DIVISION 15- MECHANICAL
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SECTION 15050 – BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 GENERAL INFORMATION

A. Contractors shall become informed of all conditions under which this work is to be done. No monetary allowance shall subsequently be made because of any errors due to not becoming informed and familiar with the project.

B. Data given in the specifications and on the drawings are as exact as could reasonably be identified. Their extreme accuracy is not guaranteed. Drawings and Specifications are for the assistance and guidance of the Contractor; exact distances, levels and grades will be governed by the confines or the existing building.

C. Mechanical materials shall be installed in a neat and workmanlike manner. Building and process piping, ductwork, and other conduits shall be properly secured and supported. Equipment shall be installed as specified and in conformance with the equipment manufacturer's recommendations and instructions. Vibrating equipment shall be installed with suitable vibration isolators to protect equipment and supporting structures from long-term damage. Lack of detail in drawings or specifications shall not relieve the Contractor of his responsibility to properly install, secure and support equipment and appurtenances.

1.02 STANDARDS AND CODES

A. Applicable Federal, State, County and Local Codes and Standards are the minimum requirements for materials and labor practices not otherwise stated. Nothing in the Plans or Specifications shall be construed or are intended to permit materials or installation not conforming to the above referenced authorities. The "Oregon State Plumbing Code" shall govern building services piping and plumbing.

1.03 FEES

A. Contractor shall obtain and pay for all permits and fees required by governing agencies having jurisdiction over this work. Work shall not begin until proper building permits are obtained and posted.

B. Contractor shall secure and pay for all inspections and tests required by Governmental or Utility Codes or ordinances prior to, during, and at the completion of this work. Contractor shall coordinate required inspections at the proper times without causing delays in work or progress.

1.04 SUBMITTALS

A. Shop Drawings. Contractor shall submit five copies to Engineer to be reviewed prior to construction or installation of work. Including, but not limited to:

1. Process or special unit piping.
2. All mounting brackets, standoffs, and supports used for piping, valves, and all mechanical fixtures.
3. Special valves and equipment.
4. Soil and drain plumbing fixtures floor or wall mounting.
5. Other submittals as required in specific Division 15 Sections.
6. See also requirements of Division 1.

1.05 QUALITY ASSURANCE

A. Division 15 materials and equipment shall be installed by qualified workers with experience specific to the items being used and methods of installation being required in the work.

B. Contractor shall obtain manufacturer's instructions for equipment and carefully review before performing work. Contractor shall also be familiar with referenced standards pertaining to installation methods and materials. Project drawings, specifications, approved shop drawings, and manufacturer's instructions shall be kept on site and adhered to.

1.06 WARRANTY

A. The Contractor shall assume full responsibility for and warrant for one year (after final acceptance) the satisfactory performance of all mechanical systems.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 TESTING

A. Contractor shall make tests of any portion of the installation as required by Engineer to determine if it is in accordance with these specifications.

B. Should any piece of apparatus or any materials or work fail in any test immediately remove and replace. Portion of work replaced shall again be tested by Contractor with no additional cost to owner.

C. Enclosed piping to be tested before concealing.

D. All tests shall be made in the presence of the Engineer.

E. Testing of building plumbing

1. Test all new plumbing system in the presence of the Plumbing Inspector and the Engineer. Provide ample advance notice of test dates. Provide all equipment, material and labor necessary for inspections and tests and repair all work not passing tests. After repairs are made, tests shall be repeated until each entire system is found satisfactory to the above authorities. Carry out tests prior to concealing, insulating or backfilling over any piping. No exceptions will be made.

2. Provide all equipment, material and labor necessary for inspection and tests, and repair all work found defective. Test pressure gauges must be of high quality and properly certified. Provide safety equipment to prevent accidental over-pressurization. After repairs are made, repeat tests until entire systems are found satisfactory.

3. All domestic water pressure piping; Hydrostatic test 150 psi for a minimum of 2 hours without drop in pressure. Exclude hot water heater from test.

4. All DWV piping; fill system with water to a point not less than 10 feet above the highest point in the system being tested. Water shall be held at that level for a

period of not less than 30 minutes. The system shall prove leak free by visible means.

F. Hydrostatic Testing of Process Water Piping. Fill process piping with potable water to a pressure of 150 psig. System must hold test pressure for a minimum of 2 hours with no drop in pressure. All leaks shall be corrected.

3.02 CLEANING

A. Equipment, fixtures, piping and all other materials furnished under this Division shall be cleaned, free from all rust, scale and dirt before covering or painting, or systems put into operation.

B. After completion of the work, all debris shall be removed, leaving entire work complete and undamaged.

3.03 CUTTING AND PATCHING

A. Necessary cutting and patching for installation of plumbing system included in this work. Work shall conform to applicable portions of project specifications. No cutting of structural members without prior written approval by Engineer.

3.04 PAINTING

A. Pipes, and all fittings including hanger rods, etc., not of stainless steel, shall be primed and painted per Division 9.

B. Shop pre-assembled equipment shall conform to painting specifications - Division 9, and shall be "touched up" or repainted if damaged during construction.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Payment for basic mechanical materials, methods and other work in this section shall be included as a portion of the lump sum price for the project as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION

SECTION 15060 – HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Piping shall be supported, in general, as described hereinafter and as shown by the pipe support details on the Drawings. Manufacturer's catalog figure numbers are typical of the types and quality of standard pipe supports and hangers to be employed. Special support and hanger details may be shown to cover typical locations where standard catalog supports are inapplicable.

B. The Contractor shall select and design all piping support systems within the specified spans and component requirements. Structural design and selection of support system components shall withstand the dead loads imposed by the weight of the pipes filled with water, plus any insulation. Commercial pipe supports and hangers shall have a minimum safety factor of 5.

C. No attempt has been made to show all required pipe supports in all locations, either on the drawings or in the details. The absence of pipe supports and details on any drawings shall not relieve the Contractor of the responsibility for providing them throughout the plant per accepted practices.

D. All support anchoring devices, including anchor bolts, inserts and other devices used to anchor the support onto a concrete base, roof, wall, or structural steel works, shall be of the proper size, strength and spacing to withstand the shear and pullout loads imposed by loading and spacing on each particular support.

E. Where piping connects to equipment, it shall be supported by a pipe support and not by the equipment. A pipe support or hanger shall be installed adjacent to each pipe fitting or in-line device such as a valve or meter for all piping larger than 4-inch.

1.02 REFERENCES

A. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel

B. ASTM A123 - Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip

C. ASTM A653 - Specification for Steel Sheet, Zinc-Coated by the Hot-Dip Process

D. ASTM A1011 – Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability *(Formerly ASTM A570)*

E. MSS SP58 - Manufacturers Standardization Society: Pipe Hangers and Supports-Materials, Design, and Manufacture

F. MSS SP69 - Manufacturers Standardization Society: Pipe Hangers and Supports-Selection and Application

G. NFPA 13 - Standard for the Installation of Sprinkler Systems A. ASTM A167- Standard specification for Stainless and Chromium-Nickel steel plate, sheet and strip.

H. ASTM D4385 – Standard Practice for Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products.

I. ASTM D635 – Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.

J. ASTM E84 - Test method for Surface Burning Characteristics of Building Materials.

K. ASTM F569 – Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

L. AISI – American Iron and Steel Institute

M. UL94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.03 QUALITY ASSURANCE

A. Hangers and supports used in fire protection piping systems shall be listed and labeled by Underwriters Laboratories.

B. Steel pipe hangers and supports shall have the manufacturer's name, part number, and applicable size stamped in the part itself for identification.

C. Hangers and supports shall be designed and manufactured in conformance with MSS SP 58.

D. Supports for sprinkler piping, if required, shall be in conformance with NFPA 13.

1.04 SUBMITTALS

A. Detailed shop drawings of all supports, including support anchoring devices, shall be supplied with the submittals specified herein.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver material carefully to avoid breakage and scoring finishes. Do not install damaged equipment.

PART 2 PRODUCTS

2.01 MANUFACTURER AND TYPE

A. Pipe Floor Supports. Horizontal piping pedestal supports shall be adjustable supports attaching to flanges or pipe stanchion saddles with U-bolts or clamps as shown in drawings.

1. Supports shall have a neoprene liner to isolate the pipe from the support and protect the PVC piping.

2. Support pipe shall be Schedule 40 galvanized steel cut to proper length. Supports shall be galvanized. Anchor bolts to concrete shall be stainless steel.

3. Supports used in the wetwell shall utilize sch 40 stainless steel pipe and stainless steel base, threaded top and clamp. Pipe shall be cut to size on site. Support base, pipe and top shall be fully welded to form a one-piece rigid construction.

3. Floor Supports shall be Standon model C92 or approved equal.

B. Pipe hangers for copper and plastic piping shall be coated with a plastic or neoprene protective cover. No metal portion of a hanger, support, or brace shall contact pipe directly. Use proper upper attachments and rods as required.

C. Pipe Hangers for piping less than 8-inch diameter shall be B-Line B3172C with threaded rod, nuts and washers, or approved equal. Assembly shall be zinc plated. Install as shown in the drawings and or as required.

D. Wall Support/Clamp shall be used where shown in drawings. Strut channel horizontal support with wall mount bracket. Galvanized finish. B-Line B3064 or approved equal.

E. Offset Clamps shall be used where shown in drawings. Galvanized finish. B-Line B3148 or approved equal.

F. Piping clamps for board or panel mounted pipe, tubing or conduit shall be one-hole clamps, short straps, split-style clamps, or offset clamps as required. Provide any required furring or stand-offs necessary for clearances. Furring on PVC equipment boards, when required, shall be PVC.

