Contact Arrangement: 3 Form C contacts.
c. Contact Rating: 10A at 28V dc or 240V ac.
d. Contact Material: Silver cadmium oxide alloy.
e. Coil Voltage: As noted or shown.
f. Coil Power: 1.8 watts (dc), 2.7VA (ac).
g. Expected Mechanical Life: 10,000,000 operations.
h. Expected Electrical Life at Rated Load: 100,000 operations.
i. Indication Type: Neon or LED indicator lamp.
j. Push-to-test button.
k. Manufacturer and Product: Potter and Brumfield; Series KUP.

4. Control Circuit Switching Relay, Latching:
a. Type: Dual coil mechanical latching relay.
b. Contact Arrangement: 2 Form C contacts.
c. Contact Rating: 10A at 28V dc or 120V ac.
d. Contact Material: Silver cadmium oxide alloy.
e. Coil Voltage: As noted or shown.
f. Coil Power: 2.7 watts (dc), 5.3VA (ac).
g. Expected Mechanical Life: 500,000 operations.
h. Expected Electrical Life at Rated Load: 50,000 operations.
i. Manufacturer and Product: Potter and Brumfield; Series KB/KBP.

5. Control Circuit Switching Relay, Time Delay:
a. Type: Adjustable time delay relay.
b. Contact Arrangement: 2 Form C contacts.
c. Contact Rating: 10A at 240V ac.
d. Contact Material: Silver cadmium oxide alloy.
e. Coil Voltage: As specified or shown.
f. Operating Temperature: Minus 10 degrees C to 55 degrees C.
g. Repeatability: Plus or minus 2 percent.
h. Delay Time Range: Select range such that time delay setpoint fall between 20 percent to 80 percent or range.
i. Time Delay Setpoint: As specified or shown.
j. Mode of Operation: As specified or shown.
k. Adjustment Type: Integral potentiometer with knob external to dust cover.

l. Manufacturer and Products: Potter and Brumfield.
   1) Series CB for 0.1-second to 100-minute delay time ranges.
   2) Series CK for 0.1- to 120-second delay time ranges.

K. Intrinsic Safety Barriers:
   1. Intrinsically Safe Relays: Monitor discrete signals that originate in hazardous area and are used in a safe area.
      a. Manufacturer and Product: Eaton; Series MTL 5500.
   2. Intrinsically Safe Barriers: Interface analog signals as they pass from hazardous area to safe area.
      a. Manufacturer and Product: Eaton; Series MTL 5500.

L. Front-of-Panel Devices:

   1. Manufacturers:
      a. Allen-Bradley.
      b. Eaton/Cutler-Hammer.
      c. General Electric.
      d. Square D.
   2. NEMA 250 Rating:
      a. In NEMA 250, Type 1 and 12 Panels: Industrial, oil-tight Type 12.
      b. In NEMA 250, Type 4X Panels: Heavy-duty, Type 4X watertight, corrosion-resistant service.
   3. Potentiometer Units:
      a. Three-terminal, resolution of 1 percent and linearity of plus or minus 5 percent.
      b. Single-hole, panel mounting accommodating panel thicknesses between 1/8 inch and 1/4 inch.
      c. Include legend plates with service markings.
   4. Indicating Lights:
      a. Heavy-duty, long life LED.
      b. Screwed on prismatic glass lenses in colors noted and factory engraved legend plates for service legend.
   5. Pushbutton, Momentary:
      a. Heavy-duty, industrial type with momentary contacts rated for 10 amperes continuous at 120V ac.
      b. Standard size legend plates with black field and white markings for service legend.
   6. Selector Switch:
      a. Heavy-duty, industrial type with contacts rated for 120V ac service at 10 amperes continuous.
      b. Standard size, black field, legend plates with white markings, for service legend.
      c. Operators: Black knob type.
      d. Single-hole mounting, accommodating panel thicknesses from 1/16 inch to 1/4 inch.

2.05 CONTROLLER

A. Controller:

1. Solid state unit capable of performing same function as conventional relays, timers, counters, sequencers, arithmetic, PID, and other special functions necessary to perform required control functions.
2. Discrete inputs shall be 120V ac or 24V dc. Discrete outputs shall be rated for 2 amps at 120V ac and 24V dc, minimum. Each input and output shall have an LED ON/OFF status indicator.
3. Discrete outputs for interface to external equipment and systems: Provide dry contact interface using one of the following methods:
   a. Provide relay type discrete output module.
   b. Power interposing relay to generate dry contact.
   c. Interposing relay is required for all digital outputs that control motor contactors.
4. Analog Inputs and Outputs:
   a. 4 mA to 20 mA dc per channel.
   b. HART capable.
5. Minimum of 25 percent, wired, excess capacity for inputs, outputs, internal memory, and other necessary functions.
6. Capable of operating in a hostile industrial environment (for example, heat, electrical transients, RFI, and vibration) without fans, air conditioning, or electrical filtering. Units operate from 0 degree C to 60 degrees C and up to 95 percent humidity, noncondensing.
7. Controllers shall be redundant.
8. Manufacturer and Product:
   a. PLC: Allen-Bradley; Control Logix to match plant standard. Provide L7 series CPU with firmware version 24. No substitutions.

B. Operator Interface Unit:

1. Color LCD display with graphics and text displays, screen navigation, status and alarm indication, and operator control and setpoint adjustment.
2. Touch screen, 15-inch.
3. Software: Latest edition of Wonderware InTouch.

C. Communication with Plant SCADA:

1. Method: DCS data communicated over network via Ethernet/IP.
2. IP Address: Assigned during construction to integrate into plant subnet.
3. Redundant communication.
4. Communicated Data:
   a. All alarm conditions.
   b. All equipment running status.
   c. Process data such as level, flow, pressure.
   d. Additionally as specified in package system specification.

2.06 INSTRUMENTATION

A. Tag equipment and instruments with nametags with manufacturer's tag number as well as project specific tag number per design drawings.

B. All instrumentation mounted outside that have a display shall be mounted with a sunshield.

2.07 NAMETAGS

A. Nametags: Permanently mounted bearing entire ISA tag number.
   1. Panel Mounted: Engraved UV resistant plastic, rectangular, minimum 3 inch by 1-1/2 inch by approximate 1/16 inch thick, black facing over white background lettering. Lettering shall be minimum 7/32 inch height. Permanently attached with screws or rivets.
   2. Field Mounted: Embossed stainless steel, rectangular, minimum 3 inch by 1-1/2 inch by approximate 0.015 thick, embossed lettering shall be minimum 7/32 inch height. Permanently attached with screws or rivets.

B. Where permanently mounting a nametag is not possible: Embossed or engraved (not laser engraved) stainless steel, flat, round, minimum 1-1/2 inch diameter. Lettering shall be minimum 7/32 inch height. Permanently attached with twisted stainless steel wire and lead meter seals.

C. Standard Light Colors and Inscriptions: Unless otherwise specified in individual equipment specifications, use the following color code and inscriptions:

Tag	Inscription(s)	Color
ON	ON	RED
OFF	OFF	GREEN
OPEN	OPEN	GREEN
CLOSED	CLOSED	RED
LOW	LOW	AMBER
FAIL	FAIL	AMBER
HIGH	HIGH	AMBER
AUTO	AUTO	WHITE
MANUAL	MANUAL	YELLOW
LOCAL	LOCAL	WHITE
REMOTE	REMOTE	YELLOW
FORWARD	FORWARD	GREEN
REVERSE	REVERSE	BLUE

   1. Lettering: Black on white and amber lenses; white on red and green lenses.

2. Standard Pushbutton Colors and Inscriptions:
   a. Use following unless otherwise noted in Instrument List:

Tag Function	Inscription(s)	Color
OO	ON OFF	Black Black
OC	OPEN CLOSE	Black Black
OCA	OPEN CLOSE AUTO	Black Black Black
OOA	ON OFF AUTO	Black Black Black
MA	MANUAL AUTO	Black Black
SS	START STOP	Black Black
RESET	RESET	Black
EMERGENCY STOP	EMERGENCY STOP	Red

   b. Lettering Color:
      1) Black on white and yellow buttons.
      2) White on black, red, and green buttons.

2.08 ELECTRICAL SURGE AND TRANSIENT PROTECTION

A. Equip control panels with surge-arresting devices to protect equipment from damage as a result of electrical transients induced in interconnecting lines from lightning discharges and nearby electrical devices.

B. Suppressor Locations:
   1. At point of connection between an equipment item, including ac powered transmitters, and power supply conductor (direct-wired equipment).
   2. On analog pairs at each end when the pair travels outside of building.
   3. In other locations where equipment sensitivity to surges and transients requires additional protection beyond that inherent to design of equipment.

C. Suppressor Design:
   1. Construction: First-stage, high-energy metal oxide varistor and second-stage, bipolar silicon avalanche device separated by series impedance; includes grounding wire, stud, or terminal.
   2. Response: 5 nanoseconds maximum.
   3. Recovery: Automatic.

4. Temperature Range: Minus 20 degrees C to plus 85 degrees C.
5. Enclosure Mounted: Encapsulated inflame retardant epoxy.

D. Suppressors on 120V ac Power Supply Connections:
1. Occurrences: Tested and rated for a minimum of 50 occurrences of IEEE C62.41 Category B test waveform.
2. First-Stage Clamping Voltage: 350 volts or less.
3. Second-Stage Clamping Voltage: 210 volts or less.
4. Power Supplies for Continuous Operation:
a. Four-Wire Transmitter or Receiver: Minimum 5 amps at 130V ac.
b. All Other Applications: Minimum 30 amps at 130V ac.

E. Suppressors on Analog Signal Lines:
1. Test Waveform: Linear 8-microsecond rise in current from 0 amp to a peak current value followed by an exponential decay of current reaching one-half the peak value in 20 microseconds.
2. Surge Rating: Tested and rated for 50 occurrences of 2,000-amp peak test waveform.
a. dc Clamping Voltage: 20 percent to 40 percent above operating voltage for circuit.
b. dc Clamping Voltage Tolerance: Plus or minus 10 percent.
c. Maximum Loop Resistance: 18 ohms per conductor.

F. Manufacturers and Products:
1. Analog Signals Lines: Emerson; SolaHD STC-642.
2. 120V ac Lines: Emerson Edco; HSP-121.
3. 480-Volt, Three-Phase Power Supplies: Square D; Model SDSA3650.
4. Field Mounted at Two-Wire Instruments:
a. Encapsulated in stainless steel pipe nipples.
b. Emerson Edco; SS64 series.
5. Field Mounted at Four-Wire Instruments: With 120V ac outlet, ac circuit breaker, and 10-ohm resistor on signal line, all in enclosure.
a. Enclosure:
1) Refer to Material and Area Classification Table in Contract Drawings for panel construction material and NEMA rating.
2) Maximum Size: 12 inches by 12 inches by 8 inches deep.
b. Emerson Edco; SLAC series.

G. Grounding:
1. Coordinate surge suppressor grounding in field panels and field instrumentation per manufacturer’s requirements.
2. Provide control panels with an integral copper grounding bus for connection of suppressors and other required instrumentation.

PART 3 EXECUTION

3.01 ELECTRICAL POWER AND SIGNAL WIRING

A. Restrain control and signal wiring in control panels by plastic ties or ducts. Secure hinge wiring at each end so bending or twisting will occur around the longitudinal axis of wire. Protect bend area with a sleeve.

B. Arrange wiring neatly, cut to roper length, and remove surplus wire. Install abrasion protection for wire bundles passing through holes or across edges of sheet metal.

C. Use manufacturer's recommended tool with sized anvil for crimp terminations. No more than one wire may be terminated in a single crimp lug. No more than two lugs may be installed on a single screw terminal.

D. Do not splice or tap wiring except at device terminals or terminal blocks.

3.02 STARTUP AND TESTING

A. Provide Functional Tests and Performance Tests of the complete control system including software functions to support startup of plant.

B. Prior to facility startup, inspect, test, and document that the control system is ready for operation.

C. Verify instruments, panels, and components for proper installation, calibration, and adjustment, on a loop-by-loop and component-by-component basis. Document results on loop test status reports, instrument calibration sheets, test forms, and check lists.

D. Perform functional tests including software functions and data communications for all control, monitoring and alarm loops and document test results on test procedure forms.

E. Provide on-site testing and startup time devoted to data exchange testing, message validation and network timing validation with plant SCADA.

3.03 PROTECTION

A. Protect enclosures and other equipment containing electrical, instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules.

B. During Work, periodically replace capsules in accordance with capsule manufacturer's recommendations. Replace capsules at Substantial Completion.

END OF SECTION

SECTION 41 22 23.20
HORIZONTAL WINCH HOISTS

EQUIPMENT AND COMPONENT NUMBER(S)

14MTR9525-01: Screenings Winch 1.
14MTR9525-02: Screenings Winch 2.

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Related sections include the following:
   1. Division 01, General Requirements.
   2. Section 05 05 19, Anchor Bolts.
   3. Section 26 05 26, Grounding and Bonding for Electrical Systems.
   4. Section 26 20 00, Low-Voltage AC Induction Motors.
   5. Section 40 99 90, Package Control Systems.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this Section:
   1. National Electrical Manufacturer's Association (NEMA):
      a. MG 1, Motors and Generators.
      b. 250, Enclosures for Electrical Equipment (1,000 volts maximum).
   2. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
   3. Occupational Safety and Health Act (OSHA).

1.03 DESIGN REQUIREMENTS

A. Stress and Safety Factors: ASME B30.7. Properly select materials of construction for stresses to which subjected.

B. Safety of Operation, Accessibility, Interchangeability, and Durability of Parts: ASME B30.7 and OSHA requirements.

C. Provide system, equipment, and components, including supports and anchorages, designed in accordance with Section 01 61 00, Common Product Requirements.

1.04 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Make, model, weight, and horsepower of each equipment assembly.
      b. Complete catalog information, descriptive literature, materials of construction, and specifications on all components part of assembly.
      c. Detail Shop Drawings of winch.
      d. Power and control wiring diagrams, including terminals and numbers for internal and customer connections.
      e. Motor nameplate data in accordance with NEMA MG 1, and include any motor modifications.
      f. Factory finish system.
      g. Submit anchorage and bracing drawings and cut sheets as required in Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:
   1. Submit anchorage and bracing calculations as required in Section 01 88 15, Anchorage and Bracing.
   2. Manufacturer's printed installation instructions.
   3. Suggested spare parts list to maintain the equipment in service for a period of 2 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
   4. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
   5. Operation and Maintenance Data: As specified in Section 01 78 23, Operation, Maintenance, and Asset Data.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Design Temperature: Maximum 104 degrees F; minimum 34 degrees F.

B. Humidity: 90 percent maximum to 10 percent relative humidity.

C. Atmosphere: Mildly corrosive; located under open-sided canopy.

PART 2 PRODUCTS

2.01 SUPPLEMENTS

A. See supplements to this Section for additional requirements.

2.02 WINCH

A. Winch shall consist of rope drum driven through gear reductions, hook, Type 316 wire rope, sheaves, and automatic internal braking system. Provide minimum 50 feet of wire rope. Winch shall be rated for intermittent duty cycle.

B. Rope drum and surrounding members constructed to minimize abrasion, crushing or jamming of winch rope. Rope drum shall include a manual freespool lever.

C. Hook: Construct with sufficient ductility to open noticeably before hook failure, equipped with safety latch, free to rotate 360 degrees with rated load and positively held in place with locknuts, collars or other devices.

2.03 ELECTRICAL

A. Furnish electrical equipment including motors and pendant control.

B. Electrical: In accordance with NFPA 70, NEC Article 610 and Section 26 20 00, Low-Voltage AC Induction Motors.

C. Grounding: External in accordance with NFPA 70, NEC Article 250 and Section 26 05 26, Grounding and Bonding for Electrical Systems.

2.04 CONTROLS

A. In accordance with general control requirements specified in Section 40 99 90, Package Control Systems.

B. Winch: Two button pendant control having momentary contact pushbuttons with a device which will disconnect motors from line on failure of power.

C. Pushbuttons: Fully magnetic, plain reversing type, housed in NEMA 250, Type 4X enclosure, with contactors of sufficient size and quantity for starting, accelerating, reversing, and stopping duty for specified winch.

D. Packaged system wiring from controls from a single 480V ac, three-phase connection, including dc power supply for 24V dc controls.

2.05 ACCESSORIES

A. Equipment Identification Plate: Provide 16-gauge Type 316 stainless steel identification plate securely mounted in a readily visible location. Plate shall bear 3/8-inch high engraved block type black enamel filled equipment identification numbers and letters

B. Lifting Lugs: Provide suitably attached for equipment assemblies and components weighing over 100 pounds.

C. Anchor Bolts: For anchor bolt and post-installed concrete and masonry anchor requirements, refer to Section 05 05 19, Anchor Bolts.

2.06 FACTORY FINISHING

A. Provide manufacturer's standard industrial service factory finish system.

2.07 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect control panels and equipment for required construction, electrical connection, and intended function.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

B. Provide lubrication and lubrication fittings.

3.02 FIELD FINISHING

A. Repair damaged factory finishes as recommended by the manufacturer.

3.03 FIELD QUALITY CONTROL

A. Functional Tests: Conduct on each hoist.
   1. Alignment: Test complete assemblies for proper alignment and connection, and quiet operation.

3.04 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by Owner for minimum person-days listed below, travel time excluded:
   1. 1/2 person-day for installation assistance and inspection.
   2. 1/2 person-day for functional and completion of Manufacturer's Certificate of Proper Installation.

B. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

3.05 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this Specification.
   1. Screenings Dumpster Cable Winch Hoists Data Sheet.

END OF SECTION

SCREENINGS DUMPSTER
CABLE WINCH HOISTS DATA SHEET

Project: San José Headworks Project

Manufacturer: Columbia Winch; or equal

Owner: San Jose-Santa Clara Regional Wastewater Facility

Model No.: WN20000

Service: Screenings Dumpster Cable Winch Hoists

Number of Units: 2

Equip. Tag Number(s): 14MTR9525-01, 14MTR9525-02

Rev/Date/By: ____/___/_____

GENERAL REQUIREMENTS

Equipment Capacity: 20,000 lbs. F

Factory Testing:

☒Required ☐Not Required

Field Testing: ☐Not required

☒Required, functional and Performance

Power Supply:

Voltage: _____

Phase: _____

Frequency _____

Method of Control: Pendant

Location of Control: _____

Equipment Location:

☐Indoors ☒Outdoors

WINCH

Type:

☒Electric, Wire Rope ☐Hand Operated, Chain

Service Class (ANSI):

☐H1 (standby) ☐H2 (light) ☒H3 (standard)

☐H4 (heavy) ☐H5 (severe)

Speed (fpm): _____ to _____

☒Constant Speed ☐Two Speed ☐Variable Speed

Motor hp: 7.5

Hook Travel: _____

Hook Manufacturer: Per manufacturer's standard

Reeving: Single

SECTION 44 31 00
BIOTRICKLING FILTER SYSTEM

EQUIPMENT AND COMPONENT NUMBER(S)

14TWR9705-01: Biotrickling Filter 1.
14PMP9708-01: Biotrickling Filter Recirculation Pump.
14PMP9715-01: Nutrient Feed Pump.
14FAN9701-01: Odor Control Exhaust Fan 1.
14FAN9701-02: Odor Control Exhaust Fan 2.

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Related sections include the following:
   1. Division 01, General Requirements.
   2. Section 05 05 19, Anchor Bolts.
   3. Section 05 50 00, Metal Fabrications.
   4. Section 09 90 00, Painting and Coating.
   5. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
   6. Section 23 31 16.16, Foul Air Ductwork and Accessories.
   7. Section 26 20 00, Low-Voltage AC Induction Motors.
   8. Section 40 27 00, Process Piping—General.
   9. Section 40 27 02, Process Valves and Operators.
   10. Section 40 99 90, Package Control Systems.

1.02 REFERENCES

A. The following is a list of standards which referenced in this Section:
   1. American National Standards Institute (ANSI).
   2. American Society of Mechanical Engineers (ASME).
   3. ASTM International (ASTM):
      a. C582, Standard Specification for Contact Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
      b. D2563, Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts.
      c. D2583, Standard Test Method for Indentation hardness of Rigid Plastics by Means of a Barcol Impressor.
      d. D2584, Standard Test Method for Ignition Loss of Cured Reinforced Resins.
      e. D3299, Standard Specification for Filament-Wound, Fiberglass Reinforced Thermoset Resin Chemical Resistant Tanks.

f. D3982, Standard Specification for Contact Molded, “Fiberglass” (Glass Fiber Reinforced Thermosetting Resin) Ducts.

g. D4097, Standard Specification for Contact Molded, Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks.

h. E544; Standard Practices for Referencing Suprathreshold Odor Intensity.

i. E679; Standard Practice for the Determination of Odor and Taste Thresholds by a Forced-Choice Ascending Concentration Series Method of Limits.

4. Institute of Electrical and Electronic Engineers (IEEE).
5. National Electrical Manufacturers Association (NEMA).
6. National Electrical Code (NEC).
7. National Fire Protection Association (NFPA): 820; Fire Protection in Wastewater Treatment and Collection Systems.
8. National Institute of Standards and Technology (NIST).

1.03 DEFINITIONS

A. The following is a list of abbreviations which may be used in this Section:
1. BOD: Biological Oxygen Demand.
2. COD: Chemical Oxygen Demand.
3. DCS: Distributed Control System.
4. D/T: Dilutions to Threshold.
5. FRP: Fiberglass Reinforced Plastic.
6. hp: Horsepower.
7. OSHA: Occupational Safety and Health Administration.
8. ppbv: Parts Per Billion, by volume.
9. ppmv: Parts Per Million, by volume.
10. TSS: Total Suspended Solids.
11. H_2S: Hydrogen Sulfide.

1.04 SYSTEM DESCRIPTION

A. General: Two biological treatment approaches are available in the marketplace. The first is a once-through type system without recirculation. This type of system is generally designated as a biotrickling type filter. The second is a recirculation system with permanent recirculation pump. This type of system is generally designated as a bioscrubber. A once-through type system (biotrickling filter) is considered the only acceptable type herein with recirculation utilized for startup only. However, the recirculation pump shall remain as a permanent component in case re-acclimation is required in the future. The pump and associated components may remain in place as part of the overall system package or may be stored for future usage in case re-acclimation is required.

B. Design Requirements:

1. Refer to Contract Drawings for additional information to supplement this section.
2. Structural design shall be prepared and sealed meeting requirements of Article Qualifications.
3. All control components located within 3 feet of odorous air leakage sources shall be UL listed for use in Class 1, Division 2, Group D hazardous area and shall be installed in compliance with NEC 500, 501.
    a. Biotrickling Filter control panel (water panel) shall be located outside the Class 1, Division 2, Group D impact zone.
4. All mechanical components shall be designed and constructed in accordance with the latest edition and revision of all applicable codes and regulations, including the following:
    a. NIST.
    b. ASTM.
    c. ANSI.
    d. ASME.
5. Equipment Components: Seismic and wind effects shall be considered in design of the equipment, attachments and supports and shall include the dynamic effects of the equipment, contents, and supports. Seismic and wind design criteria are as required for Biotrickling Filter anchorage.
    a. For Code Prescribed Loading, reference General Structural Notes in the Contract Drawings.
6. Equipment Materials: All components of the System shall be compatible with the conditions and chemicals to which they will be subjected to during normal operation.

C. Unit Responsibility and Scope of Supply:

1. A complete Biotrickling Filter System (System) shall be provided by a single Supplier having complete system responsibility. The system shall include but not be limited to:
    a. Biotrickling Filter vessel.
    b. Biotrickling Filter media.
    c. Biotrickling Filter fans.
    d. Permanent recirculation pump.
    e. Irrigation system and associated vessel interior piping and spray nozzles.
    f. Water panel (nutrient pump, interior piping, valves, controls).
    g. Control systems complete with all accessories and appurtenances, including instruments.
2. Provide media and components suitable for the service conditions listed herein.

3. Provide and guarantee the required hydrogen sulfide removal performance and overall odor removal as measured by dilutions to threshold (D/T) listed herein.
4. Provide all components and accessories of the system to enhance compatibility, ease of operation and maintenance, and as necessary to place the equipment in operation in conformance with the specified performance, features and functions.
5. The Supplier is responsible for the Biotrickling Filter vessel design including all layouts, structural calculations for floors and walls, and vessel material sizing.
6. The Subcontractor shall be responsible for coordinating with the Supplier for Subcontractor's Scope of Supply and Installation Requirements including layout dimensions and coordination with adjacent work, drains, and utility connections.
7. The Subcontractor shall be responsible for, but not limited to, the following:
    a. Odorous air ductwork including dampers and interconnecting ductwork between Biotrickling Filter fan and Biotrickling Filter vessel.
    b. Installation and assembly of all equipment and instrumentation components for a complete system including labor.
    c. Site preparation and clearing of materials.
    d. External water piping and drain piping to and from the System.
    e. Biotrickling Filter recirculation piping between the water panel and the vessel and between the vessel and the recirculation pump.
    f. Utility requirements, including main electrical service and field wiring outside the main Biotrickling Filter water panel, water supply, sanitary drain.
    g. Balancing of odorous air system per Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
    h. Confirmation of all field measurements and elevations.

1.05 SUBMITTALS

A. Action Submittals:
1. Submit Shop Drawings as follows:
    a. Make, model, weight, and horsepower of each equipment assembly.
    b. Supplier's catalog information, descriptive literature, specifications, and identification of materials of construction.
    c. Drawings and Calculations:
        1) All structural drawings and calculations shall be signed and sealed by a Professional Engineer licensed in the State of California.
        2) Provide detailed Structural and Mechanical Layout Drawings showing system fabrication, dimensions, size and locations of connections to other work and fully describing system operation.

3) Provide complete process mechanical design calculations for odor control system, which shall include but not be limited to the following:
   a) Estimated annual utility usage (water and power).
   b) Estimated nutrient monthly use and cost.
   c) Biotrickling Filter pressure drop under rated air flows.

4) Provide structural calculations and drawings for the vessels, which shall include, but not be limited to, consideration of the following:
   a) Dead loads.
   b) Live loads.
   c) Environmental loads (wind, snow, seismic).
   d) Anchor lug attachment to shell.
   e) Anchor bolt size and embedment requirements.
   f) Consideration of effect of all cutouts and openings into the vessel wall.
   g) Attachment lugs for piping, structural members, and other appurtenances.
   h) Packing support design.

d. Process and Instrumentation Drawings (P&ID) showing all components, flow rates, unit requirements, discrete signals with voltage rating and analog signals with mA rating, indicate components requiring power and what their voltage rating is.

e. Control System: Submittal shall comply with specific requirements of Section 40 99 90, Package Control Systems.

f. Motors: Per Section 26 20 00, Low-Voltage AC Induction Motors.

g. Vessel data indicating pressure rating, diameter, straight shell lengths, overall lengths, wall thickness, and details of irrigation nozzle designs.

h. Fan performance curves showing pressure, flow, horsepower, and fan efficiency for given fan speed. Provide maximum allowable rpm. Provide noise data for both inlet/discharge and radiated.

i. Pump performance data curves showing head, capacity, horsepower demand and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, and overall efficiency.

j. Supplier's Information on the Biotrickling Filter Media:

   1) Media Physical Characteristics, including:
      a) Pressure drop data through media.
      b) Media Volume/stage.
      c) Media Depth/stage.
      d) Number of stages per Biotrickling Filter.
      e) Resulting Empty Bed Retention time in media at rated flow(s).

   2) Expected compaction rates of the media.

k. External utility requirements such as air, water, power, drain, etc., for each component including required flow rates and pressures.

l. Detailed requirements for Biotrickling Filter system foundations.

m. Functional description of internal and external instrumentation to be supplied including list of parameters monitored, controlled, or alarmed.

n. Water panel elevation drawings showing construction and placement of operator interface devices and other elements.

o. Power and control wiring diagrams, including terminals and numbers.

p. Shop and Field Painting Systems: Include supplier's descriptive technical catalog literature and specifications.

q. Detailed Performance Testing Plan which Includes:

1) Test equipment and apparatus.

2) Calibration and setup procedures.

3) The specific testing methodology to be used.

4) The sampling and analysis procedures.

r. Final Performance Test Report: Narrative of the sampling activities, a copy of the original sampling log, photographs showing locations of velocity and pressure measurements, tabular summary of velocity, airflow rates, pressure, H_2S removal data, calculated results, and conclusions of these results.

s. All deviations and/or exceptions to this Section, detailed and explained with the reason for the deviation and the effect of the deviation on the operation and/or performance of the equipment.

B. Informational Submittals:

1. Submit anchorage and bracing calculations required in Section 01 88 15, Anchorage and Bracing.

2. Component and attachment seismic qualification certificate of compliance as required by Section 01 45 36, Equipment Seismic Certification.

3. Manufacturer's Certificate of Compliance.

4. Factory test report and airflow modeling report.

5. Operation and Maintenance Data.

6. Manufacturer's Certificate of Proper Installation.

7. Manufacturer's Training Program.

8. Equipment Testing and Field Startup Report.

9. Installation list showing experience with similar installations, as required by Article Quality Assurance.

10. Statement of Warranty.

1.06 QUALITY ASSURANCE

A. Qualifications:

1. The Supplier shall be recognized in the design, production and operation of biological air treatment systems in the United States.

2. The Supplier shall have at least 10 years' experience in design and fabrication of biological odor control systems similar to the type specified for this Project.
3. Similar Projects:
    a. The Supplier shall provide a list of at least 10 biological air treatment installations associated with the removal of hydrogen sulfide and/or other typical organic municipal wastewater odor causing compounds. At least two systems must be of comparable size in terms of airflow.
    b. The list shall include verifiable contact names, telephone numbers and length of service for each named installation.
    c. Installations shall be wastewater applications comparable to the type specified for this Project.
    d. The list shall be for applications using the specific type of media being proposed.
4. The Supplier's place of business shall be open for inspection.
5. The Supplier shall provide the Owner with training and field monitoring support service during the first year of operation.

1.07 SPECIAL GUARANTEE

A. General: In addition to standard warranty requirements stipulated in Contract Documents, provide special guarantee as described herein.

B. The Performance Guarantee, Biotrickling Filter Media Warranty and Biotrickling Filter Vessel Warranty shall be issued from the Supplier to the Owner in the form of a certificate signed by the Supplier that contains the conditions of the warranties as outlined in this Section. The certificate shall be issued no later than substantial completion.

C. Performance Guarantee:
1. Supplier shall Guarantee that the System shall provide H_2S removal and overall Odor removal as measured by H_2S ppmv and Odor D/T percent reduction, respectively, in accordance with the specified removal efficiencies for a period of 12 months after substantial completion of the system.
    a. If the media is shown to be the cause of not meeting the guarantee then the Supplier shall at his sole discretion either (a) add new media or (b) repair or replace any part of the defective media or (c) replace the entire media bed at no cost to the Owner.
    b. One-time performance testing as described herein shall be means of proving performance criteria is met.
2. This Guarantee shall be contingent on the following conditions:
    a. The Owner must ensure that System is operated and maintained as verified through written records in accordance with specified design criteria and in accordance with the instructions provided in the Supplier's operation and maintenance manuals.

D. Biotrickling Filter Media Warranty:
   1. The warranty period shall be for 10 years and begin on the date of substantial completion.
   2. The warranty shall provide that:
      a. The media shall not shrink or compact by more than 10 percent of the original bed depth.
      b. The media shall not degrade or decompose during the warranty period.
      c. The media shall not experience a 15 percent increase in head loss across the media at the design airflow.
      d. If the media does shrink or compact by more than 5 percent of the original bed depth or if the media is found, upon examination, to have degraded or decomposed or to be defective in material or workmanship or if the media begins to create a 15 percent increase in head loss across the media at the design airflow then the Supplier shall at the Supplier's sole discretion either (a) add new media or (b) repair or replace any part of the defective media or (c) replace the entire media bed at no cost to the Owner. Supplier shall reinstate the original media warranty with the new media.
   3. This Warranty shall be contingent on the following conditions:
      a. The Owner must ensure that System is operated and maintained in accordance with specified design criteria through written records and in accordance with the instructions provided in the Supplier's operation and maintenance manuals.

E. Biotrickling Filter Vessel Warranty:
   1. The warranty period shall be for 10 years and begin on the date of Substantial Completion.
   2. The integrity of the vessel shall be warranted.

PART 2 PRODUCTS

2.01 GENERAL

A. The Supplier shall furnish and assist in the installation of Biotrickling Filter system.

B. System will include one Biotrickling Filter system for treating odorous air from the Headworks Facility.

2.02 MANUFACTURERS

A. Materials, equipment, components, and accessories specified in this Section shall be products of:
   1. BioAir Solutions, LLC.
   2. ECS.

3. Daniel Mechanical.
4. No “or-equal” or substitute products will be considered.

2.03 SERVICE CONDITIONS

A. The system shall be designed to remove odorous constituents from process air stream under the following operating conditions:

Process Parameter	Value
Duty	Continuous
Location	Outdoors
Inlet Air Temperature	36 to 100 degrees F
Air Flow rate	9,400 cfm
Average Inlet Relative Humidity	60 to 100%
Type of Contaminants	H_2S and Reduced Sulfur Organic compounds and other odors typical of Municipal Wastewater Applications
H_2S at Inlet	Average 35 ppmv Peak 210 ppmv
D/T at Inlet	Average 35,000 D/T Peak 210,000 D/T
Reduced Sulfur Compounds	Total sulfur compounds not including hydrogen sulfide per ASTM D5504-01 adding up to less than 10 ppm.
H_2S Removal Requirements (this requirement is tied to a performance testing guarantee)	For inlet concentrations $\geq$ 10 ppmv, 99% removal For inlet concentrations < 10 ppmv, outlet H_2S concentration $\leq$ 0.1 ppmv
Odor Removal Requirements (this requirement is tied to a performance testing guarantee)	D/T Odor Reduction: 90% removal or <500 OU, whichever is greater

B. The system shall conform to the following parameters:

Design Parameter	Value
Empty Bed Residence Time (This is the minimum acceptable value. Provide a higher value if required to meet the performance requirements.)	As required to meet H_2S and Odor (D/T) removal criteria, but no less than: 15 seconds at 9,400 cfm
Instantaneous Water Supply	Not to exceed instantaneous 34 gpm maximum. Note: A minimum of 65 psi water pressure will be available at the water panel inlet.
WTR3 Spray Water Quality (treated plant effluent) Primary Irrigation Source	COD: <50 mg/L BOD: <10 mg/L N_{tot}: 8 – 16 mg N/L P_{tot}: 0.4 – 2.1 mg P/L Chlorine: 0.5 mg/L TSS: <10 mg/L Salts: <2,000 ppm (NaCl, KCl etc.) Hardness: <400 mg/L (when operated at pH 2)
WTR1 Spray Water Quality (non-potable water) Secondary Irrigation Source	Potable water quality
Air Pressure Drop	Maximum: 4.6 inches WC across the Biotrickling Filter vessel

2.04 SYSTEM COMPONENTS

A. Biotrickling Filter Vessel:
   1. General:
      a. Free standing tower including media and top spray media bed irrigation system.
      b. Designed to support the required number of media layers and treatment stages.
      c. Inspection windows, man-ways, drains, etc., provided as needed for inspection and access to internals of the Biotrickling Filter and drainage of the Biotrickling Filter. At least one access-way per stage or lift of media (if media replaced by vacuuming out old media and dumping in new media) and spray nozzle assembly.
      d. No exposed metal allowed inside the air plenum.

e. Vessel shall be configured to accept exhaust from the odorous air fan and discharge treated exhaust from an integral top mounted exhaust stack that freely disperses upward (i.e., rain hats are not allowed).

2. Vessel Construction: Fiberglass Reinforced Plastic (FRP) only. HDPE is not acceptable.
   a. Material – FRP:
      1) Vessel to be filament wound in accordance with ASTM D2399, Type II, Grade 1.
      2) Vessel to be designed for positive pressure service conditions.
      3) Contact molded components and accessories shall be fabricated in accordance with ASTM D4097.
      4) Visual defects shall be in accordance with ASTM C582.
      5) Nozzles: Flanged with gussets as required per ASTM D3299, Section 6.3.5.3. Nozzles 4 inch (100 mm) and smaller shall be supported by a suitable gusseting technique using either plate gussets or conical gussets. Plate gussets, where provided, shall be evenly spaced around the nozzle and are to be added after complete assembly by the nozzle on the shell. Larger nozzles, subject to superimposed mechanical forces, require special consideration. Flange diameters and drillings shall meet ANSI B16.5 150-pound standard and shall be rated at 100 psi. Back face of flanges shall be spot-faced, flat and parallel to flange face of sufficient diameter to accept SAE metal washer under bolthead or nut. Gaskets to be 1/8-inch thick Ethylene Propylene Rubber (EPR) full-face gaskets of 40 durometer to 50 durometer. Press-molded flanges are not acceptable.
      6) Resin:
         a) Resin shall be premium corrosion-resistant vinyl ester resin such as Ashland Chemical Hetron FR 992 or Derakane 510-A. Vinyl ester resin must be provided, no substitute.
         b) FRP fabrications shall not exceed a flame spread index of 25 when tested in accordance with ASTM E84 Tunnel Test.
         c) Add ultraviolet absorbers to surfacing resin to improve weather resistance.
         d) Color: Use no dyes, pigments, or colorants, except in the exterior gel coat.
         e) Curing System: Per Supplier's recommendations.
         f) Jacobs reserves the right to test the vessel for resin quality.
      7) Reinforcement:
         a) Veil: Chemical surfacing mat, Type C (chemical) glass, 10 mils thick, with a finish and a binder compatible with the lay-up resin.

b) Corrosion Barrier: Resin-rich interior surface of nominal 100 mils using chopped strand mat backing the veil. Use no additive in the corrosion barrier.
c) Chopped Stand Mat: Type E glass, minimum 1-1/2 ounces per square foot, with silane finish and styrene soluble binder.
d) Continuous Roving Used in Chopper Gun for Spray-Up: Type E glass.
e) Woven Roving: Type E glass, nominal 24 ounces per square yard, 4 by 5 weave, with silane type finish.
f) Continuous Roving Used for Filament Winding: Type E glass with a silane type finish, with a nominal yield of at least 110 strand yards per pound.

8) Laminate:
a) Laminate shall consist of an inner surface (corrosion barrier), an interior layer, and an exterior layer.
b) Reinforce inner surface with a resin-rich surfacing veil of 10 mils to 20 mils thick.
c) The resin content of the inner surface shall be minimum of 80 percent by weight.
d) Construct interior layer of resin reinforced with at least two plies of chopped strand mat. Thickness of interior layer shall be at least 100 mils.
e) Glass content of combined inner surface and interior layer shall be 27 percent plus or minus 5 percent.
f) The exterior or structural layer shall be filament wound. Filament winding shall be with continuous strand roving to provide a glass content of 50 percent to 80 percent.
g) Outer Color Requirements: Owner selected.

b. Workmanship:
1) Finished tank wall shall be free, as commercially practicable, of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking and delaminations that will impair the serviceability of the vessel.
2) All cut edges where openings are cut into the tanks shall be trimmed smooth.

c. Dimensions and Tolerances:
1) The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support.
2) All dimensions will be taken with the tank in the vertical position, unfilled.
3) Tank dimensions will represent the exterior measurements.
4) The tolerance for the outside diameter, including out of roundness, shall be per ASTM D3299.

5) The tolerance for fitting placements shall be plus or minus 0.5 inch in elevation and 2 degrees radial at ambient temperature.

d. Tank Access:
   1) Provide sealed manway(s), constructed of same material as vessel.
   2) Bolts shall be Type 316 stainless steel.
   3) The gaskets shall be Hypalon as specified herein.

e. Tank Attachments:
   1) Down pipes and fill pipes shall be supported at 5-foot maximum intervals with support structures.
   2) Sample tubing and differential pressure tubing shall be supported from the tank exterior wall with integral support brackets at maximum 2-foot intervals.
   3) Vertical ducting for serving future carbon polishing system shall be supported from the tank exterior wall with integral support brackets at maximum 8-foot intervals.

f. Packing Support:
   1) Quantity: Sufficient to hold packing plus entrained irrigation liquid.
   2) Opening size shall not allow passage of packing media.

g. Marking:
   1) On small plate, identify vessel with the fabricator's name, maximum temperature, design pressure/vacuum, diameter and height, vessel number, vessel name, and date of manufacture.
   2) No large signage with vendor name is allowed on vessel.

h. Stack Extension:
   1) Provide stack extension such that top of stack is minimum 35 feet above adjacent finished grade.
   2) Stack shall be a freestanding cantilever design with a flange connection to the outlet. No guy wires or external support structure will be allowed.
   3) Provide an exit cone to ensure a minimum exit velocity of 2,800 fpm at design air flows. Taper angle shall not exceed 30 degrees.
   4) Stacks shall be FRP.
   5) Stack assembly shall be provided with tee, dampers, and ducting for future connection to carbon polishing stage. Sizes and configuration shall be as shown on Drawings.

3. Access Ladder and Platform:
   a. Access ladder and platform shall be provided for each vessel.
   b. Platform shall allow access to all manways, viewports, and discharge stack.

c. The platforms and ladders shall be of FRP construction.

d. Provide handrailing and accessories meeting all local and OSHA requirements.

e. All fasteners shall be of Type 316 stainless steel.

4. Gaskets:

a. Material: Hypalon.

b. Thickness: 3/16-inch minimum.

c. Hardness: Shore A hardness of 50 to 60.

5. Synthetic Media (Media Type No. 1):

a. Composed of high porosity, chemically resistant polyurethane, polyethylene or polyvinyl chloride.

b. Media shall not shrink or swell with varying moisture content.

c. Each media layer shall be capable of supporting its own weight, removable for inspection, cleaning or replacement.

d. Treatment layers must be constructed in a manner to minimize the potential for short circuiting of the air being treated.

e. Sufficient media to provide at least the minimum contact time listed herein and meet the required performance.

f. Nonstructured media is acceptable.

g. Expanded clay or ceramic based media is not acceptable.

h. Organic media (non-inert) materials are not acceptable.

6. Irrigation System:

a. Each reactor shall be configured with at least one fluid injection spray nozzle. If necessary for system operation, additional nozzle arrays shall be provided (e.g., the Biotrickling Filter has two-internal stages).

b. The spray nozzle shall be located above each treatment stage and disperse the fluid evenly over the entire treatment layer.

7. Drain System:

a. Each reactor shall be provided with a 4-inch “normal” drain nozzle at the bottom of the vessel basin.

b. The drain piping shall include a tap for pH measurement. Coordinate piping with Subcontractor.

8. Mist Eliminator: Chevron type mist eliminator shall be provided with a support grid. Mist eliminator and support grid assembly shall be able to pass through a manhole for servicing. Mist eliminator shall remove 90 percent of all entrained water droplets greater than 10 microns in diameter and 99 percent of all droplets greater than 40 microns in diameter.

B. Biotrickling Filter Fan:

1. Performance Requirements:

a. Capacity:

1) The fan must provide stable operation under the conditions listed below.

a) Normal Operating Condition: 9,400 cfm at 8-inches WC total static pressure.

b) Emergency Operating Condition: 9,400 cfm at 14 inches WC total static pressure (includes additional pressure loss of downstream carbon polishing unit).

2) Maximum Speed: 3,300 rpm.

3) Fans shall be nonoverloading at all points on their curve.

4) The duty/operating point (for both normal and emergency operating conditions) shall be located to the right of the curve crest, and sufficiently below the curve crest to allow a minimum of 15 percent of the total rated pressure between the curve crest and the duty/operating point.

b. Drive Type: Variable speed. Drive provided by others.

c. Drive Motor: Maximum motor size 40 hp, 480V ac, three-phase. Electrical motor shall be TEFC, inverter duty, conforming to the applicable portions of Section 26 20 00, Low-Voltage AC Induction Motors. Motor must be suitable for installation in a Class 1, Division 2, Group D environment.

1) Include Motor Winding Temperature sensor, conforming to Section 26 20 00, Low-Voltage AC Induction Motors, Article Special Motors, Paragraph E.

2) Motor shall be low-noise type.

d. Acoustical Levels: The maximum weighted average housing radiated sound power level of the untreated fan, in accordance with AMCA 300 (@ Q=1, 5 feet), shall be 82 dBA.

2. Fan shall be fiberglass reinforced plastic, centrifugal type with one-piece backward-inclined impeller, single-inlet/single-width, industrial fiberglass fan. Wheel hub shall be permanently bonded to shaft and completely encapsulated in FRP. Fan shall be rated and constructed in accordance with AMCA standard test code for centrifugal fans.

3. Fiberglass construction shall conform to ASTM D4167 product standards. Fan resin shall be suitable for exposure to the specified service conditions. Resin shall have a Class I flame spread rate of 25 or less. Outside or exposed surfaces shall be resin-rich, reinforced with a nexus veil. A certificate from the resin supplier listing the nomenclature, composition, and characteristics of the resin shall be furnished with the fans.

4. Fan housing shall be constructed of fiberglass and reinforced with rigid bracing to increase structural integrity.

5. Outlet transition from rectangular to round as shown on Drawings. Connections to FRP ductwork shall conform to ASTM D3982 product standards.

6. Fan housing shall be of a curved scroll design with a minimum 1-inch NPT drain connection at the bottom of the fan scroll. Fan intake and outlets have flanged nozzles.
7. Bearing support brackets shall be positioned to directly oppose belt tension forces.
8. Fan shaft shall be Type 316 solid stainless steel. Fan shall have Teflon (labyrinth) or Viton shaft seals. The seal leak rate shall not exceed 12 cubic feet per hour at 6 psi.
9. Belt and shaft guards/covers shall be OSHA approved. Guard faces of expanded metal having minimum 60 percent free area for ventilation.
10. Flanged flexible connectors for the fan inlet and discharge will be provided.
11. Furnish open spring vibration isolators with neoprene waffle base pads top and bottom selected for 1.5-inch deflection. Provide seismic snubbers for restraints.
12. Flexible connector and ductwork between fan and scrubber vessel shall slope downward toward the vessel to prevent Biotrickling Filter solution from backing up into the fan.
13. A Type 316 stainless steel mounting frame for fan and motor will be provided.
14. Factory install sheaves for design condition.
15. Furnish grease lubricated, precision antifriction self-aligning ball bearings selected for a minimum life L-10 of over 40,000 hours, with an average life L-50 of over 200,000 hours. Bearing mounted in cast iron pillow-block housing.
16. Furnish local safety disconnect switch.
17. Fan scroll shall have a bolted cleanout door fabricated from FRP with neoprene gasketing between flanges. Door shall be bolted with Type 316 stainless steel hardware.
18. Fan shall be Arrangement 1 with motor orientation Position Z.
19. Furnish extended lubrication points.
20. Finishing: Factory prime and finish coat any exposed carbon steel components in accordance with Section 09 90 00, Painting and Coating.
21. Spark Resistant Construction:
    a. Carbon fiber veil impregnated in housing and wheel fiberglass resin corrosion barrier.
    b. Static grounding.
    c. Classification: AMCA 99-0401 Type A.
22. Housing Wrap:
    a. Provide acoustical wrap for fully attenuating fan housing.
    b. Inner Jacketing, Outer Jacketing, Gussets: 17 ounce per square yard Teflon impregnated fiberglass cloth.
    c. Liner: 16.5 ounce per square foot mass loaded acoustical septum. Provide double layer separated by air gap.

d. Insulation: Minimum 3-inch thick combination of No. 11 density needled fiberglass, No. 6 density needled fiberglass, and No. 3 density ET blanket fiberglass.
e. Thread: Teflon-coated fiberglass thread.
f. Attachments: Teflon cloth belts with stainless steel double O-rings. Hook and loop seam fastener.
g. Reduce noise level from fan housing to 62 dBA at 5 feet.
h. Suitable for outdoor application. Jacketing easily removeable and UV resistant.
i. Manufacturer and Product:
1) Advance Thermal Corp: Acoustirap.
2) "Or-equal."

23. Manufacturers:
a. Verantis.
b. New York Blower.
c. Hartzell.
d. No "or-equal."

C. Recirculation Pump:
1. Liquid Pumped: BR (Biotrickling Filter Recirculation).
2. Materials of construction shall be compatible with pumping water at pH: 1 – 2.
3. Pump Capacity: As required for proper Biotrickling Filter startup operation.
4. Total Dynamic Head: As required for proper Biotrickling Filter startup operation.
5. Magnetic, seal less drive.
6. Drive Motor: Maximum motor size: 2 hp, 480V ac, three-phase. Electrical motor shall be TEFC and inverter duty, conforming to the applicable portions of Section 26 20 00, Low-Voltage AC Induction Motors. Motor must be suitable for installation in a Class 1, Division 2, Group D environment.
7. Manufacturers:
a. Grundfos.
b. Vanton.
c. "Or-equal."