G. Strut channel systems shall be used where indicated on the plans and as required for proper support of vertical and horizontal multiple piping runs and electrical raceways. The strut systems are further described as:

1. All strut channels shall be galvanized or epoxy coated. B-Line B22 or approved equal.

2. Stainless steel hardware and accessories shall be used.

3. Strut shall be 1 5/8" wide in varying heights and in combinations and arrangements as shown on the drawings.

4. Pipe clamps shall include rubber pipe cushions or isolation pads. B-Line Vibraclamp BVT or approved equal. Galvanized finish.

H. SPLIT-STYLE PIPE CLAMPS (Behringer Clamps)

1. Split-style pipe clamps shall be used where shown on the drawings and where this style provides the most suitable clamp for wall, panel, or ceiling mounting.

2. Split-style clamps include a base plate, a bottom and top "clamp half" constructed of polypropylene, and a top plate. The separate components are connected using through bolts. The resulting assembly tightly cradles a piping section between the two clamp halves.

3. Behringer clamps are available in standard and heavy duty. Heavy duty clamps are required when being attached to strut channel. For all other applications, standard clamps are acceptable, unless otherwise recommended by the manufacturer.

4. Split-style heavy duty clamps shall be manufactured by Behringer, or approved equal. Standard split-style clamps shall be manufactured by Behringer, Stauff, or approved equal.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify piping is level, plumb and true. Verify proper wall blocking has been installed where wall connections are required. Location of supports shall be organized in such a manner as to not interfere with access and other work.

3.02 INSTALLATION

A. Unless noted otherwise on the Drawings, horizontal pipe support or hanger spacing and hanger rod sizing for pipe shall not exceed as follows:

Pipe Size (inches)	Maximum Distance Between Supports (feet)	Minimum Hangar Rod Size (inch)
1" and less	4'	3/8"
2" to 1-1/4"	5.5'	3/8"
2-1/2" to 3-1/2"	6.5'	1/2"
4" to 5"	7'	5/8"
6"	8'	3/4"
8"	8.5'	3/4"
10"	9'	7/8"
12"	10'	7/8"
14"	15'	1"

B. The load rating for universal concrete inserts shall not be less than that of the hanger rods they support.

C. When supporting cast iron and ductile iron pipe, locate hanger rods near all joints and at each change of direction.

D. All piping shall be supported in a manner which will prevent undue strain on any valve, fitting, or piece of equipment. In addition, pipe supporters shall be provided at changes in direction or elevation, adjacent to flexible couplings, and where otherwise shown. Pipe supports and hangers shall not be installed in equipment access areas.

E. All supports and clamps shall be installed as necessary to provide a secure installation in a neat and workmanlike manner.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Payment for basic mechanical materials, methods and other work in this section shall be included as a portion of the lump sum price for the project as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION

SECTION 15105 – PIPING SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Section specifies ductile iron, PVC, steel, stainless steel, copper, plastic tubing, and other piping systems to be used on the project.

B. Where indicated, the Contractor may choose a piping material. Otherwise, the material referenced will be required.

1.02 REFERENCES

A. This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and the listed documents, the requirements of this section shall prevail.

References	Title
ANSI B1.1-81	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI B1.20.1-83	Pipe Threads, General Purpose (Inch)
ANSI B16.1-89	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ANSI B16.5-88	Pipe Flanges and Flanged Fittings
ANSI B18.2.1-81	Square and Hex bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws
ANSI B18.2.2-87	Square and Hex Nuts
ASTM F37-88	Standard Test Methods for Sealability of Gasket Materials
ASTM F104-88	Standard Classification System for Nonmetallic Gasket Materials
ASTM F152-87	Standard test Methods for Tension Testing of Nonmetallic Gasket Materials
AWWA C111-85	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C207-86	Steel Pipe Flanges for Waterworks Service--Size 4 In. Through 144 In.
AWWA C213-07	Fusion Bonded Epoxy Coating for Interior and Exterior for Steel Water Pipes

1.03 RELATED SECTIONS

A. Section 15110 – Valves

B. Section 15060 – Hangers and Supports

C. Section 15120 – Misc. Fittings & Specialties

1.04 SUBMITTALS

A. Contractor shall submit 3 copies of technical data for project piping. Data shall include material data, pressure rating data, location of manufacture, and other information as necessary to show complete compliance with these specifications for each type of piping used.

B. If welded piping is to be used, submit detailed shop drawings showing dimensions, pipe sizes, field weld locations, flange locations, etc.

1.05 QUALITY ASSURANCE

A. All piping shall be new, unused and completely free from defects.

B. All pipe materials made in the USA shall be given preference.

1.06 PIPING SCHEDULE

A. Where not specifically noted on the plans or otherwise specified, pipe shall be installed in accordance with the following schedule and conform to the detailed specifications for each type of pipe.

B. Contractor may, at his own discretion and expense, furnish superior piping in material and pressure rating than that specified.

C. The following schedule (Table 1) is provided indicating the piping materials to be utilized on the project.

TABLE 1
PIPING SCHEDULE

Typical Location/Use	Material Spec.	Joint/ Connections	Pressure Rating (min.)
Discharge Piping	Class 350 DI or Sch. 40 ASTM A53 Class B Steel	Ductile Flanges, Megaflange, Cast Iron Backer Flanges for Stainless Piping	150 psi
Drain Piping (1" and larger)	Schedule 40 PVC	Glued	n/a
Domestic water supply piping	Type M or K copper Schedule 80 PVC	Soldered, glued, threaded	150 psi
Vent Piping	Stainless Steel	Welded	n/a

PART 2 PRODUCTS

2.01 PVC/CPVC PIPING, SCHEDULE 40 & 80

A. Schedule 80 PVC piping shall be manufactured from Type 1, Grade 1 polyvinyl chloride compound with a cell classification of 12454 per ASTM D1784.

B. Pipe shall be manufactured in strict compliance to ASTM D1785, consistently meeting and/or exceeding the quality assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality.

C. Fittings shall be injection molded, Schedule 40 or 80 (to match pipe schedule), manufactured in strict compliance to ASTM D2467 for socket type, and D2464 for threaded type. Use threaded fitting adapters only where specifically allowed as required to connect to valves. All threaded fittings shall have stainless steel reinforcements.

D. Pipe and fittings shall be NSF Standard 61 approved for use in potable water systems.

E. Cement shall conform to ASTM F493 and SCAQMD 1168. Cement shall be heavy-bodied, low VOC specifically recommended by the manufacturer for use in industrial sodium hypochlorite applications. Cement shall be IPS Weld-On 724 CPVC.

F. Primer shall conform to ASTM F656 and SCAQMD 1168. Primer shall be IPS Weld-On P-70, Purple.

G. Teflon tape shall conform to MIL spec P-27730A.

H. Piping shall be NSF approved.

2.02 DUCTILE IRON PIPING

A. Pipe shall be Ductile Iron Pipe (DIP), Grade 60-42-10 minimum, size and end configurations as shown in the drawings. Pressure Class 350 minimum thickness.

B. DIP shall be manufactured in accordance with ANSI/AWWA C151/A21.51 under method of design outlined in ANSI/AWWA C150/A21.50. Flanged sections shall also conform to ANSI/AWWA C115/A21.15.

C. Internal Lining. All ductile iron pipe shall be lined and seal coated with ceramic epoxy coating such as Protecto 401, factory applied. Dry film thickness shall be 40 mils nominal. Joint Compound (Protecto or equal) shall be applied by brush and in accordance with manufacturers recommendations.

D. External Coating. All DIP that will be buried or exposed to process water/wastewater on the pipe exterior shall be asphaltic seal coated on the exterior in accordance with ANSI/AWWA C151/A21.51. Interior DIP, and exterior DIP exposed to view and not subject to submergence, will require painting and may be supplied factory primed and without asphaltic coating.

E. Pipe shall be made in the USA and shall not have been refurbished or reworked by anyone other than the manufacturer.

F. Provide proper spool lengths from factory with plain and flange ends as required. If field cutting is required, follow manufacturer's instruction and coat cut pipe end.

G. Pipe shall be manufactured by American Cast Iron Pipe Company, Pacific States Cast Iron Pipe Co., US Pipe, or approved equal.

2.03 DUCTILE IRON FITTINGS

A. Fittings shall conform to ANSI/AWWA C110/A21.10 Standard (full body), or ANSI/AWWA C153/A21.53 (compact), with a 250 psi minimum working pressure.

B. Where shown in the project drawings, provide bosses on fittings at locations shown.

C. Fittings shall be factory coated with ceramic epoxy on the inside, Protecto 401, or equal. Exterior of fittings shall have an asphaltic coating in accordance with ANSI/AWWA C110/A21.10. Fittings to be installed in building interior and painted shall be supplied with primer instead of asphaltic coating.

D. Mechanical joint fittings shall be produced in the USA in accordance with all applicable terms and provisions of ANSI/AWWA C153/A21.53 (or C110) and ANSI/AWWA C111/A21.11. MJ gasket material shall be SBR rubber. T-bolts shall be Cor-Ten or other approved high strength, low alloy steel in accordance with ANSI/AWWA C111/A21.11 (current revision).

E. Flanged fittings shall be manufactured in the USA of ductile iron in accordance with all applicable terms and provisions of ANSI/AWWA C110/A21.10. Flanged surface shall be faced and drilled in accordance with ANSI Class 125 B16.1. Nominal body thickness shall not be less than as specified in ANSI/AWWA C153/A21.53. Misalignment of bolt holes of two opposing flanges shall not exceed 0.125 inches.