D. Nutrient Metering Pump:
1. Liquid Pumped: Nutrient feed.
2. Materials of construction shall be compatible with pumping supplied nutrient.
3. Pump Capacity: As required for proper Biotrickling Filter operation.
4. Total Dynamic Head: As required for proper Biotrickling Filter operation.

5. Drive Motor:
    a. Maximum Motor Size: 0.5 hp, 120V ac, single-phase. Electrical motor shall be TEFC and inverter duty, conforming to the applicable portions of Section 26 20 00, Low-Voltage AC Induction Motors.
6. Manufacturers:
    a. LMI.
    b. Wallace and Tiernan.
    c. "Or-equal."

E. Nutrient Tank:
1. Polypropylene or HDPE tank with drain.
2. Volume: To provide a 1 month supply.

F. Basket Strainer:
1. Service: WTR3 water, simplex type.
2. ANSI Class 150, threaded end connections.
3. Quick-opening cover.
4. WOG (non-shock): 275 psi at 100 degrees F.
5. Materials of Construction:
    a. Body: Type 316 stainless steel.
    b. Cover: Type 316 stainless steel.
    c. Basket O-Ring: Viton.
    d. Straining Element: Type 304 stainless steel.
    e. Bottom Drain Plug: Type 316 stainless steel.
6. Straining Element:
    a. Opening Size: 1/16-inch.
    b. Open Area: Greater than 40 percent.
7. Manufacturer and Product:
    a. Stayflow; BST1 with quick-opening cover.
    b. "Or-equal."

G. Odorous Air Ductwork and Accessories: Refer to Section 23 31 61.16, Foul Air Ductwork and Accessories.

H. Piping and Accessories: Refer to Section 40 27 00, Process Piping—General.

I. Valves: Refer to Section 40 27 02, Process Valves and Operators.

J. Spare Parts:

1. Furnish, tag, and box for shipment and storage the following spare parts and materials:

Item	Quantity
Nutrient	One year supply plus startup
Spray Nozzle	One set

2.05 INSTRUMENTATION AND CONTROLS

A. General:

1. Control of the Biotrickling Filter System shall be provided by the plant control system, provided by others.
2. The minimum functional requirements of the control system are specified herein. Provide additional instrumentation as required to provide a safe and operable system.

B. All instrumentation shall meet the requirements of Section 40 99 90, Package Control Systems.

1. Discrete signals shall be 24V dc.
2. Analog signals shall be 4 mA to 20 mA, 24V dc.
3. Power to instruments shall be 24V dc, wherever possible.

C. Water Panel:

1. Provide one water panel for each tower including, but not limited to, the following:
   a. Nutrient feed pump.
   b. Biotrickling Filter makeup water solenoid valve.
   c. Irrigation water electromagnetic flow element and transmitters and Biotrickling Filter recirculation water electromagnetic flow element and transmitter.
      1) Manufacturers and Products:
         a) ABB; Model XXXX.
         b) Toshiba; Model XXXX.
         c) "Or-equal."
   d. Biotrickling Filter recirculation pressure gauge.
   e. Water pressure reducing valve.
   f. Basket strainer upstream of wye strainer external to panel.
2. All signals external to/from the panel shall be connected to a terminal block provided in the panel.
3. Enclosure Rating: Floor mounted NEMA 250, Type 4X, Type 316 stainless steel.
4. Power: 120V ac single-phase.
5. Electric resistance space heater, with thermostat, for condensation control.

6. All components within water panel shall be pre-wired. Provide separate terminal blocks for electrical connections for interface with plant control system.
7. Provide mechanical connections for external water supply and connection with Biotrickling Filter makeup water piping.
8. Panel location as indicated on Drawings.

D. Miscellaneous Field Instrumentation:
1. Biotrickling Filter packing differential pressure transmitter.
   a. Manufacturer and Product: Rosemount; Model 3051; "or-equal."
2. Biotrickling Filter pH element and transmitter.
   a. Manufacturer and Product:
3. Nutrient feed tank low level switch.

2.06 ACCESSORIES

A. Lifting Lugs: For equipment weighing over 70 pounds.

B. For anchor bolt and post installed concrete and masonry anchor requirements, refer to Section 05 05 19, Anchor Bolts.

C. For panels, provide sunshades in accordance with Section 01 61 00, Common Product Requirements.

2.07 SOURCE QUALITY CONTROL

A. Factory Test: Perform Supplier's standard inspection and testing on equipment, which should include, as a minimum, nozzle testing and reporting, and airflow modeling through media and associated report documentation.

PART 3 EXECUTION

3.01 GENERAL

A. Biotrickling Filter system components shall be shipped loose for assembly and installation at the site. Supplier shall be responsible for coordination regarding space and structural requirements, clearances, utility connections, signals, outputs and features including safety interlocks.

3.02 INSTALLATION

A. In accordance with Supplier's written instructions.

B. Anchor Bolts: Accurately place using templates furnished by equipment manufacturer and as specified in Section 05 05 19, Anchor Bolts.

3.03 FIELD FINISHING AND CORROSION PROTECTION

A. Field touchup as determined by Supplier.

3.04 FIELD QUALITY CONTROL

A. System Startup:
   1. Performed by Supplier.
   2. Startup will commence following a visual inspection and check out of the System by the Supplier's technical representative.
   3. Specialized materials to be used during the startup such as inoculums, or nutrients shall be furnished by the Supplier. Activated sludge for startup will be available from the Owner upon request.
   4. The system will have a permanently installed recirculation system that will remain in operation only during startup mode. This system may remain intact as part of the permanent overall system or may be stored by Owner for future re-acclimation purposes.

B. Functional Tests:
   1. Conduct on each piece of equipment in the system.
   2. Alignment: Subcontractor to test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
   3. Fan Vibration Test by Subcontractor: Refer to Section 23 05 93, Testing Adjusting, and Balancing for HVAC.
   4. Ductwork Pressure Testing:
      a. Subcontractor to conduct pneumatic tests on all ductwork at the pressures listed.
      b. Test procedures shall be as specified in Section 23 31 16.16, Foul Air Ductwork and Accessories.
   5. Air Balancing:
      a. Provide for services of an independent air balancing and testing firm to balance the odorous air into Biotrickling Filter System as shown in the Contract Documents and as required in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
      b. Test and balance Biotrickling Filter odor control system in operation.
   6. Biotrickling Filter System:
      a. Test all system components for proper adjustment and operation in both the manual and automatic operating modes.
      b. Irrigation Water System:
         1) Allow the Biotrickling Filter to operate for a 24-hour period.
         2) Monitor proper irrigation system operation; make adjustments as necessary.
      c. Provide certification of proper installation prior to commencing performance testing.

C. Performance Testing:

1. General:
   a. To demonstrate that the Biotrickling Filter System furnished hereunder is installed and performs in accordance with the provisions of these Specifications, the Supplier shall conduct a performance test in accordance with an approved testing protocol.
   b. The performance test shall not commence until a Performance Testing Plan has been submitted and approved, and the functional testing has been completed.
   c. The performance test shall occur during a timeframe approved by Jacobs.
   d. The Supplier shall provide, install, and maintain, if required, all temporary metering or analytical equipment necessary to measure the various performance parameters.
   e. The Supplier shall provide for all sampling and laboratory analysis. Laboratory analysis shall be done by an independent testing laboratory and paid for by the Supplier.
   f. Before the performance test begins, Jacobs and the Supplier shall meet and agree upon the procedures and guarantee points to be used. Such agreements shall be included in the written Performance Testing Plan submittal.
   g. The Supplier shall inform Jacobs at least 14 days prior to the start of any performance testing. Jacobs shall have the right to observe, sample, and make any parallel determinations during the performance test.
   h. Within 30 days after the conclusion of the test period, the Supplier shall submit a Performance Test Report, including all laboratory and field test data, stating the conclusions of the test with regard to the performance criteria.
2. Performance Tests: Conduct performance test on Biotrickling Filter System under actual or approved operating conditions as described in this Section.
   a. Test only after supplier-approved acclimation period for Biotrickling Filter. Acclimation is not to exceed 6 weeks unless allowed by Jacobs.
   b. Test using actual H_2S loading conditions.
   c. Collect inlet and outlet Tedlar bag odor samples for analysis by ASTM Standard of Practice E679. Odor Panel presentation rate to be 20 liter/min.
3. Test Conditions:
   a. The performance test shall be conducted while the sources being controlled are fully operational and at inlet H_2S concentrations acceptable to Jacobs. The Biotrickling Filter shall have been fully functional and receiving odorous air from these facilities for a minimum of 4 consecutive weeks prior to commencing the testing.

b. All testing, adjusting, and balancing of the fan shall have been completed and approved.

c. The test shall be conducted over a 4-hour period with sampling and data measurements being evenly distributed over that time period.

d. The time when samples are collected shall be when there are low wind speeds and no rain or snow.

4. Sampling and Data Measurement:

a. During the test period, as a minimum, the following data and measurements shall be taken at the frequency indicated:

1) Overall System Airflow Rate: Every hour.

2) Biotrickling Filter Inlet Pressure in Inches of WC: Recorded hourly.

3) Hydrogen Sulfide Concentrations (in ppbv and or ppmv) at the Inlet to the Biotrickling Filter System: Every hour.

a) H_2S measurements to be performed by hand-held instrument previously approved by Jacobs, (e.g., Jerome 631X, Acrulog, Odalog).

b) Inlet H_2S concentrations during each sampling period will first be tested using gas-phase H_2S adsorbent tubes, (e.g., Gastec) to ensure that the concentrations are at a minimum that are acceptable to Jacobs before proceeding with tests.

c) Ensure instruments can measure the minimum and maximum anticipated H_2S concentrations.

4) Hydrogen Sulfide (ppbv) Concentrations at the Outlet of each Modular Unit: Every hour. Individual hourly performance results will then be calculated by:

a) Percent Removal = (Inlet (average over the period) – Outlet (average over the period))/ Inlet. Note: Percent Removal is only applicable when the Biotrickling Filter inlet sample's concentrations for hydrogen sulfide are greater than 10 ppmv. For concentrations less than 10 ppmv hydrogen sulfide, all average Biotrickling Filter outlet samples must be less than the values in Article Service Conditions. Individual hourly removal rates will be averaged to determine system average removal rates for hydrogen sulfide.

b) Instruments used for outlet concentrations shall be capable of accurately measuring a minimum of 10 ppbv.

5) Odor Concentrations at the Outlet of the Biotrickling Filter:

a) Biotrickling Filter exhaust sampling will be performed before inlet sampling to minimize risk of sample carryover.

b) Two samples to be collected; one at the beginning of the 4-hour time mark, the second at the end of the 4-hour time mark.

c) Odor removal rates to be calculated using same methodology described for hydrogen sulfide.
d) System-average exhaust odor concentrations must not exceed the values specified in Article Service Conditions.

6) Odor Concentrations at the Inlet to the Biotrickling Filter: Two samples to be collected; one at the beginning of the 4-hour time mark, the second at the end of the 4-hour time mark.

7) Reduced Sulfur Analysis at the Outlet of the Biotrickling Filter:
a) Biotrickling Filter exhaust sampling will be performed before inlet sampling to minimize risk of sample carryover.
b) Two samples to be collected; one at the beginning of the 4-hour time mark, the second at the end of the 4-hour time mark.
c) Reduced sulfur removal rates to be calculated using the same methodology described for hydrogen sulfide.

5. Reduced Sulfur Analysis at the Inlet of the Biotrickling Filter: Two samples to be collected; one at the beginning of the 4-hour time mark, the second at the end of the 4-hour time mark.

a. A photographic record of the sampling technique and sampling locations will be completed for each type of sampling.

b. Sampling Log: A sampling log shall be maintained that will include:
1) Date, time, location, sampler, and results of each sample.
2) A description of each photograph taken.
3) Weather conditions for the sampling day.
4) A qualitative description of the operation of the wastewater and wastewater treatment processes.
5) A description of any deviations from the sampling plan.

c. System Pressure Drop: Pressure differential measurements shall demonstrate that differential pressure (pressure drop) across the Biotrickling Filter; does not exceed pressure limits specified. Measurements will be recorded hourly for each Biotrickling Filter.

d. Hydrogen Sulfide Sampling and Analysis:
1) Hydrogen sulfide sampling for outlet concentrations shall be completed using an Acrulog, OdaLog, Jerome Model 631 X Analyzer or approved equal with a detection limit of 10 ppbv.
2) The analyzer shall be operated in compliance with the Supplier's instructions.
3) A copy of the instructions shall be submitted with the final report.
4) The results of the hydrogen sulfide sampling shall be recorded in the sampling log.

e. Odor Sampling and Analysis:
   1) Biotrickling Filter inlet and exhaust outlet shall be sampled and analyzed for Detection Threshold odor concentration, intensity and hedonic tone.
   2) Samples shall be collected in Tedlar bags, using the sampling procedure described in EPA Method 18 with either a vacuum chamber or vacuum pump.
   3) Odor panel shall be performed in accordance with ASTM E679 and odor intensity in accordance with ASTM E544.
   4) Odor panelist presentation rates of 20 liters per minute shall be used.
   5) Bag samples to be collected and analyzed within a 24-hour period.

6. Retesting: In the event the Biotrickling Filter fails to meet the performance requirements, the Supplier shall immediately make the necessary modifications, adjustments, and/or facility expansions to meet these requirements. The steps taken by the Supplier shall include, as necessary, design and construction of additional Biotrickling Filter capacity, upgrades to the air distribution system, and replacement of the media, all at no additional cost to the Owner.
   a. Additional performance tests will be conducted by Supplier until the performance requirements are met, at no additional cost to the Owner.
   b. If after two retests the performance requirements are still not met, the Owner will have the option, at the Owner's sole discretion, to accept the system as is or obtain a replacement at the expense of the Supplier.
   c. The maximum time between each retest will be 30 days.
7. Demonstration of Performance: Promptly after the performance test is satisfactorily completed, the Owner will give written notice of the final acceptance of the Biotrickling Filter to the Supplier.
8. During the performance guarantee period following an acceptable system performance test, the Owner may, at their cost, inspect or retest the system for conformance to these Specifications. The Supplier will be notified of these tests, and he may at the Supplier's option witness the test and inspections. If the system fails to meet the performance requirements, the performance guarantee provisions of these Specifications shall apply.
9. Demonstration of Performance: Promptly after the performance test is satisfactorily completed, the Owner will give written notice of the final acceptance of the Biotrickling Filter to the Supplier.

3.05 EXTENDED SERVICE CONTRACT

A. Supplier shall provide extended service contract that includes the following scope of services:
   1. Three additional site visits, once per quarter, for the first year of operation. During each site visit, in the presence of facility Operation and Maintenance staff, the Supplier shall perform the following tasks:
      a. Perform a full operation and maintenance check list on the system including equipment checks, instrument calibration, and troubleshooting.
      b. Complete a performance test on the system to confirm H_2S removal.
      c. Check system airflow and adjust if necessary.
      d. Provide a 2-hour classroom re-fresh for operators. This training will allow operators to understand how to adjust system parameters for changing conditions.

3.06 MANUFACTURERS' SERVICES

A. Provide manufacturer's services with the minimum days and trips as follows and in accordance with Section 01 43 33, Manufacturers' Field Services:
   1. Manufacturer's Assistance to the Contractor: 2 days and one trip per unit.
   2. Manufacturer's Certificate of Proper Installation: 1 day and one trip per unit.
   3. Manufacturer's Training Program: 2 days and one trip per unit.
   4. Functional and Performance Testing: 4 days and two trips per unit.

B. Furnish trained, personnel who have had experience in installing, starting up and training for at least three similar Biotrickling Filter systems to perform the manufacturer's services.

C. Training Lesson Plan:
   1. Provide the following:
      a. Title and objectives.
      b. Course description and outline of course content.
      c. Format (e.g., lecture, hands-on).
      d. Instruction material and equipment requirements.
      e. Resumes of instructors providing the training.

D. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

END OF SECTION

SECTION 44 42 30
INFLUENT SCREENING SYSTEM

EQUIPMENT AND COMPONENT NUMBER(S)

14SCR9508-01: Influent Screen 1.
14SCR9508-02: Influent Screen 2.
14SCR9508-03: Influent Screen 3.
14SCP9521-01: Screenings Compactor 1.
14SCP9521-02: Screenings Compactor 2.
14SCP9521-03: Screenings Compactor 3.
14SCP9521-04: Screenings Compactor 4.

PART 1 GENERAL

1.01 WORK OF THIS SECTION

A. The Work of this Section requires that the influent screens, screenings sluice, and screenings compactors, complete with all accessories and appurtenances (including, but not limited to, electric motors, shafting, safety guards, speed reducers, specified controls be the end product of one responsible system manufacturer or system supplier. The supplier shall furnish and/or coordinate all components and accessories as necessary to place the equipment in operation in conformance with the specified performance, features, and functions indicated.

B. In general, the influent screening system consists of three multi-rake front-cleaned bar screens, each nominally rated for 105 mgd. The influent screens discharge to a screenings sluice which conveys the screened material to four washer/compactors. Each screenings compactor shall be capable of handling the total sluice water flow and 50 percent of screenings conveyed from three influent screens. The screenings compactors shall wash, dewater, compact, and discharge the screened material into dumpsters for offsite removal. See Drawings for general arrangement of equipment.

1.02 RELATED SECTIONS

A. Related sections include the following:
   1. Division 01, General Requirements.
   2. Section 05 05 23, Welding.
   3. Section 05 50 00, Metal Fabrications.
   4. Section 09 90 00, Painting and Coating.
   5. Section 26 20 00, Low-Voltage AC Induction Motors.
   6. Section 40 27 02, Process Valves and Operators

1.03 REFERENCES

A. The following is a list of standards which may be referenced in this Section:
   1. American Bearing Manufacturers' Association (ABMA): 11, Load Ratings and Fatigue Life for Roller Bearings.
   2. American Gear Manufacturers Association (AGMA):
      a. 2015-1-A01, Accuracy Classification System – Tangential Measurements for Cylindrical Gears.
      b. 6034-B92, Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors.
      c. 9005-E02, Industrial Gear Lubrication.
   3. American Welding Society (AWS):
      a. D1.1/D1.1M, Structural Welding Code – Steel.
      b. QC 1, Standard for AWS Certification of Welding Inspectors.
   4. ASTM International (ASTM):
      a. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
      b. C582, Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
      c. D3917, Standard Specification for Dimensional Tolerance of Thermosetting Glass-Reinforced Plastics Pultruded Shapes.
   5. National Electrical Code (NEC).
   6. National Electrical Manufacturers' Association (NEMA): MG 1, Motors and Generators.
   7. National Fire Protection Association (NFPA): 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
   8. UL: 674, Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.

1.04 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials for construction.
      b. Detailed structural, mechanical, and electrical drawings showing equipment fabrications and interface with other items, including terminal block numbers and wire identification.
      c. Power and control wiring diagrams showing internal and customer connections. Include terminal block numbers.
      d. Dimensions, size, and locations of connections to other work.
      e. Details of attachment and support in channel.
      f. Gear output torque and rake weight lifting capacity calculations.

g. See Section 26 20 00, Low-Voltage AC Induction Motors, for motor submittal requirements.
h. Shop painting systems, including manufacturer's descriptive technical catalog literature and specifications.
i. External utility requirements for air, water, power, drain for each component.
j. Drawings of equipment enclosures designed and stamped by professional structural engineer.
k. Submit anchorage and bracing drawings and catalog information, as required by Section 01 88 15, Anchorage and Bracing.
l. Recommended detailed Control Loop Descriptions of system components for incorporation in Plant Control System.
m. Test procedures.
n. Test results, reports, and certifications.

B. Informational Submittals:
1. Statements of Qualification: Professional structural engineer.
2. Submit anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
3. Manufacturer's Certificate of Compliance of factory-applied coating system.
4. Manufacturer's installation instructions.
5. Special shipping, storage and protection, and handling instructions.
6. Written factory test report of inspection.
7. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.
8. Operation and Maintenance Data: As specified in Section 01 78 23, Operation, Maintenance, and Asset Data, including routine maintenance requirements prior to plant startup.

PART 2 PRODUCTS

2.01 GENERAL

A. A single Supplier shall be responsible for supplying the influent screen system, complete with all accessories and appurtenances.

2.02 MANUFACTURERS

A. Manufacturers:
1. Huber Technologies.
2. Kusters Water.
3. Enviro-Care.
4. "Or-equal."

2.03 SERVICE CONDITIONS

A. Material Handled:
   1. Raw sewage from a municipal collection system containing large debris and fibrous material including but not limited to rocks, wood, hair, sand, silt, plastics, and fats, oils and grease. There is no upstream screening ahead of this influent screening system.
   2. Exposure: Variable concentrations of hydrogen sulfide.

B. Location:
   1. Influent Screens: Outdoors.
   2. Screenings Compactors: Outdoors, under canopy.
   3. See Drawing G-111-01, Material Selection Table, for area classification.

C. Temperature Range: 34 degrees F to 104 degrees F.

D. Raw Sewage Flow Rate:
   1. Startup Average Flow: 114 mgd (two screens in service).
   2. Design Year Average Flow: 142 mgd (two screens in service).
   3. Design Year Dry Weather Peak Hour Flow: 209 mgd (two screens in service).
   4. Design Year Extreme Wet Weather Peak Hour Flow: 260 mgd (three screens in service).

2.04 MULTIPLE RAKE BAR SCREENS (INFLUENT SCREENS, 14SCR9508-01, 14SCR9508-02, AND 14SCR9508-03)

A. The influent screens furnished shall positively clean and remove debris from the incoming wastewater by means of a bar rack installed in a concrete channel. The bar rack shall be cleaned by multiple rakes engaging the upstream side of the bar rack from the bottom of the channel and elevating the debris and discharging it to the downstream side into a screenings sluice trough. The influent screens shall be designed for variable speed operation such that under low flow and low loading (low differential) the screen cleaning system operates at approximately 50 percent of full speed, and as differential increases to a maximum headloss, the screening cleaning system operates at 100 percent of full speed.

B. Design and Service Conditions:
   1. Bar Spacing: 3/8-inch between individual bars at their widest point.
   2. Bar Screen Inclination Angle: 80 degrees from horizontal, maximum.
   3. Flow Rate Per Screen:
      a. Rated Capacity: 105 mgd with less than 12 inches head loss with flow passage area 35 percent blocked and downstream channel liquid depth of 10.5 feet.
      b. Minimum: 30 mgd and downstream liquid depth of 7 feet.

4. Raw Sewage Channels:
    a. See Drawings.
    b. Width: 72 inches.
    c. Invert Elevation (bottom of channel): EL -8.0.
    d. Operating Deck Elevation (top of channel): EL 13.0.
    e. Discharge Elevation: EL 20.0 (to be verified with sluice elevation).
5. Discharge to mate with screenings handling system components. Minimum angle of inclination for screenings discharge plates or chutes to screenings sluice shall be 60 degrees above horizontal.
6. Downstream Water: Varies between EL -1.0 at minimum flow, to EL 2.5 at maximum flow.
7. Minimum Screen Lift Capacity:
    a. Minimum: 300 cubic feet of wet screenings per hour, per screen.
    b. Based on estimated loading per rake. To be verified by manufacturer.
8. Raking Mechanism (to be verified):
    a. Rake Spacing: 4 feet to 6 feet.
    b. Rake Speed: 6 feet to 12 feet per minute.

C. Each multiple rake bar screen assembly shall consist of the following components:
1. Frame.
2. Screen field.
3. Dead plate.
4. Rake mechanism having multiple rakes, and as an option, scrapers are allowed.
5. Discharge chute.
6. Chain sprockets and roller chain, and as an alternate, a link system may be used.
7. Drive unit.
8. Accessories.

D. Frame:
1. Screen frame and support beams shall be constructed of Type 316L stainless steel formed to a channel having a minimum thickness of 0.16 inch.
2. The frame shall consist of four bolted sections and be sufficiently braced and stiffened to ensure a rigid assembly. Bolted connections shall utilize Type 316 stainless steel fasteners.
3. The frame shall form a rolled trough at its bottom. Bottom trough shall be Type 3164L stainless steel, having a minimum thickness of 0.16 inch.
4. The frame shall have support beams having a minimum thickness of 0.16 inch.

5. Provide and install 1/2-inch thick neoprene flaps to seal the screen to the channel walls. Neoprene flaps shall be bolted to the frame using Type 316 stainless steel fasteners on 6-inch centers.
6. Each frame section shall be provided with a total of four lifting lugs constructed of Type 316L stainless steel welded to the upper end of the frame sections. Each lifting lug shall be sized and anchored to handle 200 percent of the dead weight of the equipment.

E. Screen Field:
1. The screen field shall be structurally sound, robust and capable of withstanding all forces involved in the operation in a sewer system, including screen field blinding resulting in a differential head of 10 feet of water and a force equivalent to a 200-pound object traveling at rate of 3 feet per second.
2. The framework of the screen field shall be constructed of Type 316L stainless steel having a minimum thickness of 4 mm and be sufficiently braced and stiffened to form a rigid structure.
3. Bars shall be affixed to the screen field framework which is bolted to the frame of the screen using Type 316 stainless steel fasteners. Screen field, including individual bars shall have the capability to be field replaceable.
4. Bars shall be constructed of Type 316 stainless steel having either a trapezoidal cross-section or tear drop section. The orientation of the bars shall minimize the potential for screening materials wedging between the bars.
5. Bars shall be bolted to a dead plate that extends to the point of screenings discharge. Bars shall extend a minimum of 12 inches above maximum water level.

F. Dead Plate:
1. The dead plate shall be constructed of 0.12-inch minimum thickness Type 316L stainless steel.
2. The dead plate shall extend from the top of screen field to the point of screenings discharge.
3. The dead plate shall be flat and true such that a close clearance between the rake tines and the plate can be maintained during normal operation as the rakes proceed to the discharge chute.
4. The dead plate shall be supported and stiffened on the downstream side.

G. Rake Mechanism:
1. The rake mechanism shall consist of multiple rakes affixed to the roller chain whose spacing meets the specified cleaning interval.
2. Rakes shall be designed to lift screenings collected on the bar screen and in the openings between the bars the entire length of the screen to the discharge point. To ensure screenings removal, the rakes must project a minimum of 1/2-inch into the bar spacing.

3. Each rake shall be designed such that screenings will not wrap around the rake tines and will not fall back into the sewage flow during the screening cycle.
4. Rakes shall include rake bars made of channel profile. Rake blades shall be bolted on the rake bars. The rake blades shall have teeth matching and engaging the bars of the bar rack. The rake blades shall each consist of several pieces with teeth such that only one of the pieces needs to be replaced in case that a tooth should be damaged.
5. The rake tines shall penetrate into the screen field sufficiently to ensure that screenings are completely removed during each cleaning cycle.
6. The rakes shall operate in guides on each side of screen frame to ensure engagement and to clean the bars from the upstream side of the screen.
7. Engagement of the rake tines into the bar spacings shall be by mechanical means. Engagement of the rake tines into the bar spacings by the dead weight of the rake or chain mechanism will not be acceptable.
8. During each cleaning cycle, the rake tines shall engage the bottom of the screen field at the channel invert.

H. Scraper:
1. Screenings transported to the top of the screen shall be discharged positively by means of a scraper to the discharge chute.
2. The scraper shall be constructed of Type 304L stainless steel and be designed to pivot to allow efficient cleaning of each rake on each cleaning cycle and cushioned during travel to the rest position.
3. The scraper blade shall be fabricated from high density polyethylene material and be replaceable in the field.

I. Discharge Chute:
1. Each discharge chute shall form a leak-free full enclosure that shall be constructed of 0.12-inch thick minimum Type 316L stainless steel bolted to the frame.
2. Each chute shall be oriented to deposit screenings directly into the sluice trough.
3. Each discharge chute shall attach to the screen frame by way of a flanged connection and gasket to prevent leakage.

J. Chain Sprockets and Guides:
1. The rake and chain assembly shall consist of multiple rakes attached to the roller links of the roller chain. The roller chain shall engage onto adjustable upper sprockets and fixed lower sprockets on each side of the screen.
2. The upper and lower sprockets shall be made of solid stainless steel with a minimum thickness of 27 mm. The sprockets shall be of the pitch and width to match the roller chain and shall have a stainless steel hub and sprocket teeth. The tooth width on the sprockets shall be a minimum of 27 mm.

3. The upper sprockets shall be key mounted onto a drive shaft.
    a. A chain guide shall be securely fixed to the screen side frames for the full height of travel, shall not protrude into the flow, and shall be of Type 316 stainless steel. The guides assure proper meshing between the rake tines and the bar rack, and proper clearance between the rake tines and the dead plate. Replaceable wear strips on chain guides located below the water level shall not be allowed. The chain guides shall be bolted to the side frame so they can be easily replaced.

K. Chains:
1. Each mechanically cleaned screen shall be provided with two continuous loops, one on each side of the screen.
2. Roller type chains shall be made of hardened 400 series stainless steel of high tensile strength and resistance to corrosion. Chain pins shall be constructed of stainless steel and hardened to Rockwell 26 HRC.
3. Each chain shall be provided with an L-profile, Type 316 stainless steel chain guide securely fixed to the side members of the screen frame for the full length of travel. Thickness of chain guide shall be 4 mm minimum.
4. Location of chain guide shall minimize obstruction to flow.

L. Shafting and Bearings:
1. The drive shaft shall be made of solid stainless steel, fitted with a shear pin device with bronze bushing, or auto reverse feature, to provide full protection of the drive unit. Keyways with fitted keys will be provided where necessary. The drive shaft shall be equipped with an adjustable screw type take-up providing for a 4 inch adjustment of the screen chains. The take up screw shall be made of 18-8 stainless steel. The lower sprockets shall rotate on a stainless steel stub shaft attached to the frame. Lower sprockets and bearing shall be replaceable without removing the screen from the channel.
2. Upper bearings shall be flange bearings, and shall be provided with grease nipples for easy lubrication. The bearings shall be designed for use with biodegradable grease. Sealed self-lubricating upper bearings may be utilized. Self-lubricating bearings shall meet the same criteria as that for lower bearings, described below.
3. Lower bearings shall consist of a life sealed bushing system. The system shall consist of a stainless steel stub shaft supporting a ceramic collar. The ceramic collar will interface with a high lubricity, low friction composite bushing surface to ensure zero metal to metal contact. This composite bushing shall be designed for extreme wear life in highly abrasive, high impact environments. Lower bushings that require any maintenance, or have metal to metal wear shall not be accepted.

M. Drive Unit:
1. The drive assembly shall be complete with an adjustable mounting frame, motor, and gear reducer.

2. Each motor shall be sized based on the requirements of the driven loads with consideration given to all drive train components. Comply with Section 26 20 00, Low-Voltage AC Induction Motors.
3. Motor: See Supplement at End of Section.
4. The motor shall be capable of starting under full operational loading conditions (i.e., all rakes have a full design load of screenings in place at startup).
5. Motor shall be of a size and type to be compatible with the drive service required. Torque and heat dissipation shall be sufficient for continuous operation.

N. Equipment Enclosure:
1. Influent Screens shall be provided with covers above the operating deck of the channels to contain odors. Covers shall be removable for ease of maintenance, and individual sections shall not weigh more than 40 pounds.
2. Covers shall be constructed of minimum 20-gauge Type 316L stainless steel. Each panel shall be provided with two handles for panel removal/replacement. All handles and latches shall be Type 316 stainless steel.
3. Provide cover system with 6-inch nozzle to allow fresh air into the screen. Coordinate requirements with Odor Control engineer.

2.05 SCREENINGS FLUME

A. The screenings flume, or sluice, shall be designed to collect and convey debris received from the three bar screens to the washer compactors. The sluice shall be designed to direct the conveyed screenings into two of four washer-compactors. A general configuration is shown on Drawings.

B. Design Summary:
1. Overall Length: Approximately 74 feet. See Contract Drawings.
2. Maximum Flume Slope: 1 percent.
3. Minimum Flume Slope: 0.5 percent.
4. Maximum Flume Flow: 200 gallons per minute (gpm), maximum.

C. Design and provide the screenings flume, which includes the sluice trough, covers, supports, diversion gates/valves, and flanged nozzles as described below.

D. Sluice Trough:
1. The sluice trough shall be smooth and provide no location for materials to collect while being conveyed. The trough shall be designed to carry the entire flume flow.

2. The sluice trough shall be U-shaped and constructed of 10-gauge thick Type 316L stainless steel with minimum 12-inch width and minimum 24-inch depth.
3. Trough shall be fabricated in a minimum of two sections for field assembly. Provide flanged and fully gasketed joints between sections. Trough system shall not leak.
4. At the upstream end of the sluice trough, provide bolted headplate with 2-inch NPT nozzle for connection of sluice water piping. The bolted head plate shall be removable with standard tools for the purpose of removing screenings from the upper end of the sluice. The smooth sluice interior shall extend to the headplate so that there are no obstructions to screenings in the reverse direction.
5. At the screenings compactors, provide four 12-inch diameter side-outlet flanged nozzles for connection of screenings compactor isolation gates and piping to screenings compactors. In addition, provide one isolation gate in the main sluiceway which isolates two upstream screenings compactors from two downstream screenings compactors. See Drawings for general configuration. Invert of nozzles shall be flush with invert of sluice trough to maintain a smooth flow line and not provide location for debris to collect.
6. Provide 6-inch diameter flanged overflow nozzle in location as shown on Drawings. Nozzle invert shall be approximately 16 inches above bottom of sluice trough. Other means of controlled single-point sluice overflow will be considered as recommended by system supplier.

E. Sluice Pipe: Provide 12-inch diameter Type 316 stainless steel piping between the sluice trough isolation gate valves and the screenings compactors.

F. Sluice Supports:
1. The sluice shall be furnished with supports suitable for mounting the sluice by the manufacturer's design. The supports shall be manufactured from 10-gauge (minimum) Type 316L stainless steel.
2. The sluice trough supports shall be designed to support the trough while completely full of water.

G. Sluice Covers:
1. The top of the sluice trough shall be furnished with removable cover panels. The cover panels shall have a minimum thickness of 20-gauge and be constructed of Type 316L stainless steel.
2. Removable covers shall be 4 feet in length (maximum) to facilitate ease of removal.
3. At upstream end of sluice system, provide cover with 3-inch diameter flanged connection for mounting of high level switch by others. See Drawings for location.
4. At location shown on Drawings, provide cover with a 6-inch diameter flanged connection for Foul Air duct.

H. Isolation Valves and Gate:

1. Screenings Compactor Isolation:

a. Provide four electrically actuated 12-inch diameter stainless steel knife gate valves to isolate the four washer compactors from the flume. Knife gate valves shall meet the requirements of Section 40 27 02, Process Valves and Operators, and generally be a flanged valve type for bolted connection to the sluice and screenings conveyance pipe.

b. Electric actuator shall be 480-volt, Open-Close (O/C) type and meet the requirements of Section 40 27 02, Process Valves and Operators.

2. Screenings Flume Isolation:

a. Provide one electrically actuated gate in flume to isolate upstream and downstream pairs of washer-compactors. Gate shall be the same width and depth of the flume, and meet the requirements of Section 40 27 02, Process Valves and Operators, and generally be a flanged type for bolted connection to the sluice and screenings conveyance pipe.

b. Electric actuator shall be 480-volt, Open-Close (O/C) type and meet the requirements of Section 40 27 02, Process Valves and Operators.

2.06 SCREENINGS COMPACTOR (14SCP9521-01, 14SCP9521-02, 14SCP9521-03, AND 14SCP9521-04)

A. General: The washer-compactor shall be a self-contained, hopper fed system used to wash and compact and dewater screenings that have been captured by a bar screen system. Screenings shall be directly conveyed to the washer compactor unit and fed into the system via a sluice and sluice water.

B. Design Summary (per Unit):

1. Receive screenings from the screenings flume.
2. Screenings Volume: 80 to 300 cubic feet per hour.
3. Wet Screenings Density: 60 pounds/cubic foot.
4. Hydraulic Capacity: 200 gpm, minimum.
5. Process Performance:

a. Achieve a minimum of 50 percent reduction in volume.

b. Achieve a minimum of 30 percent reduction in weight.

c. Produce dewatered screenings capable of passing the EPA Paint Filter Test per Method 9095 of EPA Publication SW-486.

6. Available Supplemental Water:

a. Flow: 20 gpm (to be verified).

b. Pressure: 50 psi.

C. Provide shafted screw-type screenings compactors in the arrangement shown on Drawings to wash, dewater, and compact screenings and discharge them to dumpster. Each screenings compactor shall consist of an inlet hopper, a screenings compactor with drive unit, spray system, discharge piping, and drain pans.

D. Screenings Compactor Inlet Hopper:

1. Provide inlet hoppers mounted on top of screenings compactors designed to direct screenings material from the screenings flume to the screw housing.
2. Hopper shall be 12-gauge (0.105-inch) thick, Type 316L stainless steel.
3. Inlet hopper connections, and hinged, latchable hatch shall be as shown on Drawings. Dimensions of the inlet hopper are the responsibility of the manufacturer. Piping sizes, layout, and connection configuration for the sluice are shown on Drawings for general configuration, and are manufacturer provided.

E. Screenings Compactor:

1. The barrel of the screenings compactor shall be fabricated of Type 316L stainless steel, and come equipped with an underdrain pan which runs the length of the barrel. The drive end of the compactor barrel shall be fitted with a flange to accept the flange of the thrust bearing through a bolted attachment. The discharge end shall be fitted with a flange for connection of the discharge pipe.
2. The lower portion of the barrel shall contain a 1/2-inch thick wedge wire or perforated drain pan. The openings shall be 3 mm or smaller. Minimum 4-inch drainage piping shall allow for drainage of the discharged liquid.
3. The underdrain pan and cover over the dewatering zone and drainage pipe shall be removable to allow full access for cleaning and maintenance.
4. The shafted screw shall be 12 inches in diameter, minimum. A nylon brush shall be mounted on the screw to ensure the drain pan remains clear.

F. Discharge Piping:

1. The discharge piping shall convey washed and dewatered screenings from the compactor to the dumpster for offsite removal.
2. The discharge piping shall be constructed of 11-gauge, Type 316L stainless steel pipe. The discharge pipe shall include a flanged long-radius elbow connected to the washer-compactor, and a section of straight discharge pipe with a flared (increasing) diameter to convey material to dumpster.
3. Configure discharge piping according to the general arrangement shown on Drawings.

G. Washwater Distribution System:

1. Provide each screenings compactor with a washwater distribution system.
2. The washwater distribution system will be supplied with chlorinated treatment plant effluent through a single point of connection. The water source will have an Open-Closed motorized valve, supplied and controlled by others, to control the flow of washwater to the screenings compactor when compactor is operating.
3. The screenings compactor shall be provided with a washwater distribution manifold to distribute water to three zones. The water shall assist in cleaning the screenings of organic material, and prevent plugging of dewatering area and underdrain pan.
4. The flow of water to each of the three zones shall be controlled by a manually-throttled stainless steel ball valve to allow for balancing of water distribution. Provide valves in accordance with Section 40 27 02, Process Valves and Operators, Type V306.

H. Drive Unit:

1. The screenings compactors shall be driven by a shaft mounted, helical bevel gear reducer. The gear reducer shall meet the requirements of AGMA 6010-E88, rating Class II. All components of the motor and drive unit system shall be rated for continuous duty capable of 30 start-stop cycles per hour.
2. Motor information specified herein must be coordinated with Section 26 20 00, Low-Voltage AC Induction Motors.
3. Motor: See Supplement at End of Section.

2.07 APPURTENANCES

A. Nuts, bolts, and other fasteners, as listed in the Area Classification Table on Drawings.

B. Furnish lifting lugs for equipment assemblies and components weighing over 100 pounds.

C. Equipment Identification Plates: 16-gauge, Type 304 stainless steel securely mounted to equipment in readily visible location. Plate shall bear 1/4-inch-high die-stamped block type black enamel filled equipment identification name and number.

D. Anchor Bolts: For anchor bolt and post-installed concrete and masonry anchor requirements, refer to Section 05 05 19, Anchor Bolts.

2.08 FABRICATION

A. Welded Construction: As specified in Section 05 05 23, Welding.

2.09 FINISHES

A. For nonstainless steel and nonaluminum metal surfaces, prepare, and prime, and finish coat in accordance with Section 09 90 00, Painting and Coating.

B. Stainless steel shall be cleaned and passivated following fabrication in accordance with ASTM A380.

2.10 INSTRUMENTATION AND CONTROLS

A. Local control stations will be provided by the Electrical Subcontractor. Operation of the equipment will be automatically controlled from the Plant Automation System provided by others, or manually through the local control stations. See P&ID drawings.

B. Provide a detailed description of the recommended manual and automatic controls and sequence of operations for the screens and screenings compactors, including equipment shutdowns.

2.11 SOURCE QUALITY CONTROL

A. Factory Tests and Adjustments:
   1. Test each screen assembly, in its operating position, to ensure meshing of rake and bar rack, and operation of protective devices and override controls.
   2. Run equipment and test for minimum of 6 hours. Testing shall be done in factory with unit oriented in its installed position.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer's written instructions.

B. Anchor Bolts: Accurately place using templates furnished by equipment manufacturer and as specified in Section 05 05 19, Anchor Bolts.

3.02 FIELD FINISHING

A. Touchup damaged areas of painted ferrous metal in accordance with and as specified in Section 09 90 00, Painting and Coating, and as follows:
   1. All nonstainless steel and nonaluminum metal surfaces above the operating floor level should be painted in accordance with System No. 5, Exposed Metal.
   2. All nonstainless steel and nonaluminum metal surfaces below the operating floor level should be painted in accordance with System No. 2, Submerged Metal.

3.03 FIELD QUALITY CONTROL

A. Component Test:
   1. Conduct on each influent screen assembly and each washer/compactor.
   2. Verification of equipment alignment.
   3. Verification that all internal protective functions are operational.
   4. Verification that connections between the influent screen discharge chute and sluice trough allow proper discharge into the sluice trough.
   5. The equipment shall be installed and tested under the direction of factory employed service technician.

B. Manufacturer's recommendations for prestart preparation and preoperational checkout procedures Performance Test:
   1. Demonstrate that the influent screening systems, complete, are capable of meeting the performance requirements. All installed screens, screenings flume and washer/compactors shall be tested.
   2. Influent Screen:
      a. Demonstrate influent screens convey maximum Hydraulic Capacity at headloss specified.
      b. Demonstrate influent screen side seals function properly at maximum possible differential water level. This test will require 100 percent blockage of the bar screens to accumulate enough water on upstream side of screen.
   3. Screenings Flume: Demonstrate that the flume meets the operational and performance requirements.
   4. Washer/Compactors: Demonstrate that the washer/compactor produce dewatered and compacted screenings meeting performance requirements.

3.04 MANUFACTURER'S SERVICES

A. Manufacturer's Representative:
   1. Present at Site or classroom designated by Jacobs, for minimum person-days listed below, travel time excluded:
      a. 5 person-days for installation assistance and inspection.
      b. 5 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
      c. 3 person-days for facility startup.
      d. 2 person-days for post-startup training of Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Owner.

B. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

3.05 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification.

1. Influent Screen 1, 2 and 3 Induction Motor Data Sheet.
2. Screenings Compactor 1 through 4 Induction Motor Data Sheet.

END OF SECTION

INFLUENT SCREEN NO. 1, 2 AND 3
INDUCTION MOTOR DATA SHEET

Project: San José Headworks Project

Owner: San José-Santa Clara Regional Wastewater Facility

Equipment Name: Influent Screens Nos. 1 - 3

Equipment Tag Number(s): 14SCR9508-01, 14 SCR9508-02, 14 SCR9508-03

Type: Squirrel-cage induction meeting requirements of NEMA MG 1

Manufacturer: For multiple units of the same type of equipment, furnish motors and accessories of a single manufacturer.

Hazardous Location: ☒ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

Motor Horsepower: 5 hp

Voltage: 480-V

Phase: 3-phase

Frequency: 60 Hz

Synchronous Speed: 1800 rpm

☐ Thermal Protection: _____

☐ Space Heater: ____ volts, single-phase

Guaranteed Minimum Efficiency at Full Load: ____ percent

Guaranteed Minimum Power Factor at Full Load: ____ percent

Service Factor (@ rated max. amb. temp.): ☐ 1.0 ☒ 1.15

Enclosure Type: TEFC

☐ Multispeed, Two-Speed: ____ / ____ rpm

Winding: ☐ One ☐ Two

Mounting Type: ☐ Horizontal ☐ Vertical

☐ Vertical Shaft: ☐ Solid ☐ Hollow

☐ Vertical Thrust Capacity (lb): Up ____ Down ____

☒ Adjustable Speed Drive: See Section 26 29 23, Low-Voltage Variable Frequency Drive System.

Operating Speed Range: 33 to 100 % of Rated Speed

☐ Variable Torque

☐ Constant Torque

Additional Motor Requirements: ☒ See Section 26 20 00, Low-Voltage AC Induction Motors.

Special Features:

SCREENINGS COMPACTOR NO. 1 THROUGH 4
INDUCTION MOTOR DATA SHEET

Project: San José Headworks Project

Owner: San José-Santa Clara Regional Wastewater Facility

Equipment Name: Screenings Compactor No. 1 - 4

Equipment Tag Number(s): 14SCP9521-01, 14 SCP9521-02, 14SCP9521-03, 14SCP9521-04

Type: Squirrel-cage induction meeting requirements of NEMA MG 1

Manufacturer: For multiple units of the same type of equipment, furnish motors and accessories of a single manufacturer.

Hazardous Location: ☒ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

Motor Horsepower: 7.5 HP

Voltage: 480-V

Phase: 3-phase

Frequency: 60 Hz

Synchronous Speed: 1800 rpm

☐ Thermal Protection: _____

☐ Space Heater: ____ volts, single-phase

Guaranteed Minimum Efficiency at Full Load: ____ percent

Guaranteed Minimum Power Factor at Full Load: ____ percent

Service Factor (@ rated max. amb. temp.): ☐ 1.0 ☒ 1.15

Enclosure Type: TEFC

☐ Multispeed, Two-Speed: ____ / ____ rpm

Winding: ☐ One ☐ Two

Mounting Type: ☐ Horizontal ☐ Vertical

☐ Vertical Shaft: ☐ Solid ☐ Hollow

☐ Vertical Thrust Capacity (lb): Up ____ Down ____

☐ Adjustable Speed Drive: See Section 26 29 23, Low-Voltage Variable Frequency Drive System.

Operating Speed Range: ____ to ____% of Rated Speed

☐ Variable Torque

☐ Constant Torque

Additional Motor Requirements: ☒ See Section 26 20 00, Low-Voltage AC Induction Motors.

Special Features: _____

SECTION 44 42 40
GRIT BASIN EQUIPMENT

EQUIPMENT AND COMPONENT NUMBER(S)

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. Hydraulic Institute Standards (HIS).

1.02 RELATED SECTIONS

A. Related sections include the following.
   1. Division 01, General Requirements.
   2. Section 05 05 19, Anchor Bolts.
   3. Section 09 90 00, Painting and Coating.

1.03 WORK INCLUDED

A. The manufacturer shall provide all materials, equipment and incidentals required to furnish, transport, and place into operation the grit basin equipment. The system must be complete and operational with base plates, supports, and accessories as shown on Drawings and specified in this section.

1.04 SYSTEM DESCRIPTION

A. The grit basin equipment shall include six Headcell™ Grit Concentrator units.

B. Each Headcell™ unit shall be placed in a concrete tank and receive the incoming screened flow. Each Headcell™ shall provide sufficient surface area to remove the specified grit particles from the specified peak flow and concentrating the grit in a sump at the bottom of the unit. Effluent from the Headcell™ unit shall be weir discharged as shown on Drawings.