1. Flange assembly bolts shall be ANSI B18.2.1 standard square or hexagon head carbon steel machine bolts with ANSI B18.2.2 standard hot pressed hexagon nuts. Threads shall be ANSI B1.1, standard coarse thread series; bolts shall be class 2A, nuts shall be Class 2B. Bolt length shall conform to ANSI B16.5. Flange assembly bolts and nuts shall be made of noncorrosive high-strength, low-alloy steel as specified in ANSI/AWWA C111/A21.11.

2. Flange gaskets shall be full-face with holes to pass bolts. Gasket material shall be neoprene rubber conforming to ASTM D2000, SAE J200, 1/8-inch thick.

F. Mechanical joints shall be positively restrained using MegaLugs, by EEBA Iron, or approved equal. Mechanical joints with retainer glands alone will not be acceptable on this project.

G. Flange and Mechanical Joint fittings shall be by Tyler Pipe, Union Foundry Company, US Pipe; or approved equal.

2.04 FIELD FLANGE FITTING

A. Restrained flange coupling adapters shall be used on the project in lieu of factory flanged spools only where indicated on the plans and approved.

B. Other types of field flanges will not be allowed on the project.

C. Restrained flanged coupling adapters shall be Mega-Flange by EEBA Iron, or approved equal.

2.05 STAINLESS STEEL VENT PIPING

A. Use where shown on drawings or as specified in Contract Documents.

B. Pipes shall be manufactured from ASTM A240 sheets and plates in accordance with ASTM A778 in 304L or 316L stainless steel.

C. Pipe minimum wall thickness shall be schedule 10S nominal.

D. Piping shall be provided in plain-end configuration in preparation for butt weld fittings.

E. Finish shall be No. 1 H.R.A.P. (Hot Rolled Annealed and Pickled) or better.

F. Fittings shall be butt weld type manufactured in accordance with ASTM-A-774 of the same grade (alloy) and in the same wall thickness as the pipe.

G. Fittings shall match pipe wall thickness. Minimum wall thickness shall be schedule 10S nominal.

H. Welding of pipe and fittings shall be performed using welders and procedures qualified in accordance with ASME Section IX. Piping and fittings with wall thicknesses up to and including 11 gauge (0.125") shall be TIG welded. Heavier walls shall be beveled and TIG welded in multiple passes. Filler metal shall be of equal or superior grade to parent metal. Weld cross section shall be equal to or greater than parent material thickness. Weld concavity, undercut, cracks, crevices, or pitting shall not be allowed. Butt welds shall have full penetration to the interior surface.

I. After fabrication, exterior welds shall be manually scrubbed and/or brushed with non-metallic pads or stainless steel wire brushes to remove weld discoloration, rinsed with clean water and allowed to air dry.

J. Extreme care shall be taken to avoid contact between ferrous materials with the stainless steel piping. All saws, drills, files, grinders, brushes, etc. shall be used for stainless steel only.

K. Contractor shall paint all exposed steel or iron flanges, and other fittings, in accordance with Section 09900. Stainless steel pipe shall remain unpainted.

L. All markings shall be removed from stainless steel pipe by Contractor to provide a consistently clean surface.

2.06 BRASS/BRONZE FITTINGS

A. Red brass pipe nipples and piping shall be seamless, MIP threaded, rated for 150 psi working pressure, and conforming to ASTM B43 and ASTM B687. Bronze fittings shall meet the requirements of ASTM B62 with NPT threaded ends conforming to ANSI/ASME B16.15.

2.07 COPPER WATER PIPING

A. Type K or M, copper tubing conforming to the requirements of ASTM B-88 unless otherwise specified.

B. Joints shall be soldered and threaded as required.

1. Solder to be used in copper piping shall be ASTM B32, Alloy Grade Sn95 or Silverbrite 100.

PART 3 EXECUTION

3.01 PREPARATION

A. Ensure that piping is properly installed and supported. Verify end connections as required on the drawings. Verify dimensions required for installations.

B. Verify that piping has not been damaged in shipping or storage.

3.02 GENERAL INSTALLATION

A. Install piping per manufacturer's instructions. Properly brace and support as directed.

B. Follow appropriate pipe joining specifications for various MJ, Flange, solvent welded and threaded ends.

C. All piping shall be cleaned and flushed prior to start of testing.

D. All piping shall be leak tested in accordance with Section 15050.

E. Potable water piping shall be flushed and disinfected in accordance with the requirement of the Oregon Department of Human Services, Drinking Water Program and OAR 331-061-050, and Section 15050.

3.03 FLANGED JOINT INSTALLATION

A. Furnish the gaskets required for each flange joint being assembled. Gasket material for flanged joints shall be 1/8-inch thick commercial neoprene sheet conforming to ASTM D2000, SAE J200 and 1 BC 609. For 12-inch and smaller pipe, gasket shall be full face cut with holes to pass bolts. For 14-inch and larger pipe, gasket shall be ring type.

B. Flanged joints shall be fitted so the contact faces bear uniformly on the gasket. Bolts shall be tightened progressively in a sequential, uniform manner to torque values recommended by the manufacturer of the flange or fitting. Flanged fittings shall be properly anchored, supported, or restrained during installation to prevent bending or torsional strains at the connection during and after the joining process.

3.04 MECHANICAL JOINT INSTALLATION

A. Joints and gaskets for mechanical joints shall conform to ANSI/AWWA C111/A21.11 Standard. Furnish gaskets and hardware necessary for each mechanical joint.

B. The pipe shall be inserted in the socket and supported as necessary to keep the pipe centered in the joint and to maintain uniform exposure of the gasket recess. The gasket shall be pressed firmly and evenly into the gasket recess prior to installing the bolts through the gland. Bolts shall be tightened progressively in a sequential, uniform manner to torque values recommended by the manufacturer of the fitting. The gland shall not be allowed to deform during the tightening process. Any required minor deflection of joints shall be made after the joint is assembled, but before final tightening of the bolts. The jointing procedure shall be repeated if effective sealing is not attained at the maximum torque. Bolts shall be tightened to manufacturer's specifications. Bolts shall not be overstressed to compensate for ineffective sealing or poor installation practice.

3.05 PRESSURE TESTING

A. All pressure and leak testing shall be conducted by the Contractor in the presence of the Engineer.

B. Testing shall not be commenced until all thrust blocking has been in place for not less than 10 days and sufficient backfill has been placed to prevent pipe movement.

C. Test Procedure

1. The test section shall be filled with water and all air expelled from the pipe prior to testing. Contractor shall coordinate with the City to obtain water for testing.

2. All valves isolating the test section shall be securely closed and the specified test pressure applied by means of a pump connected near the lowest point of the test section. All open pipe ends shall be plugged using blind flanges or restrained plugs, as applicable.

3. The test pressure shall be 150 psi and the duration shall be at least 1-hour at the test pressure. No pressure drop is allowed during the test. No visible signs of leakage will be allowed at any exposed pipe, fitting or joint.

4. Contractor shall repair or replace any defective piping or fittings at no additional cost to the Owner. Repeat pressure tests until entire system is found satisfactory.

D. All visible leaks on new pipelines shall be repaired, regardless of the amount of leakage.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Payment for piping systems, fittings and other work in this section shall be included as a portion of the lump sum price for the project as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION

SECTION 15110 – PIPELINE APPURTENANCES

PART 1 GENERAL

1.01 SUMMARY

A. The work in this Section consists of furnishing all labor, materials, equipment and performing all work necessary for the proper installation of pipe appurtenances indicated on the Plans and/or required for the completion of the proposed pump station and forcemain improvements.

B. Pipe appurtenances may include, but are not necessarily limited to the following:

a. Fittings (bends, tees, etc.)
b. Valves and Valve Boxes
c. Concrete Thrust Blocking

C. All water pipe fittings and appurtenances (including rubber gaskets) shall be made in the USA, shall be UL listed and FM approved.

D. Appurtenance Submittals – Three (3) copies of drawings and/or brochures for all appurtenances to be installed, whether as specified or a proposed substitution, shall be submitted to the Engineer for approval prior to installation.

PART 2 PRODUCTS

2.01 MATERIALS

A. Ductile Iron Fittings

1. Special note shall be taken of the various end configurations (MJ, flange, etc.) of fittings, valves, and other appurtenances as indicated in the Plans for various installation connections to existing and new materials. Thrust blocking as specified shall be installed at all fittings. Contractor may use full body or compact mechanical joint fittings, provided that the minimum pressure rating and other specifications are met.

2. All bends, tees, crosses, reducers, caps, plugs, sleeves, connectors, laterals, "Y" branches, and all other non-valve fittings shall be Protecto 401 (or equal) lined in accordance with specification included in Section 02509-2.02 Interior Pipe Lining.

3. Joints and gaskets for mechanical joint fittings shall be of domestic manufacture and conform to ANSI/AWWA C111/A21.11 Standard. Fittings shall conform to ANSI/AWWA C110/A21.10 Standard (full body), or ANSI/AWWA C153/A21.53 Standard (compact), with 250 psi working pressure minimum requirement. Furnish with ductile iron "T" head bolts and hexagonal nuts conforming to AWWA C111.

4. Flanged fittings shall be faced and drilled to standard 125-pound template per ANSI B16.1 Standard, unless otherwise specified, indicated, or required to connect to other materials. Fittings shall conform to ANSI/AWWA C110/A21.10 and/or ANSI B16.1, Class 125, and be short-body style unless otherwise indicated. Flanged fittings shall have a 250 psi minimum pressure rating. Gasket material for flanged joints shall be commercial neoprene sheet

conforming to ASTM D2000, SAE J200, 1 BC 609, 1/8-inch thick. For 12-inch and smaller pipe, gasket shall be full face cut with holes to pass bolts. For 14-inch and larger pipe, gasket shall be ring type. Furnish with coarse thread cadmium plated nuts and bolts conforming to ANSI B18.2 and B1.1 American Standards for Class 2A and 2B fit. Stainless steel nuts and bolts will be allowed.