1.05 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Make, model, and weight of each equipment assembly.

b. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction.

c. Detailed structural and mechanical drawings showing the equipment fabrications and interface with other items. Include dimensions, size, and locations of connections to other work, and weights of associated equipment.

d. Certified test data, certified summary table, or calculations indicating conformance with maximum hydraulic loss requirements.

e. Test data or calculations indicating conformance with grit removal performance requirements.

f. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Manufacturer's reference listing of previous installations of similar size.
2. Submit anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
3. Manufacturer's Certificate of Compliance.
4. Component and attachment seismic qualification certificate of compliance as required by Section 01 45 36, Equipment Seismic Certification.
5. Special shipping, storage and protection, and handling instructions.
6. Submit complete instruction for operation and maintenance of grit basin equipment components. Include the following data:
    a. Alignment, adjustment, and repair instructions.
    b. Manufacturer's installation instructions.
    c. Assembly diagrams.
    d. Troubleshooting guide.
    e. Recommended spare parts lists and predicted life of parts subject to wear.
7. Routine maintenance requirements prior to plant startup.
8. Performance test procedures and sample test log.
9. Manufacturer's Certificate of Proper Installation in accordance with Section 01 43 33, Manufacturers' Field Services.
10. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
11. Service records for maintenance performed during construction.

1.06 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

Item	Quantity
Special tools required to maintain or dismantle unit	One complete set

1.07 DELIVERY

A. In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Manufacturer:
   1. Hydro International.
   2. "Or-equal."

2.02 DESIGN AND EQUIPMENT PERFORMANCE

A. General:
   1. The grit basin equipment shall be designed to remove grit from screened wastewater at a municipal wastewater treatment plant.
   2. The grit basin equipment shall be installed in six grit concentrators (grit basins).
   3. The system shall be designed to handle a total peak flow of 260 mgd in six basins.

B. Grit Concentrators:
   1. Each grit concentrator unit shall be designed to hydraulically pass a peak flow of 46 mgd with a head loss of no more than 12 inches.
   2. Each grit concentrator unit shall remove minimum 95 percent of all grit equal to and larger than 212 micron (specific gravity 2.65) in size at flows equal to 46 mgd.
   3. At future average flow rate of 28 mgd per grit basin, each grit concentrator unit shall remove minimum 95 percent of all grit equal to and larger than 125 micron (specific gravity 2.65) in size.
   4. Each grit concentrator shall be all-hydraulic consisting of self-cleaning corrosion-resistant, nonmetallic trays with no moving parts within the unit.

2.03 MATERIALS AND CONSTRUCTION

A. Grit Concentrators:
   1. Six grit concentrator units shall be supplied.
   2. Each grit concentrator unit shall consist of a stack of twelve 12-foot diameter nested conical trays with no less than 1,356 square feet of total settling surface area.
   3. Each grit concentrator tray shall be fabricated from UV-stabilized, corrosion resistant, nonmetallic materials. Material thickness shall be a minimum 1/4-inch thick.
   4. All flow passages shall be self-cleaning and free of sharp projections or fittings that may snag stringy or fibrous materials.
   5. The stack of trays shall securely fit into a Type 316L stainless steel support frame designed and supplied by the manufacturer. The support frame shall fit and be bolted to the bottom of the concrete tank and include all vertical supports and necessary hardware.
   6. Each grit concentrator shall be provided with an underflow sump insert at bottom of the concentrator. The insert shall be Type 316 stainless steel. The underflow insert shall be provided with a 6-inch flanged connection for connection of grit removal piping. The underflow insert shall also have a 1-inch pipe stub for connection of fluidizing and flushing water.

2.04 ACCESSORIES

A. Lifting Lugs: Provide suitably attached for equipment assemblies and components weighing over 100 pounds.

B. Anchor Bolts: For anchor bolt and post-installed concrete and masonry anchor requirements, refer to Section 05 05 19, Anchor Bolts.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer’s written instructions.

3.02 FIELD QUALITY CONTROL

A. Functional Tests: Conduct on each unit.
   1. Alignment: Prior to facility startup, test complete assemblies for correct rotation, proper alignment and connection.
   2. Operate for a continuous 3-hour period without malfunction.

B. Performance Test: Conduct on each unit.

1. Perform during process commissioning and stabilization period with wastewater.
2. Test for a continuous 8-hour period without malfunction.
3. Perform with Jacobs' Engineer present.
4. Test Log: Upon completion of test, record information listed on sample test log.
5. Adjust, realign, or modify units and retest if necessary.

C. Functional and Performance Test shall comply with Section 01 91 14, Equipment Testing and Facility Startup.

3.03 MANUFACTURER'S SERVICES

A. Manufacturer's Representative:

1. Present at Site or classroom designated by Jacobs, for minimum person-days listed below, travel time excluded:
   a. 5 person-days for installation assistance and inspection.
   b. 5 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
   c. 3 person-days for facility startup.
   d. 2 person-days for post-startup training of Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Owner.

B. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

END OF SECTION

SECTION 44 42 41
GRIT WASHER/CLASSIFIER SYSTEM

EQUIPMENT AND COMPONENT NUMBER(S)

14GCL9605-01: Grit Washer 1 Stirrer.
14GCL9605-02: Grit Washer 2 Stirrer.
14GCL9605-03: Grit Washer 3 Stirrer.
14GCL9605-04: Grit Washer 4 Stirrer.
14GCL9605-05: Grit Washer 5 Stirrer.
14GCL9605-06: Grit Washer 6 Stirrer.
14GSFR9601-01: Grit Classifier 1 Drive.
14GSFR9601-02: Grit Classifier 2 Drive.
14GSFR9601-03: Grit Classifier 3 Drive.
14GSFR9601-04: Grit Classifier 4 Drive.
14GSFR9601-05: Grit Classifier 5 Drive.
14GSFR9601-06: Grit Classifier 6 Drive.
Other components listed within Section.

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Related sections include the following.
   1. Division 01, General Requirements.
   2. Section 05 05 19, Anchor Bolts.
   3. Section 09 90 00, Painting and Coating.
   4. Section 26 20 00, Low-Voltage AC Induction Motors.
   5. Section 40 27 02, Process Valves and Operators.
   6. Section 40 91 00, Instrumentation Components.
   7. Section 40 99 90, Package Control Systems.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this Section:
   1. American National Standards Institute (ANSI).
   2. American Standards for Testing and Materials (ASTM): A967, Specification for Chemical Passivation Treatments for Stainless Steel Parts.
   3. National Electrical Manufacturers' Association (NEMA): MG 1, Motors and Generators.
   4. UL: 674, Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.

1.03 SYSTEM DESCRIPTION

A. Performance Requirements:
   1. Grit Processing Capacity per Unit: 1.5 tons per hour.
   2. At Design Flow, minimum Capture Rate of the Grit having a Specific Gravity of 2.65 or Greater and size of 110 micron or Greater: 95 percent.
   3. At Design Flow, Maximum Water Content in Washed Grit Product: 15 percent.
   4. At Design Flow, Maximum Volatile Solids Content in Grit Product: 5 percent.

B. Service Conditions:
   1. Installation:
      a. Location: Outdoors, uncovered.
      b. Temperature: 34 degrees F to 104 degrees F.
      c. See Drawing G-111-01, Material Selection Table, for Area Classification.
   2. Design Flow: Grit Slurry Flow from the Underflow of the Grit Basins, 400 gpm per unit.
   3. Inlet Pressure: Less than 2 psig.
   4. Feed Slurry Concentration Range: 0.5 percent to 1.5 percent.

1.04 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Make, model, weight, and horsepower of each equipment assembly.
      b. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction.
      c. Detailed structural, mechanical, and electrical drawings showing the equipment fabrications and interface with other items. Include dimensions, size, and locations of connections to other work, and weights of associated equipment.
      d. External utility requirements such as air, water, power, drain, etc., for each component including pressure and flow rate.
      e. Motor information as required in Section 26 20 00, Low-Voltage AC Induction Motors.
      f. Power and control wiring diagrams, including terminal labeling and numbers. Include indication of internal versus customer connections.
      g. See Section 40 99 90, Package Control Systems, for additional submittal requirements.
      h. Recommended detailed Control Loop Descriptions of system components for incorporation in Plant Control System.
      i. Shop painting systems, including manufacturer's descriptive technical catalog literature and specifications.

j. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

2. Operation and Maintenance Data: As specified in Section 01 78 23, Operation, Maintenance, and Asset Data.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Special shipping, storage and protection, and handling instructions.
3. Manufacturer's written/printed installation instructions.
4. Manufacturer's Certificate of Compliance, in accordance with Section 01 43 33, Manufacturers' Field Services.
5. Certification that factory-applied coating system(s) is identical to requirements specified.
6. Routine maintenance requirements prior to plant startup.
7. Field Functional Test Report.
8. Manufacturer's Certificate of Proper Installation in accordance with Section 01 43 33, Manufacturers' Field Services.

1.05 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01 61 00, Common Product Requirements.

1.06 EXTRA MATERIALS

A. Provide recommended list of spare parts in the Operations and Maintenance Manual, in accordance with Section 01 78 23, Operation, Maintenance, and Asset Data.

B. Furnish, tag, and box for shipment and storage one complete set of special tools if required for maintenance or dismantling.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this Section shall be products of:

1. Huber Technology, Inc; Coanda Grit Washer.
2. Hydro International; Hydro GritCleanse.

2.02 SUPPLEMENTS

A. See supplements to this section for additional product information.

2.03 EQUIPMENT

A. General:
   1. Each complete unit shall include a grit washing mechanism and classification mechanism.
   2. The grit washing mechanism and fluidizing water shall provide grit washing and separation of organic and inorganic particles.
   3. The grit classification mechanism shall consist of a grit dewatering conveyor.
   4. Unit shall include structural frames, mounting brackets, and piping transitions for a complete operational unit.
   5. Number of Units: Six.

B. Materials: Type 316L stainless steel shapes, pipes, and sheets.
   1. After fabrication, equipment shall be passivated (pickled) in accordance with ASTM A967.

2.04 GRIT WASHER

A. General: Designed to maintain necessary velocities, to retain organic matter in suspension, and remove nonorganic, 110 micron particles and larger having a specific gravity of 2.65 or greater at design flow.

B. Washer Tank:
   1. Conical configuration.
   2. Construct tank of 1/4-inch (minimum) Type 316L stainless steel plate, reinforced and mounted on stainless steel supports.
   3. Nozzles:
      a. Connections shall be 125-pound, ANSI flanges.
      b. Grit Slurry Inlet: 8-inch diameter, minimum.
      c. Overflow Outlet: 10-inch diameter, minimum.
      d. Organics Outlet: 4-inch diameter, minimum.
   4. Organics Outlet:
      a. Provide the 4-inch organics outlet connection with an automatically operated electrically-actuated ball valve for removal of organic material out of the tank, controlled by Plant Control System.
      b. Provide manufacturer's standard ball valve.
      c. Provide valve operators in accordance with Section 40 27 02, Process Valves and Operators.
      d. Valve Tag Numbers: 14VLV9604-01, -02, -03, -04, -05, -06.
   5. Grit Level Monitoring:
      a. Provide a pressure probe mounted in the bottom of the grit settling area to monitor the grit level within the tank.

b. Provide in accordance with Section 40 91 00, Instrumentation Components.

c. Instrument Tag Numbers: 14LIT9606-01. -02, -03, -04, -05, -06.

C. Fluidized Grit Bed:

1. A fluidized grit bed shall be maintained in the bottom portion of the grit washer tank to wash and remove organic material from the non-organic particles.

2. Grit Stirrer:

a. A grit stirrer of manufacturer's standard design shall be provided to maintain grit fluidization.

b. Equipment Tags: 14GCL9605-01, -02, -03, -04, -05, -06.

3. Grit Stirrer Drive Unit:

a. Stirrer Drive Unit shall be manufacturer's standard design.

b. Motor shall comply with Section 26 20 00, Low-Voltage AC Induction Motors.

c. See supplement at end of section.

4. Fluidizing water shall be introduced into the bottom of the grit bed zone to generate additional energy for grit bed suspension. This washwater shall also effectively flush the organic components out of the fluidized bed towards the overflow weir.

a. The washwater supply manifold shall be provided with a variable area flow meter (rotameter) with a transparent PVC casing to allow visual inspection of the internal float for manual flow rate confirmation.

b. Washwater ON-OFF control shall be provided via a 24V dc solenoid valve. Provide valves in accordance with Section 40 27 02, Process Valves and Operators.

c. Equipment Tags:

1) Rotameter: 14FI9608-01, -02, -03, -04, -05, -06.

2) Solenoid Valve: 14VLV9607-01, -02, -03, -04, -05, -06.

D. Classifier Screw and Trough:

1. Equipment Tags: 14GSFR9603-01, -02, -03, -04, -05, -06.

2. Trough: Type 316L stainless steel construction. Minimum 10/64-inch (4-mm) thick.

3. Screw:

a. Heavy-walled, shafted screw, Type 316L stainless steel construction.

b. Shaft shall be suspended between bearings at each end. Provide sufficient clearance between screw and trough so that a build-up of sand or grit will provide a bed for the screw, minimizing trough wear.

c. Type 316L stainless steel flights shall be continuously seal welded to shaft.

d. Support lower end of screw by bearing housed in watertight enclosure.
   1) Sealed bronze, sleeve type bearing, running completely submerged in oil, requiring only yearly inspection and oil change.
   2) Internal parts of bearing sealed from outside contamination using floating satellite seals.

e. Drain: Provide a 3-inch diameter drain connection and ball valve at bottom of screw. Provide valves in accordance with Section 40 27 02, Process Valves and Operators, Type V307.

f. Discharge: Screw shall discharge dewatered grit as shown on Drawings.

4. Grit Classifier Drive Unit:
   a. Provide Classifier Screw Drive assembly per manufacturer's standard design.
   b. Motor shall comply with Section 26 20 00, Low-Voltage AC Induction Motors.
   c. See supplement at end of section.

2.05 APPURTENANCES

A. Lifting Lugs: Provide suitably attached for equipment assemblies and components weighing over 100 pounds.

B. Equipment Identification Plates: Provide 16-gauge Type 316 stainless steel identification plate securely mounted on each separate equipment component and control panel in a readily visible location. Plate shall bear 3/8-inch high engraved block type black enamel filled equipment identification numbers and letters as shown.

C. Anchor Bolts: For anchor bolt and post-installed concrete and masonry anchor requirements, refer to Section 05 05 19, Anchor Bolts.

2.06 CONTROLS

A. Grit washer/classifier system will be controlled and monitored remotely by the plant control system, furnished by others.

B. Provide recommended detailed operation and sequencing of grit washing mechanism, grit classifying screw, organics discharge valve, and other accessories for inclusion in plant control system.

2.07 FACTORY FINISHING

A. For nonstainless steel and nonaluminum metal surfaces, provide factory surface preparation and factory prime coating in accordance with System No. 4 of Section 09 90 00, Painting and Coating.

B. Stainless steel shall be cleaned and passivated following fabrication in accordance with ASTM A380 and A967.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer's written instructions.

B. Anchor Bolts: Accurately place using templates furnished by manufacturer and as specified in Section 05 05 19, Anchor Bolts.

3.02 FIELD QUALITY CONTROL

A. Perform in accordance with Section 01 91 14, Equipment Testing and Facility Startup.

B. Functional Test:
   1. Conduct on each unit with potable water (or other suitable water).
   2. Test shall include 6 hours of continuous operation of each piece of equipment specified herein.
   3. Verify continuous operation in proper direction of the Grit Stirrer and Grit Classifier auger.

C. Performance Test:
   1. Conduct on each unit with actual wastewater.
   2. Demonstrate that each unit produces a washed and dewatered grit product meeting the specified Dry Solids and Volatile Solids Content

3.03 MANUFACTURER'S SERVICES

A. Manufacturer's Representative:
   1. Present at Site or classroom designated by Jacobs, for minimum person-days listed below, travel time excluded:
      a. One trip of 2 person-days for installation assistance and inspection.
      b. One trip of 2 person-days for functional testing, completion of Manufacturer's Certificate of Proper Installation, and training. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed and accepted by the Owner and Jacobs.
      c. One trip of 5 person-days for facility startup and performance testing.

B. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

3.04 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification.

1. Grit Washer 1-6 Stirrer Induction Motor Data Sheet.
2. Grit Classifier 1-6 Drive Induction Motor Data Sheet.

END OF SECTION

GRIT WASHER 1-6 STIRRER
INDUCTION MOTOR DATA SHEET

Project: San José Headworks Project

Owner: San José-Santa Clara Regional Wastewater Facility

Equipment Name: Grit Washer 1-6 Stirrer

Equipment Tag Number(s): 14GCL9605-01, 14GCL9605-02, 14GCL9605-03, 14GCL9605-04, 14GCL9605-05, and 14GCL9605-06

Type: Squirrel-cage induction meeting requirements of NEMA MG 1

Manufacturer: For multiple units of the same type of equipment, furnish motors and accessories of a single manufacturer.

Hazardous Location: ☒ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

Motor Horsepower: 0.75 hp

Voltage: 480-V

Phase: 3-phase

Frequency: 60 Hz

Synchronous Speed: 1800 rpm

☐ Thermal Protection: _____

☐ Space Heater: ____ volts, single-phase

Guaranteed Minimum Efficiency at Full Load: ____ percent

Guaranteed Minimum Power Factor at Full Load: ____ percent

Service Factor (@ rated max. amb. temp.): ☐ 1.0 ☒ 1.15

Enclosure Type: TEFC

☐ Multispeed, Two-Speed: ____ / ____ rpm

Winding: ☐ One ☐ Two

Mounting Type: ☐ Horizontal ☐ Vertical

☐ Vertical Shaft: ☐ Solid ☐ Hollow

☐ Vertical Thrust Capacity (lb): Up ____ Down ____

☐ Adjustable Speed Drive: See Section 26 29 23, Low-Voltage Variable Frequency Drive System.

Operating Speed Range: ____ to ____% of Rated Speed

☐ Variable Torque

☐ Constant Torque

Additional Motor Requirements: ☒ See Section 26 20 00, Low-Voltage AC Induction Motors.

Special Features:

GRIT CLASSIFIER 1-6 DRIVE
INDUCTION MOTOR DATA SHEET

Project: San José Headworks Project

Owner: San José-Santa Clara Regional Wastewater Facility

Equipment Name: Grit Classifier 1-6 Drive

Equipment Tag Number(s): 14GSFR9601-01, 14GSFR9601-02, 14GSFR9601-03, 14GSFR9601-04, 14GSFR9601-05, and 14GSFR9601-06

Type: Squirrel-cage induction meeting requirements of NEMA MG 1

Manufacturer: For multiple units of the same type of equipment, furnish motors and accessories of a single manufacturer.

Hazardous Location: ☒ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

Motor Horsepower: 1.5 HP

Voltage: 480-V

Phase: 3-phase

Frequency: 60 Hz

Synchronous Speed: 1800 rpm

☐ Thermal Protection: _____

☐ Space Heater: ____ volts, single-phase

Guaranteed Minimum Efficiency at Full Load: ____ percent

Guaranteed Minimum Power Factor at Full Load: ____ percent

Service Factor (@ rated max. amb. temp.): ☐ 1.0 ☒ 1.15

Enclosure Type: TEFC

☐ Multispeed, Two-Speed: ____ / ____ rpm

Winding: ☐ One ☐ Two

Mounting Type: ☐ Horizontal ☐ Vertical

☐ Vertical Shaft: ☐ Solid ☐ Hollow

☐ Vertical Thrust Capacity (lb): Up ____ Down ____

☐ Adjustable Speed Drive: See Section 26 29 23, Low-Voltage Variable Frequency Drive System.

Operating Speed Range: ____ to ____% of Rated Speed

☐ Variable Torque

☐ Constant Torque

Additional Motor Requirements: ☒ See Section 26 20 00, Low-Voltage AC Induction Motors.

Special Features: _____

SECTION 44 42 48.01
AUTOMATIC COMPOSITE SAMPLERS
(VACUUM/PRESSURE TYPE)

EQUIPMENT AND COMPONENT NUMBER(S)

Influent Sampler: 11SMPL9752-01.

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Related sections include the following:
   1. Division 01, General Requirements.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. National Electrical Manufacturer's Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).

1.03 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Product data.
      b. Power and control wiring diagrams with labeled terminal blocks and indication of internal and customer connections.
      c. Power requirements including voltage, phase, connected amps, and demand amps.
      d. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.
   2. Samples: Manufacturer's standard color Samples for equipment enclosures.

B. Informational Submittals:
   1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
   2. Manufacturer's installation instructions.
   3. Written test reports of each inspection for equipment.
   4. Operation and Maintenance Manual as specified in Section 01 78 23, Operation and Maintenance Data.

5. Component and attachment seismic qualification certificate of compliance as required by Section 01 45 36, Equipment Seismic Certification.
6. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

1.04 EXTRA MATERIALS

A. Provide the following spare parts as a minimum per each sampler unit:

Item	Quantity
O-rings	
Set of fuses	
Pressure differential switch	
Measuring chamber	1 per sampler
Cycle timer	1 per sampler

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:
   1. Manning Environmental Corp.; Series No. S-5000.
   2. Teledyne ISCO; Optima Series.

2.02 SAMPLER UNIT

A. Performance Requirements:
   1. Each sampler shall be heavy-duty, automatic, vacuum/compressor type. Sampler vacuum/compressor pump shall be diaphragm type and delivers minimum of 1.2 cfm.
   2. An encapsulated lead sinker shall be mounted on the suction tubing.
   3. Each sampler capable of taking an adjustable sample, from 50 to 1,000 ml for each cycle with repeatability of plus or minus 5 ml. Sampler capable of drawing sample to vertical height of 20 feet at minimum velocity of 2.5 feet per second.
   4. Refrigerated compartment capable of maintaining temperature of 40 degrees F when ambient outdoor temperature is 104 degrees F.

5. Electrical Equipment:
    a. Operate on 120-volt, 60-Hz, single-phase power.
    b. Provide junction boxes on back side of each sampler for field connection.
    c. Mounted in enclosures defined in the Area Classification and Material Selection Table.
    d. All components in enclosure prewired. A single terminal block for 120V ac input power shall be provided for external connection. Output and input terminal blocks shall be provided for communications to facility DCS. Wiring between terminal blocks and components within enclosure shall be provided from the factory.

B. Design Requirements:
1. Provide each sampler unit in self-contained, 14-gauge enameled steel or fiberglass, freestanding cabinet, complete with internal controls, sampler, and adjustable temperature refrigerator of suitable size to hold sample container.
2. Cabinet doors, for both control and refrigerated compartments, shall be hinged to open in same direction.
3. Full paneled front to include a foot cover plate.
4. Each sampler shall be suitable for mounting on level concrete base.
5. Each unit supplied with NEMA 250, Type 3R insulated fiberglass outdoor enclosure.
6. Enclosure:
    a. Covering entire sampler unit, full front opening door with lock and stainless steel full length hinge.
    b. Provided with vent louvers to allow adequate ventilation for refrigerator.
    c. Suitable for mounting on level concrete base with 3/8-inch minimum diameter stainless steel anchor bolts.
    d. Enclosure, separate from sampler cabinet and shall be easily removed for maintenance.
7. Each sampler suitable for side-by-side mounting.
8. Supply each sampler with two sets of sample containers.
9. Design measuring chamber and spout so sample fluid shall not touch metal unless it is Type 316 stainless steel.
10. Size of Metering Chamber Suction Line: Inside diameter 3/8 inch minimum.
11. Size of Metering Chamber Discharge Line: Greater than 3/8 inch.
12. Number of Process Flows Sampled: One.

13. Refrigerator Capacity: One collection jar.
14. Sample Collection Jar Capacity: 2-1/2 gallons.
15. Size of Solids Sampled: 1/4 inch maximum.
16. Sampler shall Lift a Raw Water Sample: 20 feet.
17. Length of Suction Line Required: 25 feet.

2.03 SERVICE CONDITIONS

A. Sampled Material: Raw Sewage.

B. Location: Outdoors.

C. Design Ambient Temperature: 34 degrees F to 104 degrees F.

2.04 APPURTENANCES

A. Lifting Lugs: Equipment weighing over 100 pounds shall be furnished with lifting lugs to permit easy handling.

B. Equipment Identification Plates:
   1. Furnish laminated plastic identification plate, securely mounted on front of each sampler in readily visible location.
   2. Plate shall indicate in 1/2-inch laminated or die-stamped letters the process flow being sampled and equipment tag number.

C. Control Nameplates: Engraved laminated plastic nameplates, clearly describing function of each switch, pushbutton, timer, and other devices on sampler instrument panel.

D. Instrumentation and Controls:
   1. ON/OFF selection switch to control power supply to unit.
   2. TIMER/REMOTE mode selector switch. Modes of operation as follows:
      a. TIMER-sample cycle initiation by integral timer.
      b. REMOTE-sample cycle initiation by remote contact closure; contact closure shall be rated for 2 amps at 24V dc and shall remain closed for 250 milliseconds.
   3. HAND switch to manually initiate sample cycle.
   4. Unit ON light to indicate when main power is supplied to sampler and refrigerator.
   5. Red cycle ON indicator light to show when sampler is in sampling cycle.

6. Dial adjustable multirange cycle timer for sample cycle initiation when in TIMER mode. Period between sample cycle initiations shall be manually selectable between 4 minutes and 100 minutes.
7. Automatic sample shutoff with JAR FULL indicator warning light. Sample cycle shall not restart until collector jar is emptied and sampler is manually reset for new cycle.
8. Sampler shall take only one sample on each initiation signal.
9. Upon receiving a sample cycle initiation signal, sampler shall purge line with air at not less than 25 psig. After purging, metering chamber shall be evacuated, drawing sample into metering chamber. Sampler shall discharge desired amount of sample (range from 50 mL to 1,000 mL) under pressure into refrigerated sample collector. Post-purged sample line after sample is taken.
10. Should plugging of sample suction tube occur, sampler shall automatically purge sample suction tube and attempt to obtain a sample again. If desired sample volume is not obtained after minimum of two complete purge/draw cycles, sampler shall signal an audible alarm and actuate LINE PLUGGED alarm light.
11. Furnish a SAMPLER TROUBLE contact which actuates on any one of the following conditions:
    a. Sample jar full.
    b. Sample line plugged.
12. Contacts shall be normally open (close on actuation) and shall be rated for 2 amps at 24V dc.

2.05 SHOP/FACTORY FINISHING

A. Furnish manufacturer's standard enamel finish, color as selected.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

A. Functional Test: Prior to plant startup, inspect equipment for alignment, quiet operation, connection, and performance test.

3.03 MANUFACTURER'S SERVICES

A. Manufacturer's Representative:

1. Present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:
    a. 1 person-day for installation assistance and inspection.
    b. 1 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
    c. 1 person-day for prestartup classroom or Site training.
    d. 1 person-day for facility startup.
    e. 1 person-days for post-startup training of Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Owner.

B. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

END OF SECTION

SECTION 44 42 56.03
VERTICAL TURBINE PUMPS

EQUIPMENT AND COMPONENT NUMBER(S)

Raw Sewage Pump 1: 14PMP9655-01.
Raw Sewage Pump 2: 14PMP9655-02.
Raw Sewage Pump 3: 14PMP9655-03.
Raw Sewage Pump 4: 14PMP9655-04.
Raw Sewage Pump 5: 14PMP9655-05.
Additional motors, sensors, and control equipment to be provided by pump manufacturer are specified herein.

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Related sections include the following.
   1. Division 01, General Requirements.
   2. Section 03 62 00, Grouting.
   3. Section 05 05 19, Anchor Bolts.
   4. Section 09 90 00, Painting and Coating.
   5. Section 26 19 00, Medium-Voltage Induction Motors.
   6. Section 40 80 02, Physical Hydraulic Modeling Standards and Requirements.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Bearing Manufacturers Association (ABMA):
      a. 9, Load Ratings and Fatigue Life for Ball Bearings.
      b. 11, Load Ratings and Fatigue Life for Roller Bearings.
   2. American Petroleum Institute (API):
      a. 610, Centrifugal Pumps for Petroleum, Petrochemical, and Natural Gas Industries.
      b. 670, Machinery Protection Systems.
   3. ASTM International (ASTM):
      a. A36/A36M, Standard Specification for Carbon Structural Steel.
      b. A532 Standard Specification for Abrasion Resistant Cast Irons.
      c. A536, Standard Specification for Ductile Iron Castings.

d. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.

e. A743 Standard Specification for Castings, Iron-Chromium, Iron Chromium-Nickel, corrosion Resistant for General Application.

4. Hydraulic Institute Standards (ANSI/HI):

a. 9.6.4, Rotodynamic Pumps for Vibration Measurements and Allowable Values.

b. 9.8, Rotodynamic Pumps for Pump Intake Design.

c. 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

5. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.

6. NSF International (NSF):

a. NSF/ANSI 61, Drinking Water System Components - Health Effects.

b. NSF/ANSI 372, Drinking Water System Components - Lead Content.

1.03 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.04 SUBMITTALS

A. Action Submittals:

1. Make, model, weight, and horsepower of each equipment assembly.

2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.

3. Performance data curves showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions.

4. Calculations:

a. Structural dynamic analysis of the combined pump and motor systems, as defined herein.

b. Torsional analysis for complete rotating assembly. Analysis report shall include the specific items for a level 2 analysis specified in ANSI/HI 9.6.8 for VS pumps.

c. Lateral vibration analysis for discharge head motor assembly for column pipe bowl assembly, and for structural response. Analysis shall include all applicable items for a level 2 analysis in ANSI/HI 9.6.8 for VS pumps.

d. Reverse Rachet sizing calculations.

e. Physical Modeling calculations, study, and report.

5. Pump maximum downthrust or upthrust in pounds.
6. Detailed structural, mechanical, and electrical drawings showing equipment dimensions, size, and locations of connections and weights of components.
7. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, parts nomenclature, and materials of construction lists.
8. Baseplate drawings with leveling jackscrew details, anchor bolt and sleeve details, and minimum foundation installation and leveling requirements.
9. Shaft enclosing tube seal water flow, pressure, and purity requirements.
10. Power and control wiring diagrams, including terminals and numbers.
11. Motor information as specified in Section 26 19 00, Medium-Voltage Induction Motors.
12. Factory finish system.
13. Vibration and temperature monitoring system information including technical product bulletins and descriptions, specification data sheets, wiring diagrams including terminal block labels for internal and external connections, communications hardware and software, enclosure product data, documentation sufficient for configuration of functions specified herein and shown on Drawings.
14. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.
15. Installation list of all similarly sized installations of the same design as proposed herein, including installation contact, date of initial operation, size of pumps, horsepower, flow capacity, and number of pumps. A similar installation shall be defined as pumps which convey raw sewage, upstream of primary clarifiers, and for which a means of contacting the operations staff still exists.
16. Vibration analysis information, including Campbell diagrams, mode shape diagram of rotating elements, critical speed map, damped lateral rotordynamic analysis, calculated radial and axial hydraulic loads, eigenvalue calculation and unbalanced force response, impeller-casing interaction coefficients, and static and dynamic sleeve bearing coefficients, nonlinear iteration analysis for sleeve bearings, linear structural analysis of pump.

17. Third party vibration analyst qualifications.
18. Physical modeling submittals as part of Section 40 80 02, Physical Hydraulic Modeling Standards and Requirements.

B. Informational Submittals:
1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Special shipping, storage and protection, and handling instructions.
3. Manufacturer's printed installation instructions.
4. Factory Functional and Performance Test Reports and Log. Factory test data for each pump shall be submitted, reviewed, and approved by Jacob's Engineer prior to shipment of equipment.
5. Suggested spare parts list to maintain equipment in service for a period of 1 year and 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
6. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
7. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
8. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.
9. Pump manufacturer statement certifying that all pumps will operate over the entire design range within HI hydraulic and vibration standards based on physical modeling and vibration analysis performed by subcontractors to the pump manufacturer.

1.05 EXTRA MATERIALS

A. Furnish the following
1. One complete set bearings.
2. Five complete set gaskets and O-ring seals.
3. One complete set of shaft sleeves.
4. Five complete set keys, dowels, pins, etc.
5. Five complete mechanical seals.
6. One complete wear ring.
7. One complete set of special tools required to dismantle pump.

1.06 QUALITY

A. Prior to manufacture, the pump manufacturer shall submit the vibration analysis described herein. For the dynamic vibration analysis described, minimum and maximum operating speeds will be as required to meet performance requirements specified herein. The dynamic vibration analysis shall be performed by a qualified third party (not by the pump manufacturer).

1. Analyst Qualifications: Experienced in performing analysis of pump and motor units of comparable size and complexity.
2. Prepare a written report for each completed analysis and calculations procedures.
3. Submit results of each analysis for review and acceptance prior to pump and motor manufacturer.

B. Structural Response Frequency Analysis: Structural dynamic analysis of the combined pump/motor system including the connected and interconnected concrete deck, walls, and foundation; the piping out to the first pipe restraint or expansion joint. Analysis shall not simply assume the foundation is rigid rather it shall incorporate foundation design shown on Drawings. The structural dynamic analysis shall predict that no first or second bending mode frequencies will exist within a pump speed range from 20 percent below minimum operating speed to 20 percent above maximum operating speed, with all supplied pumps operating simultaneously at the same speed. The analysis shall conform to ANSI/HI 9.6.8 level 2 analysis, when possible.

C. Lateral Analysis: A lateral rotor dynamic analysis of the pump rotating system (i.e., motor rotor, line shafting, couplings, bowl shafting and impellers, etc.) shall identify and predict that the first lateral critical speed shall have a separation margin of at least 20 percent above the maximum pump speed or 20 percent below the minimum pump speed. The analysis shall conform to ANSI/HI 9.6.8 level 2 analysis, when possible.

D. Torsional Analysis: A torsional rotordynamic analysis of the complete rotating system (pump, motor, intermediate shafting, and coupling) shall identify and predict that no torsional natural frequencies occur within a separation margin extending from 20 percent below to 20 percent above the specified pump operating speed range. Additionally, no natural frequencies shall be plus or minus 10 percent of 2x times running speed, line frequency, 2x line frequency, vane pass frequency, and VFD control frequencies (if applicable). If a design modification (i.e., such as a shaft diameter change or different coupling arrangement) cannot resolve a separation margin deficiency or is not practical, a forced damped response analysis shall be performed to show that infinite life will be achieved with a safety factor of at least two.

E. Campbell diagrams shall be submitted, documenting the structural lateral, rotating component lateral, and torsional analysis results, graphically demonstrating the separation margins specified above.

F. Maximum vibration velocity in inches per second RMS, measured in the field, shall conform to the requirements of ANSI/HI 9.6.4. In addition, for operating motor speeds less than or equal to 600 rpm, field vibration displacement in mils peak-to-peak shall conform to the requirements of ANSI/HI 9.6.4.

G. Pump manufacturer shall conduct physical modeling prior to manufacture of pumps. Physical modeling shall be in accordance with HI standards and shall be based off of the Design Drawings provided by Jacobs' Engineer, and pump dimensional drawings provided by the pump manufacturer. Physical modeling shall include the entire 120-inch RS pipe that conveys flow into the pump station wetwell, the wetwell forebay, including gates, spray piping, or other minor features, the individual pump bays, and the pump bowl, bell, and column. Chamfers and concrete forming and sloping shall be included in the model. Physical modeling shall demonstrate passing requirements stipulated in the HI Standards. Additionally, it shall demonstrate passing requirements at max pump station flow, and at flushing flow. These conditions will be stipulated by the Jacobs' Engineer.

PART 2 PRODUCTS

2.01 GENERAL

A. The pump manufacturer shall furnish a pump and motor as a complete system. The pump manufacturer shall furnish thermal and vibration sensory equipment and panels as specified herein and in the medium voltage motor specification. The pump shall be specifically designed for handling raw sewage and solids and shall specific design elements to prevent accumulation of rags, wipes, fibers; to resist abrasion from grit within the pumped fluid, and to resist corrosion from corrosive gasses found in sewage. The pumps discharge to a high point, where flow transitions to gravity into a channel. The pumps do not come equipped with isolation or check valve, as the high point has a siphon break. Pumps shall have an external seal water system provided by Contractor to flush the bearings of the enclosing tube.

B. Pumps' dimensions shall conform to dimensions and elevations listed on Drawings, unless specifically indicated otherwise in the specification or if the listed dimensions or elevations are incompatible with successful design and construction of the pump.

C. The five pumps shall be installed as indicated on Drawings. The pumps will pump municipal sewage and are located downstream of 3/8-inch multirake bar screens, but upstream of grit removal. The pumps will be outdoors, with no cover, and will be exposed to the weather of San José, California.

D. The manufacturer shall guarantee that the equipment furnished is suitable for the installation characteristics. All equipment provided shall be in compliance will all local, state, and federal rules and regulations. All equipment furnished shall operate as a complete system and shall not rely on additional equipment, unless explicitly indicated in the specification. The furnished pump system shall be designed and or modified by pump manufacturer to be within HI vibration acceptance limits in both the factory testing and installed condition.

E. All components of the shaft, impeller, and motor coupling, shall be designed to not loosen or unscrew during reverse flow through the pump.

F. The pump manufacturer shall locate interconnections connections, flanges, access doors, and mounting locations as shown on drawings unless changes are coordinated with and accepted by Jacobs' Engineer.

G. Adjustable Speed Drives:
   1. Where required, furnish coordinated operating system complete with pump, driver, and speed controller.
   2. Coordinate pump and motor requirements with adjustable speed drive manufacturer and be responsible for the following:
      a. Torsional vibration of rotating assembly and related stresses.
      b. Motor thermal rating.
      c. Structural design of pump and motor assembly.
      d. Drive capacity for actual motor's nameplate current rating being supplied.
      e. Minimum motor speed rating for required corresponding torque.

H. Lateral and Torsional Vibrations:
   1. Pump and motor assembly shall have no natural frequencies within 20 percent of operating speed range.
   2. Fundamental critical speed of rotating assembly shall be no less than 50 percent above the rated speed.
   3. Pump manufacturer shall conduct an analysis of the lateral and torsional vibration of pump and motor assembly.
      a. Excitation frequency range of the analysis shall include, but not be limited to, number of motor poles and number of impeller vanes.

b. Perform detailed stress analysis for pump, coupling, motor system at each critical speed, and steady-state operating condition.

c. Stress analysis shall demonstrate that in no case shall maximum stress on pump, coupling and motor component exceed endurance limits of pump, coupling and motor assembly components materials of construction.

2.02 SUPPLEMENTS

A. Some specific requirements are attached to this section as supplements.

2.03 SHAFT SEALS

A. Sealing system for vertical turbine pump shafts shall be mechanical seal or packed stuffing box as indicated in pump data sheet.

B. Mechanical Seal Requirements:

1. Nonfretting type requiring no wearing sleeve for shaft.
2. Shafts for pumps specified with mechanical seals shall be furnished with no reduction in size through seal area.
3. Arrangement shall allow removal of seal without disturbing pump or driver.
4. Hard/hard faces shall be used.
5. Design such that dynamic O-ring moves towards a clean surface as face wears and springs are not in pumped fluid.
6. Stationary seal face shall be spring loaded to provide self-aligning despite stuffing box misalignment.
7. Cartridge Type Mechanical Seals:
   a. Single, balanced, flexible stator design.
   b. Capable of 600 psig service.
   c. O-ring secondary seals and setscrew drive with three-point centering to ensure 0.003-inch maximum perpendicularity of rotary face to shaft.
   d. Gland shall have flush port and be affixed to equipment with adjustable tabs to fit irregular bolt patterns.
   e. Manufacturers and Products:
      1) A.W. Chesterton Company; 155.
      2) Crane; 1B.
8. Seal Materials:
   a. Metals:
      1) Loaded Parts Over 0.060-inch Cross Section: Type 316 stainless steel minimum.

2) Thinner Parts (springs): Hastelloy-C, Alloy 20, AMS5876 Elgiloy, or other alloy that is not vulnerable to chloride stress corrosion.

b. Elastomers: Fluorocarbon Viton preferred, unless seal manufacturer recommends ethylene propylene for service conditions.

c. Faces: Homogeneous construction. Surface treatments and plated faces are unacceptable.

1) Acceptable hard faces include nickel bound tungsten carbide, self-sintered silicon carbide, reaction bonded silicon carbide, or graphitized silicon carbide. Silicon carbide is preferred because of its higher pressure-velocity capability.

2) Acceptable soft face is carbon-graphite, either Union Carbide 658RC or Purecarbon P8412.

9. Seal Environmental Controls:

a. Pipe seal flush port drain to wetwell or hub drain as shown on Drawings. Provide venting of seal chamber.

b. Material of Construction: Type 316 stainless steel.

c. Connect mechanical seal to water purge supply where indicated on Drawings.

10. Provide Seal with drainage box and NPT connection at elevation 13.95.

2.04 VIBRATION AND TEMPERATURE TRANSDUCERS AND MONITORING SYSTEM

A. General:

1. Meet requirements specified herein and with motor temperature and vibration sensors specified in Section 26 19 00, Medium-Voltage Induction Motors.

2. Provide temperature and vibration monitoring system, one per pump, in a NEMA 4X cabinet per Area Classification and Material Selection Table on Drawings. Monitoring system may include multiple transceivers/monitors within a single enclosure. Program, test, calibrate, fully configure and place into operation the monitoring system. Each vibration monitoring system shall be labeled, as follows:

a. Raw Sewage Pump 1: 14MMS9660-01.

b. Raw Sewage Pump 2: 14MMS9660-02.

c. Raw Sewage Pump 3: 14MMS9660-03.

d. Raw Sewage Pump 4: 14MMS9660-04.

e. Raw Sewage Pump 5: 14MMS9660-05.

B. Features:

1. Locally mounted enclosure, one per pump Machine Monitoring System (MMS).
2. Modbus TCP/IP communication interface selections to plant control system with data from each individual vibration and temperature element.
3. Individual alarm set points per channel.
4. Programmable operating ranges.
5. 24V dc input power.
6. Connect to VFD control via a discrete output, rated 24V dc.
7. Alarm Contacts: Configured to be normally closed, open in alarm condition, and open on loss of power.
8. Cables requiring special calibration for optimum performance shall be calibrated by vibration system supplier.
9. Manufacturer and Product: Bentley; Nevada Series 2300.
10. Panel(s) shall be as specified in Section 40 99 90, Package Control Systems.

C. Pump Vibration Velocity Transducers:

1. Two radial velocity transducers shall be provided on the motor mounting flange measuring the directions perpendicular to the axis of the pump drive shaft.
2. Two radial velocity transducers shall be provided with one measuring the outboard thrust bearing and one at 90 degrees to the thrust bearing direction. See Section 26 19 00, Medium-Voltage Induction Motors.
3. Elements:
    a. Accelerometers, providing inches per second RMS (root mean squared) velocity output.
    b. Minimum Rated Operating Frequency: Less than minimum pump operating speed.
    c. Vibration element shall include shielded signal cable and be enclosed in NEMA 4X housing.
    d. Sensors shall be as specified in Section 26 19 00, Medium-Voltage Induction Motors.

D. Motor Temperature Transducers:

1. Two temperature sensors on each winding of the motor.
2. Two temperature sensors on motor inboard and motor outboard thrust bearings.
3. On motor winding or motor bearing high temperature, provide hardwired contact to motor drive for

4. Sensors shall be as specified in Section 26 19 00, Medium-Voltage Induction Motors.

E. Vibration and temperature transducers shall be installed in accordance with guidelines provided by API 670.

2.05 MOTOR

A. See Section 26 19 00, Medium-Voltage Induction Motors, for more requirements.

B. Suitable for outdoors, uncovered installation.

C. The motor shall be designed for mounting to the pump column, or coupling stand provided by the pump manufacturer.

D. The motor rated bhp shall not be exceeded at any point within the pump duty points, nor during pump testing. The motor's rated bhp at reduced speeds shall not be exceeded at the respective speed required by the pump to meet any duty points. Note that deadheading the pump is not possible in the installed condition due to no downstream valves.

E. Provide motor with anti-reverse rotation rachet. The rachet shall be designed to indefinitely resist reverse rotation of the pump while the entire flow passes backwards through the pump, at the pumps highest rated flow and highest TDH. The rachet shall be designed with a safety factor of 150 percent.

F. The motor and pump shall be designed to have a maximum noise emission as follows:

1. 85 dBA sound pressure at 3 feet from the motor, per pump, with one pump operating, in the installed conditions.

2.06 ACCESSORIES

A. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in a readily visible location.

B. Lifting Lugs or Tabs: Equipment weighing over 100 pounds.

C. Anchor Bolts: Galvanized, sized by equipment manufacturer, 1/2-inch minimum diameter, and as specified in Section 05 05 19, Anchor Bolts. Coat in accordance with Section 09 90 00, Painting and Coating.

D. Hydrocone with Baffles: Furnish five Type 316 stainless steel hydrocones, each with two anti-rotation baffles as detailed on Drawings. Baffles shall be 1-inch minimum thickness, and peripherally welded to the cone. Hydrocone anchorage shall be determined by the manufacturer. Provide angled end piece to one baffle to not interfere with grout fill.

2.07 FACTORY FINISHING

A. Prepare and prime and finish coat in accordance with Section 09 90 00, Painting and Coating

B. Line the interior of the pump column and the exterior of the shaft enclosing tube with Manufacturer's premium ceramic epoxy suitable for wastewater immersion service in accordance with Section 09 90 00, Painting and Coating. Two coats 20 MDFT to 30 MDFT per coat. Surface prep SSPC SP-10. Lining is not required on stainless steels Lining is not required where lining will interfere with precision dimensions required for the function or performance of the pump.

C. Line all other interior surfaces of the pump with manufacturer's standard lining for raw sewage service.

2.08 SOURCE QUALITY CONTROL

A. Inspect equipment for required construction, electrical connection, and intended function.

B. Factory Tests and Adjustments: Test all pumps furnished using a motor and VFD purchased as part of Section 26 19 23, Medium-Voltage Variable Frequency Drive System, and Section 26 19 00, Medium-Voltage Induction Motors. The VFDs will not be furnished by the pump manufacturer. The motors shall be furnished by the pump manufacturers. The pump manufacturer shall assist the VFD manufacturer in installing the VFD in the factory test setting. Additional motors and VFDs may be shipped directly to the project site after approval of factory testing of the pumps and approval of required submittals and testing for motors and VFDs. The Factory Test may be witnessed at the Owner and Jacobs' discretion. Notify Jacobs of testing schedule at least 60 calendar days before testing.

   1. Testing with motor shall include system efficiency test reports as part of Section 26 19 00, Medium-Voltage Induction Motors.

C. Factory Test Report: Include test data sheets, curve test results, performance test logs, certified correct by a registered professional engineer.

D. Factory Functional Test:

1. Perform manufacturer's standard, test on equipment. Factory Performance Test:
    a. Conduct on each pump at rated speed.
    b. Perform under simulated operating conditions.
    c. Test for a continuous 3-hour period without malfunction.
    d. Test Log:
        1) Record the following:
            a) Total head, subtracting hydraulic friction losses internal to the pump column and discharge bend.
            b) Capacity.
            c) Horsepower requirements.
            d) Flow measured by factory instrumentation and storage volumes.
            e) Average distance from suction well water surface to pump discharge centerline for duration of test.
            f) Pump discharge pressure converted to feet of liquid pumped and corrected to pump discharge centerline.
            g) Calculated velocity head at the discharge flange.
            h) Bowl head.
            i) Driving motor voltage and amperage measured for each phase.
    e. Adjust, realign, or modify units and retest in accordance with Hydraulic Institute Standards if necessary.

E. Factory Performance Test:

1. Conduct performance test in accordance with ANSI/HI 14.6 with acceptance grade 1U. Ensure motor nameplate rating is not exceeded when throttling the pump to pressures above the primary duty point.
2. Run pumps for a minimum of 1 hour prior to taking readings. Run pump for a minimum of 1 hour after warmup for taking performance readings. All readings measured shall be reported in testing submittals.
3. Additionally, test each pump at reduced speed to demonstrate efficiency stipulated in purchase order.
    a. To calculate bhp a torque gauge shall be used and placed on either the pump shaft or motor shaft near the pump/motor coupling. The torque gauge shall be calibrated from the BHP and speed measurements made during across the line testing of the pump/motor on sine wave power (60 hz). To calibrate the torque gauge, the input power to the motor will be measured along with the motor manufacturer's efficiency testing and the torque gauge readings will be compared to the output power of the motor. Once

the torque gauge is calibrated at full speed, it will be used for measuring the pump power at the pump/motor coupling during reduced speed tests.

F. Motor Test: See Section 26 19 00, Medium-Voltage Induction Motors.

G. Hydrostatic Tests: Pump casing(s) tested at 150 percent of shutoff head. Test pressure maintained for not less than 5 minutes.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

B. Level soleplate by means of leveling screws to manufacturer's required levelness (expected to be 0.005 inch/foot of level). Measure levelness at mounting flange with device capable of detecting 0.001-inch deviations.