5. Mechanical joint and flange joint fittings shall be as manufactured by Tyler Pipe; Union Foundry Company; Pacific States Pipe; Stockham: U.S. Pipe; or approved equal.

6. Joint restrainers for MJ fittings shall be Megalug manufactured by EBAA Iron, Inc. designed specifically for pipe material used. Use on all mechanical joints.

7. All blind flanges for pipe of 12-inch diameter and larger shall be provided with lifting eyes in the form of welded or screwed eye bolts attached to the edge of the flange. Eye shall be located such that it is at the exact top center of blind flange when mounted on a horizontal pipe. Certification of eye tensile strength shall be provided.

B. Couplings – All couplings shall be supplied with cadmium plated bolts or stainless steel bolts and other hardware conforming to nuts and bolts specified for flanged fittings. Contractor shall verify outside diameters (O.D.) of pipes to be connected prior to ordering couplings. Supply with standard shop coat enamel coating. Use only where specified on Plans.

1. Transition, reducing, and straight couplings, 2-inch through 12-inch, shall have cast ductile iron or carbon steel body, and resilient gaskets. TPS Hymax 2000 Series; Romac 501; or approved equal.

2. End caps couplings, 3-inch through 12-inch, shall have cast ductile iron sleeves, end rings and end caps, and resilient gaskets. Smigh-Blair 482; Romac EC501; or approved equal.

3. Flange coupling adapters, 3-inch through 12-inch, shall have cast iron body and end ring, and resilient flange and coupling gaskets. Smith-Blair 912; Romac FCA501; or approved equal.

4. Flange by mechanical joint (Flg x MJ) adaptors, 3-inch through 20-inch, shall have ductile iron bodies and joints conforming to applicable fitting specifications herein. Tyler; Union Foundry Co.; or other approved pipe/fittings manufacturer.

5. Couplings, ½-inch through 2-inch, for IPS pipe shall be compression type with rubber gaskets. Body shall be at least 3 ¾-inches long and constructed of galvanized carbon steel, with ASTM A 47 malleable iron nuts. Smith-Blair 522; Romac 702; or approved equal.

C. Galvanized Pipe Fittings – Galvanized pipe fittings shall be 150-pound standard malleable iron screwed fittings, rated for 300 psi non-shock cold water, oil or gas (W.O.G.) pressure minimum. Fittings shall meet Federal Specification WW-P-521, shall be UL listed and conform to:

Material	- ASTM A 197-87
Dimensions	- ASA B16.3
Threads	- ASA B2.1
Galvanizing	- ASTM A 153-82(87)

D. PVC Drain Waste Vent Fittings – PVC molded DWV fittings shall be a minimum Schedule 40, solvent weld unless otherwise stated. Fittings shall be manufactured in compliance to ASTM D 2665, ASTM D3311, ASTM F 1866, ASTM D 1784 and shall be certified to NSF Standard 14 and the Uniform Plumbing Code.

E. Eccentric Full-Port Plug Valves

1. Eccentric Plug Valves shall be of the tight closing, resilient faced non-lubricating variety and shall be of eccentric design such that the valve's pressure member (plug) rises off the body seat contact area immediately upon shaft readaptation during the opening movement. Valves shall be drip-tight at the rates pressure and shall be satisfactory for applications involving throttling service as well as frequent or infrequent on-off service. The valve closing member should rotate approximately 90° from the full-open to full-closed position and vice-versa.

2. The valve body shall be constructed of cast iron conforming to ASTM A 126, Class B. Body ends shall be flanged with dimensions, facing and drilling in full conformance with ANSI B 16.1, Class 125. Mechanical joint to meet the requirements of AWWA C111/ANSI A21.11.3.

3. Port shall be minimum 80% of full pipe area.

4. Valve plug shall be constructed of cast iron conforming to ASTM A126, Class B. The plug shall have a cylindrical seating surface that is offset from the center of the plug shafts. The plug shafts shall be integral. The portion of the plug in the valve body shall be fully encapsulated with Buna-N rubber. Rubber compound shall be approximately 70 (Shore A) durometer hardness. Rubber to metal bond must meet ASTM D-429-73 Method B.

5. Plug shaft seals shall be adjustable. All packing shall be replaceable without removing the bonnet or actuator and while the valve is in service. Shaft seals shall be Buna-N.

6. Manual valves shall have worm gear type actuators with handwheels or 2" square nuts.

7. Valve end configurations and sizes as shown on Plans.

8. Buried valves shall be furnished with a cast iron valve box as specified herein, and shall have operators designed for direct bury service. Furnish with a stem extension such that the operating nut is within 30-inches of the ground surface. Furnish hand wheel operators for all non-buried valves, including valves in vaults.

9. Valves shall be Clow, M&H, Kennedy; or equal.

F. Swing Check Valves (4" – 12")

1. Swing Check valves, 4-inch through 12-inch, shall be iron body, full opening swing type. Valve clapper shall swing completely clear of the waterway when valve is full open, with open flow area equal to nominal pipe diameter.

2. Check valves, 4-inch through 12-inch shall be rated at 175 psi water working pressure and 350 psi hydrostatic test for structural soundness. Seat tightness at rated working pressure shall be in accordance with values shown in AWWA Standard C-500 for gate valve and fully conform to AWWA C508. Check valves shall be UL listed and FM approved.

3. Cast iron shall conform to ASTM-A-126 Class B. Casting shall be clean and sound without inclusion or defect that will impair service. Furnish with fusion bonded epoxy meeting ANSI/AWWA C550 standard.

4. Clappers shall be cast iron and rubber faced. Hinge pins shall be 18-8 stainless steel.

5. Check valves shall be constructed to permit top entry for complete removal of internal components without removing the valve from the line. Glands shall be O-ring type.

6. Check valves shall be equipped with external lever and adjustable weight. Provisions shall be included to allow addition of spring assist assembly in the field.

7. Check valves shall be equipped with external limit switches to indicate a "valve open" condition or "valve closed" condition. See Division 16.

8. Bosses shall be provided on check valves for NPT taps. Bosses shall be provided at locations conforming to the Manufacturers Standardization Society Specification SP-45-1953. For 10-inch check valves, provide 1 ½" NPT tap at locations C and D, as defined in SP-45-1953. Provide galvanized malleable iron, square head pipe plug, rated for minimum 125 psi and conforming to ANSI/ASME B16.4 and ASTM A126 Class A; or approved equal.

9. Check valve end configurations and sizes shall be as shown on the Plans.

10. Joint materials, nuts and bolts for mechanical and flange joints shall be as specified in Section 02514-2.01.A.

11. Check valves shall be manufactured in the United States.

12. Check valves shall be as manufactured by Clow; M&H; Kennedy, American Flow Control; or approved equal.

G. Bronze Gate and Globe Valves (½" Through 3")

1. Bronze valves shall be Class 150 globe style or non-rising stem solid wedge gate style. Angle style where shown or required. Threaded or union bonnet. Threaded ends.

2. Body and bonnet shall be ASTM B61 or 62 bronze. Disc shall be bronze or Teflon. Handwheel shall be bronze or malleable iron. Stem shall be brass or copper-silicon bronze. Packing shall be non-asbestos Kevlar/Teflon or plastic/graphite.

3. Valves shall be manufactured by Red White Valve, Stockham, Kennedy; or approved equal.

H. Valve Boxes

1. Cast iron valve boxes with PVC extensions shall be furnished and installed with all buried gate valves. See standard detail drawing.

2. Valve box shall have a single piece top section and separate cover. Box and cover shall be manufactured from ASTM A48, Class 30 cast iron and shall be

rated for H20 traffic loading. Cover shall have "S" or "SEWER" formed in the casting.

3. Box shaft shall be 18-inches long with a 7-inch I.D. and 7½-inch O.D. Top flange of box shall be 12-inches in diameter. Cover shall be 7¾-inch diameter.

4. A PVC extension shall be placed at the valve extending to within 6-inches of the ground surface. The cast iron valve box is placed over this PVC extension. The PVC section shall be 6-inch diameter PVC, ASTM D3034, SDR35.

5. A hole shall be drilled through the cast iron box section to bring a length of toning wire into the box in accordance with the standard detail drawing.

6. Valve box assemblies shall be set such that the completed assembly is straight and plumb. The completed valve box assembly shall be centered over the operating nut of the valve and shall not transmit shock or stress to the valve, operating nut, or valve operator extension. Valve box assembly shall be kept free of rocks and other debris for the duration of the project. Valve box assembly shall be set flush with finish grade during final surface finishing.

7. Cast iron valve boxes shall be Olympic Foundry, Inc. VB-910; or approved equal.

I. Thrust Blocks – Furnish and place thrust blocks, sized as shown on the Plans, using portland cement concrete conforming to ASTM C94 and which develops a 28-day compressive strength of at least 3,000 psi.

1. If, in the opinion of the Engineer, the undisturbed earth against which the bearing surface has been established is compromised by the adjacent trenches or excavations, the contractor shall, as directed by the Engineer, excavate additional material as required to establish a new bearing surface that is consistent with the size, configuration and location of the piping.

2. The area where the blocking is to be placed shall be sufficiently excavated to receive the concrete so that the proper shape and bearing surface is attained. The bearing surface shall be placed so that the pipe and fitting joints will be accessible for repair. Concrete shall in no case extend around more than one-half the circumference of the fitting at any point. Thrust blocks shall be neatly formed with plywood.

3. A 6-mil plastic sheet shall be placed between the concrete and any portions of the valve, fitting, or nuts and bolts with which the concrete comes in contact.

4. The size of thrust block shall be determined by the size, configuration, and location of the piping. Minimum bearing areas for thrust restraint are outlined in the standard details. The contractor shall not increase the size of the bearing area or volume of concrete without the approval of the Engineer. Thrust blocks with volumes of concrete that are in excess of or less than that specified for the size and configuration of the piping shall be removed by the contractor, at the contractor's expense, when directed to do so by the Engineer.

5. Concrete gravity blocking is not permitted under any circumstances.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. Fitting Installation – Install fittings at the location shown or as directed by the Engineer. Handle, clean, lubricate and install fittings as specified in the appropriate sections for laying pipe. Where a cut in the pipe is necessary for inserting fittings or closure pieces, cut the pipe mechanically without damaging it or its lining and leave a smooth end at right angles to the centerline of the pipe. Dress and bevel the cut end of the pipe to remove sharp edges and projections which may damage the gasket. Any lining or coating damaged to a significant degree during the cutting process, as determined by the Engineer, shall be cause for removing the damaged section by recutting the pipe or for rejecting the pipe altogether. On the pipelines, securely anchor all tees, plugs and elbows as shown or directed to prevent movement due to thrust. Achieve anchorage only by use of approved thrust blocking or approved joint restraint.

B. Valves – Set valves in the same manner as specified in Section 02315 for pipe. Clean the face of flanges thoroughly before assembling the flanged joint. Insert the gasket and tighten the nuts uniformly around the flange. Align pipe carefully on both sides of the valve before final tightening of the flanges to avoid stressing the valve body. After installation, operate the valve from full open to full closed to ensure proper operation of the valve. Correct any malfunction in the operation of the valve. Test valve joints with adjacent pipeline. Repair any leaks as observed around the valve. Backfill around valves as specified in Section 02315 for pipe.

C. Valve Boxes – Center valve boxes and set plumb over the operating nut of the valve. Set valve boxes so they do not transmit shock or stress to the valve. Set valve box covers flush with the surface of the finished pavement or such other level as may be directed. Adjust the extensions to the proper length as required for proper installation. Backfill shall be as specified for the connecting pipeline. Correct any misalignment of valve boxes without additional expense to the Owner. Drill a minimum 3/8" hole in the wall of the upper section of the valve box, 1-inch to 2-inches below the bottom of the cover, and pass the locator wire through the hole.

D. Thrust Blocking – Provide thrust blocking, as shown or directed by the Engineer, using concrete as specified. Place the concrete blocking between undisturbed earth and the fitting to be anchored. The bearing surface shall be sized and located to adequately withstand the applied thrust force. Do not encase pipe joints or fittings with concrete. See the Plans for thrust block configurations.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Measurement and payment for fittings, including but not limited to Valves, Tees, Elbows, End Caps, Couplings, Adapters, Sleeves and Blind Flanges shall be included within the lump sum price for the Project as stated on the Bid Form. No separate or additional payment will be made for nuts, bolts, washers and other fitting related hardware or supplies. Payment for fittings shall include compensation for thrust and resistance blocking and connection to new forcemain. No additional measurement for this item will occur.

2. Payment for Valve Boxes shall be included as a portion of the lump sum bid amount stated on the Bid Form for the various valves as applicable. No additional compensation will be allowed for valve boxes.

3. Payment for Thrust and Resistance Blocking shall be included as a portion of the lump sum bid amount stated on the Bid Form for the various fittings and valves. No additional compensation will be allowed.

END OF SECTION

SECTION 15113 – VALVES AND PROCESS CONTROL

PART 1 GENERAL

1.01 WORK INCLUDED

A. Section specifies specialty valves used in the project.

B. Work includes furnishing, installing, testing, and adjusting valves for proper installation and operation.

C. Valve type, size and material for each application shall be as shown in the Plans and specified herein.

1.02 QUALITY ASSURANCE

A. All valves shall be new, unused and completely free from defects.

B. All valves of similar type shall be by a single manufacturer.

1.03 VALVE END CONFIGURATIONS

A. Valve end configurations shall be as shown in the drawings and required for the intended application.

B. Flanged valves shall be manufactured in accordance with ANSI B16.1 Class 125/150, including facing, drilling and flange thickness.

PART 2 PRODUCTS

2.01 BRONZE GATE AND GLOBE VALVES

A. Bronze valves shall be Class 150 globe style or non-rising stem solid wedge gate style. Angle style where shown or required. Threaded or union bonnet. Threaded ends.

B. Body and bonnet shall be ASTM B61 or 62 bronze. Disc shall be bronze or Teflon. Handwheel of malleable iron. Stem of copper-silicon bronze. Packing shall be non-asbestos, kevlar fibers with Teflon.

C. Valves shall be manufactured by Stockham, Kennedy, Red-White Valve Corp., or approved equal.

2.02 REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTER

A. Reduced pressure principle backflow preventer shall prevent contamination of the potable water supply due to back-siphonage or backpressure from substances that are health or non-health hazards. The assembly shall be manufactured in the U.S. of A. The bronze body shall be configured with individually accessible top access check valves including top-mounted test cocks. The relief valve shall be bottom centered with a separate cover. The replaceable seat rings shall be glass filled Noryl and the reversible seat discs shall be silicone rubber. Shall be equipped with Y-strainer and union-end ball valves on both ends of backflow preventer body.

B. RP Backflow Preventer shall be Apollo RP40; or approved equal.

C. Enclosure shall be fiberglass, lockable, insulated above-ground enclosures designed for insulation of pipeline appurtenances. Model shall be Lox Box LB1.5 by Hubbell, color choice per owner; or approved equal.

2.03 WASTEWATER COMBINATION AIR VALVE

A. Wastewater combination air valves shall be automatic float operated valves designed to exhaust large quantities of air during the filling of a piping system and close upon liquid entry. The valve shall open during draining or if a negative pressure occurs. The valve shall also release accumulated air from a piping system while the system is in operation and under pressure. The valve shall perform the functions of both wastewater air release and wastewater air/vacuum valves and furnished as a single body or dual body type as indicated on the plans.

B. Single body valves 4 inch and smaller shall have full size NPT inlets and outlets equal to the nominal valve size with a 2 inch inlet on 1 inch valves. The body inlet shall be hexagonal for a wrench connection. The valve shall have 3 additional NPT connections for the addition of backwash accessories.

C. Single body valve shall provide an extended body with a through flow area equal to the nominal size of the valve. Floats shall be unconditionally guaranteed against failure including pressure surges.

D. Single body valves shall have a full port orifice, a double guided plug, and an adjustable treaded orifice button. The plug shall be protected against direct water impact by an internal baffle and an extended float stem. The plug shall have a precision orifice drilled through the center stem. The float shall include a sensitivity skirt to minimize spillage.

E. Valve body and cover shall be cast iron. Float, plug, guide shafts, and bushings shall be constructed of Type 316 stainless steel.

F. Backwash accessories shall be furnished and shall consist of an inlet shut-off valve, a blow-off valve, a clean water inlet valve, rubber supply hose, and quick disconnect couplings. Accessory valves shall be quarter turn, full ported bronze ball valves.

G. Valve interior and exterior shall be coated with fusion bonded epoxy.

H. Valve shall have 2" NPT inlet and 1" NPT outlet.

I. Valve shall be Val-Matic Series 801A, or approved equal.

PART 3 EXECUTION

3.01 PREPARATION

A. Ensure that piping is properly installed and supported. Verify valve end configurations required with the drawings. Verify dimensions required for valve installations. Verify proper manual operators, extensions, etc. are on-site for valve operation.

B. Verify that valves have not been damaged in shipping or storage and are operating correctly.

3.02 INSTALLATION

A. Install valves per manufacturer's instructions. Properly brace and support valves.

B. Follow appropriate pipe joining specifications for various MJ, Flange, solvent welded and threaded ends.

C. Flush all pipelines prior to valve operation to remove all grit.

D. Operate all valves after installation to ensure smooth and proper operation. Adjust, clean, and lubricate as required.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Payment for Valves, Process Control and other work in this section shall be included as a portion of the lump sum price for the project as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION

SECTION 15115 – PIPE PENETRATION SLEEVE AND SEALS

PART 1 GENERAL

1.01 SUMMARY

A. The work in this Section consists of furnishing all labor and materials, and performing all work necessary for the proper installation of annular space seals.

1.02 REFERENCES

A. Section 03300 – Cast-In-Place Concrete

B. Section 02509 – Site Piping

1.03 SUBMITTALS

A. Submit product data in accordance with Section 01300.

1.04 PROJECT CONDITIONS

A. Verify all relative dimensions, pipe outside diameter and required sleeve inside diameter, before ordering product. Contractor is responsible for product fitment and function.

1.05 DELIVERY, STORAGE AND HANDLING

A. General: Comply with Division 1 Product Requirements Sections.

B. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Sequence deliveries to avoid delays and minimize on site storage.

D. Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by the Manufacturer. Protect from sunlight, weather, excessive temperatures and construction operations.