C. Adjust pump assemblies such that driving units are properly aligned, plumb, and level with driven units and interconnecting shafts and couplings. Do not compensate for misalignment by use of flexible couplings.

D. After pump and driver have been set in position, aligned, and shimmed to proper elevation, grout space between bottom of baseplate and concrete foundation with a poured, nonshrinking grout of the proper category, as specified in Section 03 62 00, Grouting. Remove wedges after grout is set and pack void with grout.

E. Vibration and Temperature Transducers:

1. Install in accordance with API 670.
2. Provide cable from motor bearing temperature transducers to remote monitoring enclosure, located near motor. Provide cable from motor vibration transducers to remote monitoring enclosure, located near motor.

F. Connect suction and discharge piping without imposing strain to pump flanges.

G. Anchor Bolts: Accurately place using equipment templates and as specified in Section 05 05 19, Anchor Bolts.

3.02 FIELD FINISHING

A. As specified in Section 09 90 00, Painting and Coating.

3.03 FIELD QUALITY CONTROL

A. Functional Tests: Conduct on each pump.
   1. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
   2. Noise Test: A noise test shall be conducted by Jacobs' Engineer to confirm conformance with noise requirements specified herein.
   3. Vibration Test:
      a. Test with unit installed and in normal operation, and discharging to connected piping systems at rates between low discharge head and high discharge head conditions specified, and with actual building structures and foundations provided shall not develop vibration exceeding 80 percent of limits specified in ANSI/HI 9.6.4. Conduct Vibration test with two or three pumps running simultaneously at the same speed, if possible.
      b. If unit exhibits vibration in excess of limits specified, adjust or modify pump as necessary.
   4. Flow Output: Measured by plant instrumentation and storage volumes.
   5. Operating Temperatures: Monitor bearing areas on pump and motor for abnormally high temperatures.
   6. Test for continuous 3-hour period.
   7. Test Report Requirements: In accordance with ANSI/HI 14.6.

3.04 MANUFACTURER'S SERVICES

A. Manufacturer's Representative:
   1. Present at Site or classroom designated by Owner for minimum person-days listed below, travel time excluded:
      a. 3 person-days for installation assistance and inspection.
      b. 5 person-days for functional testing and completion of Manufacturer's Certificate of Proper Installation.
      c. 1 person-day for prestartup classroom or Site training.
      d. 1 person-day for facility startup.
      e. 1 person-day for temperature/vibration monitoring system training.

B. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

3.05 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this Specification.

1. Raw Sewage Pump 1, 2, 3, 4, and 5 Pump Data Sheet.

END OF SECTION

RAW SEWAGE PUMPS 1, 2, 3, 4, AND 5 PUMP DATA SHEET

Tag Numbers: 14PMP9655-01, 14PMP9655-02, 14PMP9655-03, 14PMP9655-04, 14PMP9655-05

Pump Name: Raw Sewage Pump 1, Raw Sewage Pump 2, Raw Sewage Pump 3, Raw Sewage Pump 4, Raw Sewage Pump 5

Manufacturers and Product: (1) Fairbanks Nijhuis, VTSH

(2) Flowserve MVX

(3) "Or-equal"

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): Screened Raw Sewage with Grit

Pumping Temperature (Fahrenheit): Normal _____ Max _____ Min _____

Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: 1.0 cP

Vapor Pressure at 60 Degrees F: _____. pH: _____

Abrasive (Y/N): Yes Caused by: Grit

Possible Scale Buildup (Y/N): _____ Caused by: _____

Corrosive (Y/N): Yes Caused by: H2S attack

Largest diameter solid pump can pass (inches) 5 inch minimum

Min. NPSH Available (Ft. Absolute): _____

Suction Pressure (Ft): Max _____ At Rated Capacity _____.

Altitude (Feet above Mean Sea Level): 0

Area Classification: Class 1 Div 1 below mounting plate, Class 1 Div 2 within 36" envelope of mounting plate

Ambient Temperature (degrees F.): 34-104

Location: Indoor (Y/N): N Outdoor (Y/N): Yes

PERFORMANCE REQUIREMENTS

Capacity (US gpm): Primary Duty Point: 36,500 Secondary Duty Point: 17,350
Total Dynamic Head (Ft): Primary Duty point : 38, excluding pump column friction losses
Secondary Duty Point: 33, excluding pump column friction losses

The pump shall be able to operate continuously at any flow between primary and secondary flows while at any dynamic head between primary and secondary pressures. Refer to purchase order for definition of Total Dynamic Head.

BHP at Rated Point: Not to exceed 500

Min. Pump Hydraulic Efficiency at Certain Flows and TDH (%): See purchase order performance guarantee table for penalties

Max. NPSH Required at Rated Secondary Capacity (Ft. Absolute):

Max. Pump Speed at Rated Capacity (rpm): 600

Constant (Y/N): N

Adjustable (Y/N): Yes

DESIGN AND MATERIALS

Pump Type Enclosed Line Shaft (Y/N) Yes

Bowl: ASTM A48 CL30 Bowl Wear Rings: Required, ASTM A743, CA6NM or ASTM 532 CR28, minimum 250 Brinell hardness
Bowl Lining: Manufacturer's standard for corrosive service
Bowl and Suction Bell Maximum Diameter (inches): 60" Suction Bell, bowl per HI recommended requirements

Bowl Bearings: Manufacturer's standard for corrosive service

Column: Manufacturer's Standard with anti-rotation vane, 42" diameter.

Column Lining: Ceramic Epoxy

Line Shafting: Type 416 Stainless steel Max. Bearing Span (Feet): 10 feet max. Adjust spacing as required for vibration resistance.

Line Shaft Bearings: Manufacturer's standard for enclosed shaft

Discharge Head:

Type: Flanged, designed to prevent accumulation of stringy material (in the opinion of Jacobs' Engineer)

Material: Fabricated Steel, ASTM A36/A36M

Discharge Nozzle Size (inches): 42 Flange Standard/Class: ANSI 150 lb

Impeller:

Type: 4 vane, mixed flow, designed to prevent rag, wipe, or fiber accumulation

Material: ASTM A743, CA6NM or ASTM 532 CR28, minimum 250 Brinell hardness

Impeller and bowl Wear Rings: ASTM A743, CA6NM or ASTM 532 CR28, minimum 250 Brinell hardness

Head Shaft Material: Type 416 stainless steel Shaft Sleeve Material:

Shaft Sealing: Mechanical (Y/N) Y Type: Cartridge Y

Seal Lubrication: Plant Water

Coupling: Manufacturer Standard (Y/N) __Y___, provide coupling access

Baseplate Material: ASTM A36

Sole plate: Provide ASTM A36 sole plate with coated bottom to match exterior coating of pump column for section of sole plate above opening hole. Provide leveling screws for installation.

Motor Base Material: Standard

DRIVE MOTOR (See Section 26 19 00, Medium-Voltage Induction Motors)

Horsepower: 600 Voltage: 4,000 Phase: 3

Synchronous Speed (rpm): 600, max

Service Factor: 1.0

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve within the allowable operating range.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC _____ CISD-TEFC _____
TEWAC _____ WPI _____ WPII ____X__

Mounting Type: Vertical Hollow Shaft _____ Nonreverse Ratchet (Y/N) _____Y

Vertical Solid Shaft Yes

ABMA 9 and ABMA 11, B-10 Motor Bearing Life (hrs): 100,000, see motor specification

REMARKS

SECTION 44 42 56.04
SUBMERSIBLE PUMPS

EQUIPMENT AND COMPONENT NUMBER(S)

12PMP9705-01, 12PMP9705-02, 12PMP9705-03, and 12PMP9705-04: Recycle PS 1 Pump 1, 2, 3 and 4.
14PMP9725-01, 14PMP9725-02, and 14PMP9725-03: Headworks 3 Recycle PS Pump 1, 2 and 3.
14PMP9793-01 AND 14PMP9793-02: Grit Pump Room Sump Pump 1 and 2.

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Related sections include the following:
   1. Division 01, General Requirements.
   2. Section 05 05 19, Anchor Bolts.
   3. Section 26 20 00, Low-Voltage AC Induction Motors.
   4. Section 26 24 19, Low-Voltage Motor Control.
   5. Section 26 29 23, Low-Voltage Variable Frequency Drive System.

1.02 REFERENCES

A. The following is a list of standards that may be referenced in this section:
   1. American Bearing Manufacturers Association (ABMA):
      a. 9, Load Ratings and Fatigue Life for Ball Bearings.
      b. 11, Load Rating and Fatigue Life for Roller Bearings.
   2. American Society of Mechanical Engineers (ASME): B16.1, Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125, and 150.
   3. ASTM International (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
      b. A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
   4. Hydraulic Institute Standards (HIS):
      a. 11.6, Submersible Pump Test.
      b. 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.
   5. National Electrical Manufacturers Association (NEMA).

6. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code.
   b. 497, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.
7. UL.

1.03 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to ratings and nomenclature of Hydraulic Institute Standards.

1.04 SUBMITTALS

A. Action Submittals:
   1. Make, model, weight, and horsepower of each equipment assembly.
   2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction, including cable seal details.
   3. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over entire operating range of pump, from shutoff to maximum capacity. Indicate separately head, capacity, horsepower demand, overall efficiency, and minimum submergence required at guarantee point.
   4. For variable speed motors, provide variable speed curves for every 50 rpm over the operational range.
   5. Power and control wiring diagrams, including terminals block labels and numbers. Provide indication of internal and customer connections.
   6. Moisture and temperature relay module product data and wiring diagrams and as required of Section 26 20 00, Low-Voltage AC Induction Motors.
   7. Motor data, in accordance with the requirements of Section 26 20 00, Low-Voltage AC Induction Motors. Including variable frequency drive data per Section 26 29 23, Low-Voltage Variable Frequency Drive System.
   8. Factory-finish system.
   9. If required, wiring for motor protection module.
   10. Submit anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:
   1. Submit anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
   2. Special shipping, storage and protection, and handling instructions.

3. Manufacturer's printed installation instructions.
4. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
5. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
6. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.
7. Component and attachment seismic qualification certificate of compliance as required by Section 01 45 36, Equipment Seismic Certification.

1.05 EXTRA MATERIALS

A. Furnish one complete set of special tools required to dismantle pump.

PART 2 PRODUCTS

2.01 GENERAL

A. Large Waste Water Submersible Pumps:
   1. Submersible, vertical shaft, centrifugal nonclog type, for pumping wastewater.
   2. Designed for continuous operation under submerged or partially submerged conditions, and intermittent operation when totally dry without damage to pump or motor.
   3. Pump and Electrical Driver: Meet requirements for class, group, and division location in accordance with NFPA 70.
   4. Where adjustable speed drives are required, furnish a coordinated operating system complete with pump, drive, and speed controller.
   5. Pumps furnished under this section to be provided by a single manufacturer.

B. Small Sump Mounted Submersible Pumps:
   1. Pump type as indicated under the individual sections below.
   2. Pump and Electrical Driver: Meet requirements for class, group, and division location in accordance with NFPA 70.

3. Pumps furnished under this section to be provided by a single manufacturer.
    a. Grit Pump Room Sump Pump 1 and 2 (14PMP9793-01 and 14PMP9793-02).
        1) Description:
            a) Type: Heavy-duty, nonclog, close-coupled submersible centrifugal sewage ejector pump.
            b) Volute: Volute: Cast iron, powder coated epoxy, leg mounted.
            c) Impeller: Cast iron, vortex.
            d) Motor Enclosure: Cast iron, Buna-N O-ring seals with powder coated epoxy corrosion-resistant exterior finish.
            e) Power/Control Cord Length: 50 feet.
                (1) Electrical Subcontractor to cut cable to fit installation with an excess of 5 feet.
            f) Motor: Continuous-duty.
                (1) Power Supply: 460-volt, three-phase, 60 hz.
                (2) Motor Rating (hp): 1.
                (3) Pump Speed (rpm): 3,450.
            g) Shaft Seals: Dual mechanical type.
            h) Shaft: Type 416 stainless steel.
            i) Bearings: Sleeve type, upper and lower.
            j) Operation: Non-automatic (no float controls).
        2) Oil filled motor cooling.
        3) Stainless Steel Retrieval Chain: Length as required for installation depth.
        4) Performance Requirements:
            a) Rated Capacity (gpm): 83.
            b) Rated Total Dynamic Head (ft): 30.
        5) Manufacturer and Product: Zoeller; 4293.
    b. Headworks 3 Recycle Pump Station Pump 3 (14PMP9725-03):
        1) Description:
            a) Type: Heavy-duty, grinder style, close-coupled submersible centrifugal sewage ejector pump.
            b) Volute: Cast iron, powder coated epoxy leg mounted.
            c) Impeller: Bronze, vortex.
            d) Cutter: 440C stainless steel.
            e) Motor Enclosure: Cast iron, Buna-N O-ring seals with powder coated epoxy corrosion-resistant exterior finish.
            f) Power/Control Cord Length: 30 feet.

g) Motor: Continuous-duty, built-in thermal overload protection.
   (1) Power Supply: 460-volt, three-phase, 60 hz.
   (2) Motor Rating (hp): 2.
   (3) Pump Speed (rpm): 3,450.
h) Shaft Seals: Dual mechanical type with leak detection.
i) Shaft: Type 416 stainless steel.
j) Bearings: ball type, upper and lower.

2) Oil filled motor cooling.

3) Stainless Steel Retrieval Chain: Length as required for installation depth.

4) Performance Requirements:
   a) Rated Capacity (gpm): 34.
   b) Rated Total Dynamic Head (ft): 50.

Manufacturer and Product: Zoeller; Shark 842.

2.02 LARGE WASTE WATER SUBMERSIBLE PUMPS

A. Equipment consists of pump complete with motor, guide rail, anchoring brackets, base elbow, power cable, and pump lifting cable.

B. Characteristics:
   1. Motor and rotating parts shall be removable from motor end of pump.
   2. Mating surfaces to be watertight and fitted with nitrile O-rings.
   3. Pumps fitted with dynamically balanced nonclog impellers designed to pass course solids and stringy materials.

C. Lifting Arrangement:
   1. Stainless steel chain, 2 feet minimum, and one “grip-eye.”
   2. Attach chain permanently to pump and access platform with stainless steel wire rope.
   3. “Grip-eye” capable of being threaded over and engaging links of stainless steel chain so pump and motor may be lifted with “grip-eye” and independent hoist.

D. Sliding Guide Bracket:
   1. Integral part of pump unit.
   2. Pump unit to be guided by no less than two guide bars, or equivalent cable system, and pressed tightly against discharge connection elbow with metal-to-metal contact or through use of profile-type gasket, provided gasket is attached to pump’s flange and can be easily accessed for inspection when pump is lifted out of wetwell.

3. Pump metal parts that come into contact with guide rail or cable system shall be made of nonsparking materials.

E. Motor nameplate horsepower not to be exceeded at head-capacity point on pump curve.

F. Pump motor and sensor cables shall be suitable for submersible pump application and cable sizing shall conform to NFPA 70 specifications for pump motors. Cables shall be of sufficient length to reach junction boxes without strain or splicing. Electrical Subcontractor to cut cable to suit installation with an excess of 5 feet.

G. Motor moisture and temperature Module(s): Provide pump with a motor moisture and temperature module for remote mounting. Contract Drawings are based on first named submersible pump manufacturer and motor protection module. If pump and motor protection module other than first named manufacturer is provided, provide revised motor control wiring for the motor protection module. Coordinate with Section 26 24 19, Low-Voltage Motor Control.

H. Cable Entry System:
1. Junction chamber and motor separated by stator lead sealing gland or terminal board that prevents foreign material entering through pump top.
2. Utilize cable with factory-installed sealing gland with nonshrink epoxy seal system.
3. O-ring compression seal between sealing gland and cable entry point shall also be acceptable.

2.03 SUPPLEMENTS

A. Specific requirements for the Large Waste Water Submersible Pumps are attached to this section as supplements.

2.04 ACCESSORIES

A. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in readily visible location.

B. Anchor Bolts: For anchor bolt and post-installed concrete and masonry anchor requirements, refer to Section 05 05 19, Anchor Bolts.

2.05 FACTORY FINISHING

A. Manufacturer’s standard epoxy system for continuous submergence in corrosive water.

2.06 SOURCE QUALITY CONTROL

A. Pump:
   1. Factory Performance Test:
      a. In accordance with HIS 11.6, Level 2Bfor submersible pump tests.
      b. Include test data sheets, curve test results, and performance test logs.
   2. Conduct on each pump.
   3. Perform under actual or approved simulated operating conditions.
      a. Throttle discharge valve to obtain pump data points on curve at 2/3, 1/3, and shutoff conditions.

B. Submersible Motor Functional Test: In accordance with HIS 11.6.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

B. Mount the discharge elbow to the floor of the wetwell floor with stainless steel bolts.

C. Connect piping without imposing strain to flanges.

D. No portion of pump shall bear directly on floor of sump.

3.02 FIELD QUALITY CONTROL

A. Functional Test: Conduct on each pump.
   1. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
   2. Flow Output: Measured by plant instrumentation and storage volumes.
   3. Test for continuous 1-hour period.
   4. Test Report Requirements: In accordance with Hydraulic Institute Standards for submersible pump tests HIS 14.6 and 11.6.

B. Pump Test:
   1. General:
      a. Conduct on each pump provided.
      b. Conduct in accordance with HIS 11.6.

3.03 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are part of this Specification.

1. Recycle Pump Station 1 Pump 1, 2, 3 and 4 Submersible Pump Data Sheet.
2. Headworks 3 Recycle Pump Station Pump 1 and 2 Submersible Pump Data Sheet.

END OF SECTION

RECYCLE PUMP STATION 1 PUMP 1, 2, 3, AND 4 SUBMERSIBLE PUMP DATA SHEET

Tag Numbers: 12PMP9705-01, 12PMP9705-02, 12PMP9705-03 and 12PMP9705-04

Pump Name: Recycle Pump Station No. 1 Pump 1, 2, 3 and 4

Manufacturer and Model Number: (1) Xylem/Flygt NP3202 LT 3~618

(2) _____

SERVICE CONDITIONS

Liquid Pumped (Material and Percent Solids): Mixed Storm Water, Sanitary Sewer and other Process flow streams

Pumping Temperature (Fahrenheit): Normal: _____ Max _____ Min _____

Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: _____

_____ pH: _____

Abrasive (Y/N) Y Possible Scale Buildup (Y/N): _____

Minimum diameter solid pump can pass (inches) per manufacturer

Min. NPSH Available (Ft. Absolute): _____

PERFORMANCE REQUIREMENTS

Capacity (US gpm): Rated: 4610 Secondary (reduced speed): 1,500

Total Dynamic Head (Ft): Rated: 20.25 Secondary (reduced speed): 19.2

Shut off Head Range (Ft): 50 to 60

Min. Rated Pump Hydraulic Efficiency at Rated Capacity (%): 75

Max. Pump Speed at Rated Capacity (rpm): 1170 Constant (Y/N): N
Adjustable (Y/N): Y

DESIGN AND MATERIALS

Pump Type: Heavy-Duty Nonclog (Y/N) Y Other: _____

Volute Material: Cast Iron ASTM A48
Pump Casing Material: Cast Iron ASTM A48

Motor Housing Material: Cast Iron ASTM A48

Wear Rings Case (Y/N): _____ Material: _____

Wear Ring Impeller (Y/N): _____ Material: _____

Elastomers: Nitrile Rubber

Fasteners: Stainless Steel

Impeller: Type: Double-Shrouded Non-Clog (Y/N): _____ Other: _____
Material: Cast Iron ASTM A48

Shaft Material: Carbon Steel, ASTM A576 with stainless steel sleeve or all stainless steel.

Base Elbow: Cast Iron ASTM A48

Double Mechanical Seal (Y/N): Y Bearing Life (Hrs): _____

DRIVE MOTOR (See Section 26 20 00, Low-Voltage AC Induction Motors, and Section 26 19 00, Medium-Voltage Induction Motors.)

Horsepower: 35 Voltage: 460 Phase: 3

Synchronous Speed (rpm): 1200

Enclosure: Immersible, may run with motor unsubmerged continuously

CLASSIFICATION: Class 1, Group D, Division 1

Adjustable Speed Drive Range: 50% min to 100% max, See Section 26 29 23, Low-Voltage Adjustable Frequency Drive System.

Other Features: _____

Moisture Detection Switches (Y/N): Y

Thermal Protection Embedded in Windings (Y/N): Y

REMARKS: _____

HEADWORKS 3 RECYCLE PUMP STATION PUMP 1 AND 2 SUBMERSIBLE PUMP DATA SHEET

Tag Numbers: 12PMP9725-01 and 12PMP97-02

Pump Name: Headworks 3 Recycle Pump Station Pump 1 and 2

Manufacturer and Model Number: (1) Xylem/Flygt NP 3127 LT 3~Adaptive 426

(2) _____

SERVICE CONDITIONS

Liquid Pumped (Material and Percent Solids): Storm Water, Process and Sanitary Sewer

Pumping Temperature (Fahrenheit): Normal: _____ Max _____ Min _____

Specific Gravity at 60 Degrees F: _____ Viscosity Range: _____

_____ pH: _____

Abrasive (Y/N) Y Possible Scale Buildup (Y/N): _____

Minimum diameter solid pump can pass (inches) per manufacturer

Min. NPSH Available (Ft. Absolute): _____

PERFORMANCE REQUIREMENTS

Capacity (US gpm): Rated: 1135

Total Dynamic Head (Ft): Rated: 9.6

Min. Rated Pump Hydraulic Efficiency at Rated Capacity (%): _____

Max. Pump Speed at Rated Capacity (rpm): 1750 Constant (Y/N): N
Adjustable (Y/N): Y

DESIGN AND MATERIALS

Pump Type: Heavy-Duty Nonclog (Y/N) Y Other: _____

Volute Material: Cast Iron ASTM A48

Pump Casing Material: Cast Iron ASTM A48

Motor Housing Material: Cast Iron ASTM A48

Wear Rings Case (Y/N): _____ Material: _____

Wear Ring Impeller (Y/N): _____ Material: _____

Elastomers: Nitrile Rubber

Fasteners: Stainless Steel

Impeller: Type: Double-Shrouded Non-Clog (Y/N): _____ Other: _____
Material: Cast Iron ASTM A48

Shaft Material: Carbon Steel, ASTM A576 with stainless steel sleeve or all stainless steel.

Base Elbow: Cast Iron ASTM A48

Double Mechanical Seal (Y/N): Y Bearing Life (Hrs): _____

DRIVE MOTOR (See Section 26 20 00, Low-Voltage AC Induction Motors.)

Horsepower: 7.5 Voltage: 480 Phase: 3 Synchronous Speed (rpm): 1,800

Enclosure: SUB

CLASSIFICATION: Class 1, Group D, Division 1

Adjustable Speed Drive Range: _____ min to _____ max, See Section 26 29 23, Low-Voltage Adjustable Frequency Drive System.

Other Features: _____

Moisture Detection Switches (Y/N): Y

Thermal Protection Embedded in Windings (Y/N): Y

REMARKS: _____

SECTION 44 42 56.09
NON-CLOG DRY-PIT CENTRIFUGAL PUMPS

EQUIPMENT AND COMPONENT NUMBER(S)

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Related sections include the following.
   1. Division 01, General Requirements.
   2. Section 03 62 00, Grouting.
   3. Section 05 05 19, Anchor Bolts.
   4. Section 09 90 00, Painting and Coating.
   5. Section 26 20 00, Low-Voltage AC Induction Motors.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Bearing Manufacturers' Association (ABMA):
      a. 9, Load Ratings and Fatigue Life for Ball Bearings.
      b. 11, Load Rating and Fatigue Life for Roller Bearings.
   2. American Society of Mechanical Engineers (ASME):
      a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
      b. B106.1, Design of Transmission Shafting.
   3. ASTM International (ASTM): A48/A48M, Standard Specification for Gray Iron Castings.
   4. Department of Defense (DoD) Test Method Standard: MIL STD 167, Mechanical Vibrations of Shipboard Equipment.
   5. Hydraulic Institute Standards (HIS):
      a. 9.6.4, Rotodynamic Pumps for Vibration Measurements and Allowable Values.
      b. 11.6, Rotodynamic Submersible Pumps for Hydraulic Performance, Hydrostatic Pressure, Mechanical, and Electrical Acceptance Tests.
   6. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.
   7. Occupational Safety and Health Administration (OSHA).
   8. ISO 1940 Balance Quality Requirements of Rigid Rotors.