PART 2 PRODUCTS

A. MODULAR SEALS FOR PIPE PENETRATIONS

a. Annular space between the pipe and wall shall be sealed by use of modular seals consisting of interlocking synthetic rubber links shaped to continuously fill the annular space.

b. The elastomeric element shall be sized and selected per manufacturer's recommendations and have the following properties as designated by ASTM.

c. Coloration shall be throughout elastomer for positive field inspection. Each link shall have a permanent identification of the size and manufacturer's name molded into it.

d. Modular seal links shall be black EPDM rubber suitable for use in untreated wastewater.

e. Modular seal pressure plates shall be molded of glass reinforced Nylon Polymer with the following properties: Izod Impact – Notched = 2.05 ft-lb/in. Per ASTM D-256, Flexural Strength @ Yield = 30,700 psi per ASTM D-790, Flexural Modulus = 1,124,000 psi per ASTM D-790, Elongation break = 11.07% per ASTM D-638. Specific Gravity = 1.38 per ASTM D-792.

f. All fasteners shall be 316 stainless steel per ASTM F593-95 with 85 ksi average tensile strength.

g. Modular link seals shall be manufactured by PSI-Thunderline/Link-Seal, or approved equal. Modular seal links and modular seal pressure plates shall be products of the same manufacturer.

h. Link-Seal models LS200, 275, 300 and 315 shall incorporate the most current Link-Seal Modular Seal design modification sand shall include an integrally molded compression assist boss on the top (bolt entry side) of the pressure plate, which shall permit increased compressive loading of the rubber sealing element.

i. Link-Seal models 315, 325, 340, 360, 400, 410, 425, 475, 500, 575, and 600 shall incorporate an integral recess designed to accommodate commercially available fasteners to insure proper thread engagement for the class and service of metal hardware.

B. FLEXIBLE CONNECTORS FOR PIPE PENETRATIONS

a. Connections to precast riser gravity sections shall be accurately core-drilled and shall utilize a properly sized flexible rubber boot providing a watertight seal. Adapter shall be factory tested for watertightness up to 10.8 psi. Kor-N-Seal 106 series as manufactured by NPC, Inc. or approved equal.

b. Connectors shall use stainless expansion bands, 8-inches in length.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install per manufacturers recommendations and per contract drawings.

B. Modular seals shall not be allowed to bear the weight of pipe, either during installation or anytime thereafter. Proper pipe supports shall be supplied where appropriate.

C. Center the pipe in wall opening, making sure to properly support the pipe at both ends.

D. Insert Modular Seal according to Manufacturer recommendations, do not add or remove links from the seal to reduce or increase "sag".

E. Tighten bolts starting at the 12 O' Clock position and continue in a clockwise pattern. Do not tighten any bolt more than 4 turns at a time. Continue the clockwise pattern until all links are uniformly compressed. Do NOT use electric or pneumatic tools to tighten bolts, hand tighten only, follow manufacturers recommendations. Tighten until modular sealing elements "bulge" around the pressure plates.

F. For questions regarding installation of Link-Seal modular seals call (800) 423-2410.

G. Flexible connectors shall be installed using hand tools utilizing a ½" socket wrench and preset torque limiter to 12 foot lbs.

H. Pipe shall be smoothes and inserted into the center of the connector opening and clamped to 60 inch pounds of force.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Payment for pipe penetration seals and other work in this section shall be included as a portion of the lump sum price for the project as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION

SECTION 15117 – DUCK BILL CHECK VALVE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specifications for the slip-on style duckbill check valve provided for the valve vault and flow meter vault drain, air release valve manhole drain and overflow outfall.

1.02 SUMMARY

A. The duckbill check valve shall feature a soft sleeve end for slip over connection to plain pipe end and shall be fastened with stainless steel clamp(s).

1.03 QUALITY ASSURANCE

A. Manufacturer shall specialize in manufacture of valves for municipal and industrial applications.

1.05 WARRANTY

A. Warranty shall meet the standard warranty requirement as outlined in the contract documents.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer or as otherwise shipped and protected by the manufacturer.

B. Store equipment in a clean dry area indoors in accordance with manufacturer's instructions. Keep containers sealed until ready to use.

C. Protect equipment during handling and installation to prevent damage or contamination.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The duck bill check valve shall be Cla-Val Series DBO, Red Valve Tideflex TF-2; Proco; or approved equal.

B. The inline check valve shall be Red Valve Tideflex Checkmate; or approved equal.

2.02 PERFORMANCE

A. Cracking pressure of 2 to 3-inch valve shall be approximately 3 inches of water or less.

B. Cracking pressure of 4 to 6-inch valve shall be approximately 6 inches of water or less.

C. Cracking pressure of 12" valve shall be approximately 6 inches of water or less.

D. Valve shall be manufactured in the closed position and shall not require backpressure for sealing.

2.03 CONSTRUCTION

A. Duck bill check valve shall be slip-on type for installation over the end of plain end pipes. Valve shall be sized for pipe O.D., Contractor to determine actual pipe diameter.

B. Valve shall be fastened to pipe using two stainless steel band clamps. Follow manufacturer's recommended torque setting.

C. Valve shall be of Ethylene-Propylene (EPDM) or Hypalon elastomer construction.

D. 12" Valve shall be inline style mounted at overflow manhole discharge location utilizing a single stainless steel clamp

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions. Mount with the bill in the vertical position for proper valve function. Do not use a lubricant to ease the installation, this may cause the valve to slip off the pipe.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Payment for duck bill check valves and other work in this section shall be included as a portion of the lump sum price for the project as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION

SECTION 15120 – MISCELLANEOUS FITTINGS AND APPURTENANCES

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section contains specifications for miscellaneous fittings, components, and appurtenances that are required to provide complete installations for a number of systems required on the project.

B. Items specified in this Section include:

1. Floor drain assembly
2. Utility yard hydrant

1.02 RELATED SECTIONS

A. Section 15105 – Piping Systems

1.03 SUBMITTALS

A. Submittals shall meet the requirements of Section 01300.

PART 2 PRODUCTS

2.01 FLOOR DRAINS

A. Drain with grate to be installed in valve vault. Drain shall be 9-inch diameter, connected drain pipe shall be 3-inch.

B. Drain body shall be designed to be cast into concrete floor and shall have a threaded connection for pipe. Body to be epoxy coated cast iron with bottom outlet, and flat corrosion resistant grate.

C. Install at location shown on the drawings. Install such that top of grate is 1/8 inch below surrounding concrete slab surface.

D. Floor drain shall be Zurn Z551; or equal.

2.02 UTILITY YARD HYDRANT

A. Utility yard hydrant shall feature automatic draining when hydrant is shut off to prevent freezing. Provide minimum 2-feet of bury depth to valve.

B. All working parts shall be removable from the top of the hydrant.

C. Valve shall be operated by manual lever. Lever shall be manual close.

D. Valve body shall be brass with 1-inch FNPT threads.

E. Casing shall be 1-inch galvanized pipe.

F. Operating rod shall be minimum ¼-inch galvanized steel rod.

G. Hydrant outlet shall be 1-inch MNPT located approximately 2 feet above grade. Provide machined brass 1" NPT x 1" NPSH adapter.

H. Utility yard hydrant shall be Woodford U100; or equal.

2.03 UTILITY YARD HOSE

A. Utility yard hose shall be 50 feet long x 1-inch ID flexible hose. Couplings shall be 1-inch NPSH both ends, machined brass. Hose shall be flexible, kink resistant, 6-ply construction, minimum 300 psi burst strength.

B. Utility yard hose shall be Gilmour Flexogen; or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install all equipment per manufacturer's recommendations and instructions.

B. Installation shall be performed in the arrangement and position as shown on the drawings.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Payment for fittings and appurtenances and other work in this section shall be included as a portion of the lump sum price for the project as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION

SECTION 15125 – INSIDE DROP SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specifications for the inside drop system including drop bowl, drop pipe and pipe bracket.

1.02 SUMMARY

A. Inside drop system shall be installed in the pump station wetwell as shown on the Plans.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer or as otherwise shipped and protected by the manufacturer.

B. Store equipment in a clean dry area indoors in accordance with manufacturer's instructions. Keep containers sealed until ready to use.

C. Protect equipment during handling and installation to prevent damage or contamination.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The inside drop system shall be Reliner Inside Drop System by Duran, Inc; or equal.

2.02 CONSTRUCTION

A. Drop bowl shall be constructed of marine grade fiberglass.

B. Fiberglass drop bowl shall be finished in ISO gel coat.

C. Drop pipe shall be sized as indicated on the Plans. Drop pipe shall be minimum SDR 35 PVC pipe.

D. Drop pipe shall be secured to wall using clamp and bracket provided by drop system manufacturer. Clamp and bracket shall be type 304 stainless steel, 11 gauge. Hardware shall be 18-8 stainless steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and in accordance with the Plans and Specifications. Locate as shown on plans and as directed.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Payment for Inside Drop System and other work in this section shall be included as a portion of the lump sum price for the project as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION

SECTION 15762 – CABINET, UNIT AND WALL HEATERS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Work in this section includes furnishing and installing all cabinet, unit and wall heaters required on the project.

B. Heaters for this project include: Control Building Heater.

1.02 RELATED SECTIONS

A. Division 16 - Electrical

1.03 SUBMITTALS

A. The Contractor shall submit 3 copies of specific brochure data for each heater proposed showing electrical characteristics, construction, features, dimensions, mounting details, and control details.

PART 2 PRODUCTS

2.01 UNIT HEATER

A. Supply and install new UL listed heater to maintain control building temperatures above 45°F.

B. Heater shall be 3000 Watts with a supply voltage of 208 VAC, single phase.

C. Provide wall thermostat Lux model LV2 120/240VAC heating only; or approved equivalent.

D. Motor. 1/100 HP 1600 RPM enclosed.

E. Heater shall be wall/ceiling mount unit heater MUH-03-81 by QMark; or approved equivalent.

F. Mounting bracket shall be MMB-10 Universal Wall and Ceiling Bracket by QMark; or approved equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install heaters and accessories in accordance with the manufacturer's instructions and NEC.

B. Properly secure and support, support bracket as required. Position as shown in detail drawings.

C. Coordinate with Owner when options for mounting locations and thermostat locations exist.

D. Test heater controls for proper operation. Set thermostats as directed.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Furnish materials and provide work in this Section as a portion of the lump sum price for Electrical as stated in the Bid Form. No separate payment will be made for work in this Section.