1.03 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.04 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Make, model, weight, and horsepower of each pump assembly.
      b. Complete pump and motor catalog information, descriptive literature, specifications, and identification of materials of construction.
      c. Plan and section dimensional outline drawings of the pumps and motors identifying all components, anchor bolts, external connections, and appurtenances.
         1) Include all components identified with quantity, part name and corresponding materials of construction complete with ASTM designation on sectional drawings.
      d. Performance data curves showing head, capacity, horsepower demand, net positive suction head required (NPSH3), and pump efficiency over entire operating range of pump, from shutoff to maximum capacity.
         1) Include the pump's preferred operating range (POR) and the manufacturer's defined maximum allowable operating range (AOR) for continuous steady state service on performance curves.
         2) Indicate separately head, capacity, horsepower demand, NPSH3, and overall efficiency required at the AOR's minimum and maximum continuous stable flow conditions and at the Rated Conditions and at Secondary Conditions (if applicable).
      e. Certified detail structural, mechanical, and electrical drawings showing equipment dimensions, arrangement, assembly, including locations and type of connections and weights of major equipment and components.
      f. Motor information as specified in Section 26 20 00, Low-Voltage AC Induction Motors.
      g. Power and control wiring diagrams including terminal labels and indication of internal and customer connections.
      h. Factory finish system.
      i. Bearing life calculation confirming compliance with L10 bearing life requirement.
      j. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Equipment seismic certification as required by Section 01 45 36, Equipment Seismic Certification, certification by analysis per Article Mechanical and Electrical Component Certification, Paragraph E.
3. Special shipping, storage and protection, and handling instructions.
4. Manufacturer's printed installation instructions.
5. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, that factory finish system is identical to requirements specified herein.
6. Factory Functional and Performance Test Reports and Log.
7. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.
8. Suggested spare parts list to maintain equipment in service for period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
9. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

1.05 EXTRA MATERIALS

A. One complete set of any special tools required to dismantle pump.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide a complete, coordinated, and fully functional operating system.

B. Coordinate pump requirements with motor manufacturer and be responsible for pump and motor requirements.

C. Pumps supplied under this section to be a standard product of manufacturer and to have proven reliability.

2.02 SUPPLEMENTS

A. Specific service, performance, and design requirements are attached to this section as supplements.

2.03 EQUIPMENT

A. Pump:

1. Heavy-duty, solids handling, non-clog, dry pit design, suitable for raw sewage service.
2. Configuration: See supplements.

3. See Drawings for pump orientation and rotation.
4. Continuously rising head-capacity curve from runout to shutoff.
5. Designed to operate continuously at any point on specified operating range of performance curve without cavitation, overheating, or excessive vibration.
6. Motor nameplate horsepower rating not to be exceeded by pump brake horsepower required at any point on nominal pump performance curve within allowable operating range.

B. Casing:
1. Back pullout design allowing for removal of rotating element without disturbing piping connections.
2. Heavy wall, one-piece volute construction with integral flanged discharge flange and smooth fluid passages. Provide drilled and tapped volute priming and drain connections.
3. Wear ring securely fastened to casing (or suction cover) with recessed stainless steel screws.
4. Provide handhole for cleanout purposes at volute centerline located to provide access to interior of pump.
5. Flanges:
   a. Conform to ASME B16.1, Class 125-pound, flat face standard.
   b. Provide 1/2-inch gauge connection drilled and tapped in discharge flange.
6. Diffusion vanes or stationary guides are not allowed.

C. Suction Cover (Fronthead):
1. Single-piece construction designed to provide even flow to impeller eye.
2. Flanged connection conforming to ASME B16.1, Class 125-pound, flat face standard.
3. Machine register fitted to casing.

D. Suction Connection:
1. ASME B16.1, Class 125-pound flat face standard for mating with formed suction inlet (Army Corps Type 10, per Hydraulic institute).
2. Provide 1/2-inch gauge connection.

E. Stuffing Box Cover (Backhead):
1. Single-piece construction designed with integral stuffing box suitable for use of either conventional packing or mechanical seal. Drilled and tapped 3/4-inch drain connection and large openings to allow easy access to stuffing box.
2. Designed for installation of a minimum of five rings of packing and a split type lantern ring and a split type gland follower. Provide stuffing box with 1/4-inch minimum drilled and tapped connection for injection or venting of the stuffing box.

3. Machine register fitted to casing.

F. Bearing Frame and Bearings:
   1. Removable, single-piece construction.
   2. Machined for accurate bearing alignment and completely enclosing shaft between bearings.
   3. Provide with retainer covers on inboard and outboard ends of frame equipped with lip-type grease seals to prevent entrance of contaminants.
   4. Single or double row bearings at inboard and outboard ends designed to take radial, weight, and thrust loads of pump and associated shafting loads. Bearings to be designed for an L10 life per ABMA at best efficiency point.
   5. Provide jacking screws for adjustment of impeller.
   6. Grease packed at factory and provided with grease fittings for bearing lubrication.

G. Impeller:
   1. Single suction, enclosed, non-clogging type design with extremely smooth passageways to prevent clogging.
   2. Single-piece construction.
   3. Secure to shaft with stainless steel bolt, washer, and key to prevent loosening from either forward or reverse rotation.
   4. Dynamically balanced to assure vibration limits for pump are not exceeded.
   5. Wear ring securely fastened to impeller with recessed stainless steel screws. Impeller wear ring to be a minimum of 50 Brinell softer than suction head wear ring, with a minimum hardness of 235 Brinell.
   6. Impeller to be ASTM A753 CA6NM, ASTM 534 CR 28, or equal, in the sole determination of Jacobs' Engineer. Minimum Brinell Hardness 285.

H. Shaft:
   1. Accurately machined over entire length and precision ground at bearing locations.
   2. Designed to transmit full motor horsepower with a liberal safety factor to carry maximum loads imposed and to meet pump vibration requirements.
   3. Provide keyways at both ends.
   4. Provide renewable, hooked shaft sleeve positively secured to shaft to prevent leakage.

I. Pump Base: Rugged, heavy duty, with ample strength for support of entire pump and imposed static and operational loads.

J. Coupling:
   1. Designed to provide flexible connection between pump and motor.
   2. Flexible coupling to be designed to carry maximum horsepower of motor, including service factor, and additional forces imposed by rotating assembly.
   3. Provide fabricated coupling guard to comply with OSHA safety standards.

2.04 ACCESSORIES

A. Lifting Lugs: Provide suitably attached for equipment assemblies and components weighing over 100 pounds.

B. Equipment Identification Plates: Provide 16-gauge Type 304 stainless steel identification plate securely mounted on each separate equipment component in a readily visible location. Plate shall bear 3/8-inch high die-stamped block type black enamel filled equipment identification number and letters indicated in this Specification and as shown.

C. Anchor Bolts: For anchor bolt and post installed concrete and masonry anchor requirements, refer to Specification Section 05 05 19, Anchor Bolts.

2.05 FACTORY FINISHING

A. Manufacturer to prepare, prime and finish coat in accordance with Section 09 90 00, Painting and Coating.

2.06 SOURCE QUALITY CONTROL

A. Factory Tests and Adjustments:
   1. Factory testing to be in accordance with the standards of the Hydraulic Institute, latest edition.
      a. Pump Test Acceptance Grade: 2B.
   2. Test all pumps actually furnished. Use actual motor to be provided for factory tests.
   3. Factory tests to include the following:
      a. Hydrostatic testing of pump pressure containing components, to include as a minimum, pump volute, suction cover, and stuffing box cover. Test pressure to be the greater of 150 percent of rated condition. Test for 30 minutes.
      b. Performance testing of fully assembled pump, per Hydraulic Institute Standard 1.6. Performance testing to be at rated speed. Dynamically balance rotating assembly to ISO 1940 Grade G2.5 or better prior to final assembly.

c. Vibration testing of fully assembled pump with the Project motor at full rated speed.
   1) Limits of Vibration of Fully Assembled Pump: Less than 90 percent of those established in standards of the Hydraulic Institute.

d. Include complete test records, performance curves certified correct by an authorized representative of the pump manufacturer of each test performed.

e. Motor Test: See Section 26 20 00, Low-Voltage AC Induction Motors.

f. Make necessary adjustments, realignments, and retest to bring pumps into compliance.

g. Witnessing of factory testing shown on supplements at end of this section.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

B. Level base by means of steel wedges (steel plates and steel shims). Wedge taper not greater than 1/4 inch per foot. Use double wedges to provide level bearing surface for pump and driver base. Accomplish wedging so there is no change of level or springing of baseplate when anchor bolts are tightened.

C. Adjust pump assemblies such that driving units are properly aligned, plumb, and level with driven units, pump shafts, and couplings. Do not compensate for misalignment by use of flexible couplings.

D. After pump and driver have been set in position, aligned, and shimmed to proper elevation, grout space between bottom of pump pedestals and concrete foundation with a poured, nonshrinking grout of the proper category, as specified in Section 03 62 00, Grouting. Remove wedges after grout is set and pack void with grout.

E. Connect suction and discharge piping without imposing strain to pump flanges.

F. Anchor Bolts: Accurately place using equipment templates and as specified in Section 05 05 19, Anchor Bolts.

3.02 FIELD FINISHING

A. Equipment as specified in Section 09 90 00, Painting and Coating.

3.03 FIELD QUALITY CONTROL

A. Functional Tests:
   1. Conduct on each pump, system, and subsystem as specified in Section 01 91 14, Equipment Testing and Facility Startup.
   2. Alignment:
      a. Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
      b. Verify alignment of complete extended shaft assembly, including angularity of pump and motor shafts, meets requirements of shafting manufacturer.
      c. Shafting manufacturer's authorized representative shall verify installation alignment and prepare and submit a report confirming compliance.
   3. Flow Output: Measure using plant instrumentation and storage volumes.
   4. Operating Temperatures and Vibration: Monitor bearing areas on pump and motor and on extension shafting for abnormally high temperatures or vibrations.
   5. Vibration Test:
      a. Test with units installed and in normal operation, and discharging to connected piping systems at rates at 20 percent speed increments over the anticipated operating speed range of the pump and with actual building structures and foundations provided.
         1) Confirm vibration is below 90 percent of limits specified in HIS 9.6.4.
      b. If units exhibit vibration in excess of the limits, adjust or modify as necessary to bring units into compliance.
      c. Prepare test report, including test records for each pump.

3.04 MANUFACTURER'S SERVICES

A. Manufacturer's Representative:
   1. Present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:
      a. 1 person-day for installation assistance and inspection.
      b. 1 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
      c. 1 person-day for prestartup classroom or Site training.
      d. 1 person-day for facility startup.

B. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

3.05 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this Specification.

1. West Primary Drain Pump 1 and 2 Pump Data Sheet.

END OF SECTION

WEST PRIMARY DRAIN PUMP 1 AND 2 PUMP DATA SHEET

Tag Numbers: 23PMP2401, 23PMP2402

Pump Name: West Primary Drain Pump 1, West Primary Drain Pump 2

Manufacturer and Model Number:

(1) Fairbanks Nijhuis

(2) Flowserve-Worthington

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): Primary Sewage

Pumping Temperature (Fahrenheit): Normal: _____ Max: _____ Min: _____

Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: 1.0 Cp

Vapor Pressure at 60 Degrees F: _____ pH: _____

Abrasive (Y/N) Y caused by municipal grit

Possible Scale Buildup (Y/N): N caused by _____

Corrosive caused by N

Total Suspended Solids (mg/L) _____

Min. NPSH Available (Ft. Absolute): _____

Area Classification: Unclassified

Ambient Temperature (F): 50-80

Location Indoor/Outdoor: Indoors

Altitude: sea level

PERFORMANCE REQUIREMENTS

Capacity (US gpm): Primary: 1000

Total Dynamic Head (Ft): Primary: 30.4

BHP at Primary flow and primary TDH:

NPSH Required, Max. (Ft Absolute) at Rated Point: _____

Maximum Shutoff Pressure (Ft): _____

Min. Rated Pump Hydraulic Efficiency (%):

Max. Pump Speed at Rated Capacity (rpm): 1780

Constant Speed: Y

Adjustable Speed: N Minimum Speed: _____

Maximum Head, Rated Impeller (ft): _____

Maximum Power, Rated Impeller (BHP): _____

Sphere Size Required (to pass through impeller), Min. (in): _____

PUMP CONSTRUCTION DETAILS

Configuration:	Horizontal, Frame Mounted: Y
	Vertical, Close-Coupled: N
	Vertical, Extension Shafting: N
Size:	Suction (in.): _____ Discharge (in.): _____
Casing:	Single Volute: Y
	Tangential Discharge: Y Centerline Discharge: _____
Impeller:	Enclosed: _____ Two Vane: 2 vane minimum
	Bladeless: N
Wear Rings:	Manufacturer's standard for abrasive service
Bearings L10 Life:	100,000 Hr: Y 50,000 Hr: _____ 25,000 Hr: _____
Shaft Sleeve:	Yes X No _____
Pump Base:	Heavy Duty Fabricated Steel: _____
	Cast Iron Combination Base Elbow: N
	Cast Mounting Pads Integral With Casing: N
Suction Elbow:	Yes _____ No X Type: _____
	Material: Cast Iron, ASTM A48 Class 30: _____
Coupling:	Standard Flexible Type: _____ Spacer Type: _____
	Manufacturer: _____ Manufacturers Standard: Y
Seal:	Packing: N
	Mechanical Seal: Y Single: N Double: Y
	Mechanical Seal Manufacturer/Model: _____
	Lubrication: Potable water
Materials:	Pump Castings (includes casing, suction cover, stuffing box cover, bearing frame):
	Cast Iron, ASTM A48/A48M Class 30 With 3% Nickel
	Cast Iron, ASTM A48/A48M Class 35 With 3% Nickel
Impeller:	Cast Iron, ASTM A48/A48M Class 30 With 3% Nickel
Pump Shaft:	High Strength Steel _____ AISI 1045 Steel, HR _____
	Type 4140 Alloy Steel _____ Type 304 Stainless Steel _____

Shaft Sleeve: Hardened Stainless Steel Y_____

Wear Rings: Hardened Stainless Steel Y_____

Packing: Graphite Impregnated Braided Synthetic _____

Lantern Ring: Bronze _____ Teflon _____

Follower Gland: Bronze _____ Cast Iron _____ Steel _____

Mechanical Seal: Buna N _____ Viton _____ EPT _____

Carbon _____ Tungsten Carbide _____ Silicone Carbide _____

18-8 Stainless Steel _____ Type 316 Stainless Steel _____

DRIVE MOTOR (See Section 26 20 00, Low-Voltage AC Induction Motors)

Horsepower: 10 Voltage: 460 Phase: 3 Hertz: 60

Synchronous Speed (rpm): _____1800_____

Service Factor (at max. ambient temp.): 1.15_____

Insulation Class: _____ Temperature Rise: _____

Inverter Duty Rated (Y/N): N____ Thermal Protection: Y_____

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve within the allowable operating range.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC __X___ CISD-TEFC _____

TENV _____ WPI _____ WPII N_____ SUBM _____

Mounting Type: Horizontal ___Y__ Vertical Solid Shaft: N_____

REMARKS_____

_____

_____

SECTION 44 42 56.12
INDUCED FLOW (RECESSED IMPELLER) CENTRIFUGAL PUMPS

EQUIPMENT AND COMPONENT NUMBERS(S)

14PMP9601-01: Grit Pump 1.
14PMP9601-02: Grit Pump 2.
14PMP9601-03: Grit Pump 3.
14PMP9601-04: Grit Pump 4.
14PMP9601-05: Grit Pump 5.
14PMP9601-06: Grit Pump 6.

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Related sections include the following:
   1. Division 01, General Requirements.
   2. Section 03 62 00, Grouting.
   3. Section 05 05 19, Anchor Bolts.
   4. Section 09 90 00, Paints and Coatings.
   5. Section 26 20 00, Low-Voltage AC Induction Motors.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Bearing Manufacturers Association (ABMA).
   2. Hydraulic Standards Institute (HIS).
   3. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.

1.03 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.04 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Make, model, weight, and horsepower of each equipment assembly.

b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.

c. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the guarantee point.

d. Detailed structural, mechanical, and electrical drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment.

e. Power and control wiring diagrams, including terminals with labels and numbers. Include indication of internal and customer wiring.

f. Motor information as specified in Section 26 20 00, Low-Voltage AC Induction Motors.

g. Factory finish system.

h. Submit anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Submit anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, that factory finish system is identical to the requirements specified herein
3. Component and attachment seismic qualification certificate of compliance as required by Section 01 45 36, Equipment Seismic Certification.
4. Special shipping, storage and protection, and handling instructions.
5. Manufacturer's printed installation instructions.
6. Factory Functional and Performance Test Reports.
7. Suggested spare parts list to maintain the equipment in service for a period of 1 year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
8. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
9. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
10. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

1.05 EXTRA MATERIALS

A. Furnish for this set of pumps One complete set of special tools required to dismantle pump.

PART 2 PRODUCTS

2.01 GENERAL

A. Coordinate pump requirements with drive manufacturer and be responsible for pump and drive requirements.

2.02 SUPPLEMENTS

A. Specific requirements are attached to this section as supplements.

2.03 ACCESSORIES

A. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in a readily visible location.

B. Lifting Lugs: Equipment weighing over 100 pounds.

C. Anchor Bolts: For anchor bolt and post-installed concrete and masonry anchor requirements, refer to Section 05 05 19, Anchor Bolts.

2.04 FACTORY FINISHING

A. Prepare, prime, and finish coat in accordance with Section 09 90 00, Painting and Coating.

B. Manufacturer’s standard enamel finish.

2.05 SOURCE QUALITY CONTROL

A. Factory Test Report: Include test data sheets, curve test results, certified correct by a registered professional engineer.

B. Functional Test: Perform manufacturer’s standard test on equipment.

C. Performance Test:
   1. Conduct on each pump.
   2. Perform under simulated operating conditions.

3. Conduct in accordance with Hydraulic Institute Standards 11.6, Acceptance Grade 1U.
4. Test for a continuous 3-hour period without malfunction.
5. Test Log:
    a. Record the following:
        1) Total head.
        2) Capacity.
        3) Horsepower requirements.
        4) Flow measured by factory instrumentation and storage volumes.
        5) Average distance from suction well water surface to pump discharge centerline for duration of test.
        6) Pump discharge pressure converted to feet of liquid pumped and corrected to pump discharge centerline.
        7) Calculated velocity head at the discharge flange.
        8) Field head.
        9) Driving motor voltage and amperage measured for each phase.
6. Adjust, realign, or modify units and retest in accordance with Hydraulic Institute Standards if necessary.

D. Motor Test: See Section 26 20 00, Low-Voltage AC Induction Motors.

E. Hydrostatic Tests: Pump casing(s) tested at 150 percent of shutoff head. Test pressure maintained for not less than 5 minutes.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

B. Level base by means of steel wedges (steel plates and steel shims). Wedge taper not greater than 1/4 inch per foot. Use double wedges to provide a level bearing surface for the pump and driver base. Accomplish wedging so that there is no change of level or springing of the baseplate when the anchor bolts are tightened.

C. Adjust pump assemblies such that the driving units are properly aligned, plumb, and level with the driven units and all interconnecting shafts and couplings. Do not compensate for misalignment by use of flexible couplings.

D. After the pump and driver have been set in position, aligned, and shimmed to the proper elevation, grout the space between the bottom of the baseplate and the concrete foundation with a poured, nonshrinking grout of the proper category, as specified in Section 03 62 00, Grouting. Remove wedges after grout is set and pack void with grout.

E. Connect suction and discharge piping without imposing strain to pump flanges.

F. Anchor Bolts: Accurately place using equipment templates and as specified in Section 05 05 19, Anchor Bolts.

G. Pipe pump drain(s) to hub drain or scupper.

3.02 FIELD FINISHING

A. Touchup damaged coating on equipment as recommended by equipment manufacturer.

3.03 FIELD QUALITY CONTROL

A. Functional Tests: Conduct on each pump.
   1. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
   2. Vibration Test:
      a. Test with unit installed and in normal operation, and discharging to the connected piping systems at rates between low discharge head and high discharge head conditions specified, and with actual building structures and foundations provided shall not develop vibration exceeding the 80 percent of the limits specified in HIS 9.6.4.
      b. If units exhibit vibration in excess of the limits specified adjust or modify as necessary. Units that cannot be adjusted or modified to conform as specified shall be replaced.
   3. Flow Output: Measured by plant instrumentation and storage volumes.

B. Operating Temperatures: Monitor bearing areas on pump and motor for abnormally high temperatures.

C. Performance Test: In accordance with Hydraulic Institute Standards.

3.04 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by Jacobs, for minimum person-days listed below, travel time excluded:
   1. 2 person-days for installation assistance and inspection.
   2. 3 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
   3. 2 person-days for prestartup classroom or Site training.
   4. 2 person-days for facility startup.
   5. 2 person-days for post-startup training Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Jacob's Engineer.

B. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

3.05 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this Specification.
   1. Grit Pump 1-6 Data Sheet.

END OF SECTION

GRIT PUMP 1-6 DATA SHEET

Tag Numbers: 14PMP9601-01, 14PMP9601-02, 14PMP9601-03, 14PMP9601-04, 14PMP9601-05, 14PMP9601-06
Pump Name: Grit Pump 1 - 6

Manufacturer and Model Number: (1) Wemco, Model C
(2) Morris Model 6100
(3)

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): Grit Slurry

Pumping Temperature (Fahrenheit): Normal: 70 Max 80 Min 55

Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: 1 cp

pH: 6 -9

Corrosive (Y/N) Y Nature of Corrosive Conditions: Hydrogen Sulfide

Abrasive (Y/N) Y Nature of Abrasive Conditions: Grit

Possible Scale Buildup (Y/N): N

Total suspended solids (mg/L): 5,000 to 10,500

Largest diameter solid pump can pass (inches): 3

Min. NPSH Available (Ft. Absolute):
Altitude (Feet above Mean Sea Level): Sea Level

Area Classification: Unclassified

Ambient Temperature (degrees F.): 40 to 90

Location: Indoor (Y/N): Y Outdoor (Y/N): N

PERFORMANCE REQUIREMENTS

Capacity (US gpm): Rated: 400 Secondary: 200

Total Dynamic Head (Ft): Rated: 15 Secondary: 20

BHP at Rated Point:

Min. Pump Hydraulic Efficiency at Rated Capacity (%): _____

Max. NPSH Required at Rated Secondary Capacity (Ft. Absolute): _____

Max. Pump Speed at Rated Capacity (rpm): 1,800
Constant (Y/N): Y
Adjustable (Y/N): N

DESIGN AND MATERIALS

Pump Type: Horizontal (Y/N) Y Frame-Mounted (Y/N) N

Vertical (Y/N) N Other Belt Driven; See Drawing for Orientation

Fully-Recessed Impeller Type: Y

Impeller Material: Ni-Hard, ASTM A532, BHN 650

Removable Suction Flange/Wear Plate (Y/N): Y

Wear Plate Material: Ni-Hard, ASTM A532, BHN 650

Removable Radial Wear Plate (Y/N): _____ Material: _____

Removable Wear Plate w/Pump-out Vanes behind Impeller (Y/N): _____

Material: _____

Primary Wear Surface Minimum Brinnell Hardness: 650

Primary Wear Surface Minimum Thickness (in.): 1-1/4

Casing Type: Two-Piece Radial Split Min Thickness (in.) 3/4

Casing Material: Ni-Hard Cast-on Feet (Y/N): _____

Shaft Material: Steel, ASTM A276 Type 410

Shaft Sleeve Material: 450 BHN

Shaft Seal: Packing (Y/N) N Mechanical (Y/N) Y

Seal Type: Single, Mechanical, Tungsten Carbon Seal Faces

Seal Lubrication: External flushing water

ABMA B-10 Bearing Life (hrs): 100,000 Lubrication: Oil bath

DRIVE MOTOR (See Section 26 20 00, Low-Voltage AC Induction Motors.)

Horsepower: 25 Voltage: 480 Phase: 3 Synchronous Speed (rpm) 1800

Service Factor: 1.15 Inverter Duty: No

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC _X_____ CISD-TEFC _____ TENV _____ WPI _____ WPII _____ SUBM _____

REMARKS