END OF SECTION

SECTION 15810 – DUCTWORK

PART 1 GENERAL

1.01 WORK INCLUDED

A. Work in this section includes furnishing and installing all ductwork and accessories as shown on the Plans and specified, including but not limited to, ductwork, manufactured duct joints, casings, and flexible duct fan connections as applicable.

1.02 RELATED SECTIONS

A. Section 15830 – Fans

1.03 REFERENCES

A. ASHRAE – Fundamentals Handbook – Duct Design.
B. ASHRAE – Equipment Handbook – Duct Construction.
C. ASTM A90 – Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
D. ASTM A525 – General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
E. ASTM A527 –Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
F. NFPA 90A – Installation of Air Conditioning and Ventilating Systems.
G. NFPA 90B – Installation of Warm Air Heating and Air Conditioning Systems.
H. SMACNA – Duct Construction Standards.
I. UL 181 – Factory-Made Air Ducts and Connectors.
J. UL 555 – Fire Dampers, UL 555C & UL 555S.
K. Uniform Mechanical Code
L. Uniform Building Code
M. SMACNA – HVAC Duct Leakage Test Manual.

1.04 SUBMITTALS

A. The Contractor shall submit 3 copies of shop drawings for the proposed ductwork layout showing plan; elevation; cross-sections; and indicating the locations of all fabricated fittings, including dampers, flexible connections, taps, and reducers.

1.05 DESIGN REQUIREMENTS

A. Ductwork

1. Design ductwork in accordance with ASHRAE and SMACNA guidelines and standards.

2. All duct construction, including sheet metal gage and reinforcement, shall follow the SMACNA HVAC Duct Construction Standards, latest edition, unless otherwise noted.

3. Ductwork for special exhaust systems shall conform to NFPA 91 and the Uniform Mechanical Code.

4. All ductwork shall be insulated to R-11 minimum.

B. Sound Attenuation – Ductwork shall be designed such that air noise and vibration are kept to a minimum.

C. Air Leakage – Comply with applicable duct sealing requirements as listed in SMACNA HVAC Duct Construction Standards.

D. Flexible Duct Fan Connections

1. Provide at least one-inch slack in connections to insure that no vibration is transmitted from fan to ductwork.

2. Exhaust ducts shall have flexible connections appropriate for the type of exhaust and NFPA/UMC requirements.

E. Elbows

1. Elbows with throat radius (measured at inside surface) equal to duct depth should be used wherever possible. Rectangular elbows are discouraged. If rectangular elbows are needed, they shall have single-wall turning vanes, with intermediate supports if the length of the vanes exceeds 36-inches. Edges of the turning vanes shall be parallel with the sides of the elbow.

PART 2 PRODUCTS

2.01 MATERIALS

A. General – All duct materials shall be non-combustible or conforming to requirements for Class 0 or Class 1 air duct materials, per UL 181 with limitations as noted in NFPA 90A.

B. Steel Ducts – Steel ducts shall be formed of ASTM A525 or ASTM A527 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz. per sq. ft. for each side in conformance with ASTM A90.

C. Sealant – Duct sealant shall consist of non-hardening, non-asbestos, water resistant, UL classified fire resistive sealant compatible with mating materials.

2.02 MANUFACTURED JOINTS

A. Manufactured duct joints shall consist of components of standard catalog manufacture and shall be of same brand as the duct system being installed, or approved equal.

B. Manufactured duct joints shall be formed of equal gauge metal as duct system, or as recommended by manufacturer.

2.03 FLEXIBLE CONNECTORS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards, and as indicated.

B. Flexible connectors shall be fire-resistant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Fabric shall be minimum 30 oz. per sq. yd. density, crimped into metal edging strip.

2.04 EAVE CAPS FOR EXHAUST FAN AND FRESH AIR INTAKE

A. Inlet/Outlet caps for exhaust fan shall form an airtight seal to the ducting. Caps shall have bird screens,

B. Inlet/Outlet caps shall be mounted on outside walls as shown in drawing.

C. Inlet cap shall be stainless steel down facing hood, with a 6 inch round duct connector, stainless bird/insect screen, and inlet damper.

D. Outlet cap shall be stainless steel down facing hood, with a 6 inch round duct connector, stainless bird/insect screen, and outlet damper.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install ducting and accessories in accordance with applicable portions of SMACNA HVAC Duct Construction Standards and as indicated on the approved shop drawings.

B. Properly secure and support all ductwork and accessories.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Furnish materials and provide work in this Section as a portion of the lump sum price for the project as stated in the Bid Form. No separate payment will be made for work in this Section.

END OF SECTION

SECTION 15830 –EXHAUST FAN

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section contains specifications for the ceiling fan that is to be placed into the filter room ceiling and related appurtenances.

1.02 RELATED SECTIONS

A. Division 16 – Electrical
B. Section 15810 - Ductwork

1.03 SUBMITTALS

A. Submittals shall meet the requirements of Section 01300.

PART 2 PRODUCTS

2.01 MATERIALS

A. Ventilation fan shall be of the ceiling mount type with an air delivery of at least 150 CFM at 0.125" static pressure per HVI.

B. Sound level shall be no more than 1.6 sones per the Home Ventilating Institute (HVI).

C. Fan power consumption shall be no greater than 1.5 amps at 120 Volts.

D. Fan shall have a centrifugal blower wheel, cushioned vibration isolators for motor, permanent motor lubrication, and impact resistant blower wheels. Integrated automatic damper to prevent back draft quietly.

E. Fan to incorporate a horizontal 6 -inch duct connection port. Fan shall have a painted metal grill.

F. Fan shall be Model L150MG by Broan, or approved equal.

G. Fan shall be thermostat controlled to intake outside air on hot day. Thermostat shall be Lux LV3 120/240V cooling only thermostat; or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install per manufacturer's recommendations and instructions.

B. Installation shall be performed in the arrangement and position as shown on the drawings.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Cost for items specified in this section shall be included as a portion of the lump sum price for the project as indicated on the Bid Form. No separate measurement for these quantities will occur.

END OF SECTION

DIVISION 16- ELECTRICAL
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SECTION 16050 – BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY

A. Contractor shall conform to the General Conditions, Supplementary General Conditions, and related work in all other divisions and all work in Division 16. Correlation of contract requirements is the responsibility of the Contractor.

B. The Contract Documents are complimentary. What is required by any one, as affects this Division, shall be as binding as if repeated therein.

C. Separation of this Division from other Contract Documents shall not be construed as complete segregation of the work nor shall it suggest a scope of work for a Contractor or subcontractor.

D. Particular attention is called to the Bidding Information, Conditions of the Contract, and Special Specifications.

E. All deviations from the Drawings or Specifications must be approved, in writing, by the Engineer and the Owner.

1.02 WORK INCLUDED

A. It is the intention of this Section of the Specifications and the accompanying drawings to describe and provide for the furnishing, installing, testing and placing in satisfactory and successful operation all equipment, materials, devices and necessary appurtenances to provide a complete electrical system, together with such other miscellaneous installations and equipment hereinafter specified and/or shown on the Plans. The work shall include all materials, appliances and apparatus not specifically mentioned herein or noted on the Plans, but which are necessary to make a complete working installation of all electrical systems shown on the Plans and described herein. Certain equipment and devices furnished and installed under other Divisions of this Contract (or by Owner) shall be connected under this Division. The drawings and specifications are complimentary and what is called for in either is as binding as if called for in both. To restate: Contractor is responsible for connecting all electrical equipment in this project, even if the connections are not described or detailed on the drawings or specifications.

B. Provide equipment and installation not otherwise shown on the drawings but required by code or required to make a complete and functional electrical system.

C. Contractor shall offer electrical assistance to all other contractors.

D. Contractor shall include all programming, dialer and HMI screens setup required by the systems operators to run and troubleshoot the pump station.

1.03 WORK NOT INCLUDED

A. Equipment furnished and installed under another Division. However, electrical connection of equipment installed or furnished under another Division shall be the responsibility of the Division 16 contractor unless the task is specifically assigned in the Division documents to another contractor.

1.04 DIVISION 16 WORK DESCRIBED IN OTHER DIVISIONS INCLUDES:

A. Temporary Power. See General Requirements.

B. Mechanical control wiring and alarm wiring. See pertinent Divisions.

C. Equipment control wiring. See Division 11 and Division 13.

D. Electrical connection to all new equipment and interconnections with existing facilities, whether detailed on plans or not, is a responsibility of the Division 16 contractor.

1.05 EXAMINATION OF SITE

A. The Contractor shall visit the premises to thoroughly familiarize himself with all details of the work and working conditions and verify all dimensions in the field, and shall advise the Engineer of any discrepancy before permitting the work. The Contractor shall be specifically responsible for the coordination and proper relation of the electrical work to the building structure and to the work of other trades.

B. Owner shall not be responsible for any loss of unanticipated costs which may be suffered by the successful bidder as a result of such bidder's failure to fully inform himself in advance in regard to all conditions pertaining to the work and character of the work.

C. Field-verify scale and dimensions shown on all contract documents and drawings, since exact locations, distances and levels shall be governed by actual field conditions.

1.06 PROTECTIVE AND ACCESS REQUIREMENTS

A. Protection. Exposed parts that are subject to high operating temperatures or are energized electrically and moving parts of which are of such nature or so located as to be a hazard to operating personnel, shall be insulated, fully enclosed or guarded. Guarding shall be arranged in a manner that will not impair the proper functioning of these parts.

B. Access. Where equipment is more than 8 feet above the floor, steel platforms and ladders shall be provided where required to permit easy access for inspection and maintenance.

1.07 COORDINATION

A. The Division 16 Contractor shall coordinate his work with that of the other Contractors doing work in the buildings and shall examine all drawings, including the several Divisions of mechanical, ventilation, structural and general, for construction details and necessary coordination.

B. Special attention shall be given for the following items and all conflicts shall be reported to the Engineer before installation for decision and correction:

1. Location of radiators, grilles, pipes, ducts and other mechanical equipment so that all electrical outlets, lighting fixtures and other electrical outlets and equipment are clear from and in proper relation to these items.

2. Within the limits indicated on the drawings, the maximum practicable space for operation, repair, removal and testing of equipment shall be provided.

C. The Contractor will not be paid for cutting, patching and finishing required for relocation of work installed due to interference between the various Contractors' work.

D. Composite Interference Drawings. Before any sleeves or inserts are set or any electrical equipment or foundations are installed, prepare and submit for approval, by the Engineer, in accordance with the General Provisions, composite coordination drawings for all equipment rooms, spaces and other areas in which the probability of interference exists. Drawings shall show the work of all trades covered, shall be drawn to a scale not smaller than 1/2" = 1'-0", and shall show clearly in both plan and elevation that all work can be installed without interference.

E. Prior Installation. Any electrical work installed prior to approval of coordination drawings shall be at the Contractor's risk. Subsequent relocations required to avoid interferences shall be made without additional expense to the Owner. In case interference develops, the Engineer will decide which work shall be relocated, regardless of which was installed first.

F. Outages. Schedule any power or communication outages which may affect existing facilities with the Owner and Engineer.

1.08 CODES AND STANDARDS

A. If any conflict occurs between government adopted code rules and this Specification, the codes are to govern. Nothing in these drawings and specifications shall be construed to permit work not conforming with governing codes. Also, this shall not be construed as relieving the Contractor from complying with any requirements of the plans or specifications which may be in excess of requirements of the hereinbefore mentioned rules and not contrary to same.

B. All electrical equipment shall bear the label of the testing laboratories recognized by the State of Oregon as meeting the testing standards for minimum electrical safety.

C. All electrical systems shall be designed to the following current National Standards. The Contractor is required to familiarize himself with the detailed requirements of these standards and any local codes and ordinances as they affect the installation of specific electrical systems.

1. National Electrical Code (NEC)

2. Uniform Building Code (UBC) as applicable.

D. Comply with State and any local electrical codes, safety orders, ordinances, applicable building codes, and requirements of serving utilities.

E. Materials shall, where rated, be UL listed and conform to applicable ANSI, NEMA, ISA and OSHA, or other recognized standards.

F. Design features specified or shown which are over and above requirements of relevant codes and standards shall take precedence.

1.09 PERMITS AND FEES

A. The Contractor shall obtain and pay for all licenses, permits and inspections required by laws, ordinances and rules governing work specified herein. The Contractor shall arrange for inspection of work by the inspectors and shall give the inspectors all necessary assistance in their work of inspection. Contractor shall make all necessary arrangements for installation of electrical services indicated on plans.

B. Contractor shall pay all communications, security and power company fees and/or costs for power installation, regardless if provided overhead, underground or rerouted.

1.10 CONTRACT DRAWINGS

A. Conduits and ground connections are shown diagrammatically only and indicate the general character and approximate location. The layout does not necessarily show the total number of conduits for the circuits required, nor are the locations of indicated runs intended to show the actual routing of the conduits. The Contractor shall furnish, install and place in satisfactory condition, ready for operation, all conduits, cables and other materials required for a complete electrical system.

B. The horsepower of motors and apparatus wattages indicated on the plans and in the panel schedules are estimated requirements of equipment furnished under other Divisions of this contract and bid shall be based on these sizes. Overload elements, contactors, circuit breakers, fuses, conductors, etc., shall be furnished to suit actual equipment installed. Advise Engineer of any equipment changes affecting electrical circuits.

C. Any minor changes in the location of the conduits, outlets, etc., from those shown on the plans shall be made without extra charge, if so directed by the Engineer before installation.

D. Contractor shall consult the architectural drawings for the exact height of all outlets not specified herein or on the drawings.

E. Outlet locations shown on the drawings are approximate. Contractor shall study the building drawings in relation to spaces and equipment surrounding each outlet so that the lighting fixtures are symmetrically located according to ceiling tile and room layout. When necessary, with the Engineer's approval, outlet shall be relocated to avoid interference with structural features of the building.

When conduit, insert or sleeves for outlet boxes and/or conduits are required, Contractor shall supply and install all conduits, inserts or sleeves and shall fully coordinate the installation thereof with other trades.

1.11 SUBMITTALS

A. Submittals shall meet the requirements of Section 01300.

B. All material shall be new and a standard product of a reputable manufacturer. Deliver to site in original factory cartons with full manufacturer's warranty. Each type of material or equipment shall be of the same manufacturer throughout the project.

C. The Contractor shall submit for approval shop drawings and cutsheets for each item and system. Furnish catalog data for all items of material, except where the information is included with shop drawings. Shop drawings shall show the ratings of items and systems and how the components of an item and system are assembled, function together, and how they would be installed on the project. Data and shop drawings for component parts of an item or system shall be coordinated and submitted as a unit.

1. Required for all electrical equipment and includes but is not limited to the following:

a. Qualification certificates

b. Contract Cost Breakdown

c. Panelboards, switchboards and breakers

d. Light fixtures, standards and appurtenances

e. Switches and receptacles

f. Motor control centers, motor starters, VFDs

g. Equipment controllers and switches

h. Disconnects and fusible switches

i. Special switches, pushbutton stations and controls

j. Those specific items called out elsewhere in the specifications which require special coordination and/or details

k. Electric heaters and thermostats

l. SCADA & Telemetry systems

m. Computer & networking equipment & PLC equipment

n. Fans and grilles

o. Raceways, wiring devices, floor boxes, wires and cables

p. Generators & Transfer switches

q. All instruments, sensors & equipment

r. Instrumentation, metering, flow, level, temperature, pressure, etc., sensing equipment

D. Single Submission. Data and shop drawings shall be supported and included in a single submission. Multiple submissions are not acceptable except where prior approval has been obtained from the Engineer. In such cases, a list of data to be submitted later shall be included with the first submission. Submit five copies in one or more 3-ring binder notebooks, vinyl covered, with proper index and dividers.

E. Context. The lists of materials and equipment shall be supported by sufficient descriptive material, such as catalogs, cuts, diagrams and other data published by the manufacturer, to demonstrate conformance to the specification requirements; model numbers alone will not be acceptable. The contractor shall submit photometric performance curves for each lighting fixture to assure proper lighting distribution and quality at the design conditions. The data shall include the name and address of the nearest service organization. All cut sheets must be marked to show the actual model of each item used and all related appurtenances with proper model and part numbers.

F. Shop Drawings. Shop drawings shall include complete construction details, dimensions, material descriptions, diagrams or pictures showing physical characteristics, performance and test data, description of operation, installation methods, wiring diagrams and any other data or information necessary for a complete evaluation. (Note: do not re-draw the

contract drawings. The drawings to be submitted under this subsection are all the supplemental drawings and manufacturers' specification drawings which are not included in the contract drawings.) Shop drawings are in addition and supplemental to the contract drawings.

G. Identification. In addition to the requirements of Special Provisions, submittals shall be identified by the name of the system and applicable specification paragraph number.

H. Delivery Prior to Approval. No item of material or equipment shall be delivered to the site or installed, until approved. After the proposed materials have been approved, no substitution will be permitted except where approved by the Engineer.

I. Compliance. Should the Contractor fail to comply with the requirements of these provisions, the Engineer reserves the right to select any or all items of materials and systems. Selection shall be final and binding upon the Contractor. Materials so selected or approved shall be used in the work at no additional cost to the Owner.

J. Departures. If departures from the contract drawings are deemed necessary by the Contractor, details of such departures, including changes in related portions of the project and the reasons therefore, shall be submitted with the drawings. Where such departures require raceways or equipment to be supported otherwise than as shown, the details submitted shall include loadings and type and kind of frames, brackets, stanchions, or other supports necessary. Approved departures shall be made at no additional cost to the Owner.

K. Electrical Diagrams. A complete electrical connection diagram for each item of equipment furnished under Division 16, which has electrically controlled components having more than one automatic or manual control device, shall be submitted for approval. Wiring diagrams shall identify each component, and one diagram shall show all interconnected or interlocked components. It is understood that the contract electrical drawings do not have to be submitted or copied for inclusion in this submittal.

L. Contractor agrees that submittals processed by the Engineer are not change orders; that the purpose of submittals by the Contractor is to demonstrate to the Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use.

M. Late submittals will not be considered an excuse for time extension for the project.

1.12 SUBMITTAL RECORD DRAWINGS/ASBUILTS/O & M MANUAL (AT PROJECT END)

A. Record Drawings. Corrections and changes made to the contract drawings during the progress of the work shall be recorded in a legible hand, in red pencil, continuously on a copied set of the contract drawings kept readily available at the project under construction. The purpose of these Record drawings is to provide the Engineer with an easy to read, complete record of the installation so that at the end of the project the Engineer can revise the original contract drawings to represent the actual installation. Color-coded and highlighted notes shall be used if these would make the Record Drawings easier to read. These drawings shall also include such information as all wiring labels, conduit sizes and labels, overload sizes and accurately locate all underground and under-slab piping and stub-outs. At the completion of the work, Contractor shall furnish the Engineer this set of drawings. Final payment to the Contractor will not be authorized until these drawings have been submitted to and accepted by the Engineer.

B. Supplemental As-Built Electrical Drawings. As-Built Drawings supplementary to and not already included in the contract drawings shall be assembled and delivered to the Engineer in the form of five bound copies. The Electrical Engineer will revise the original bid drawings by information supplied by the Contractor on the Record Drawings but any other electrical equipment or connections not shown on the bid drawings or Record Drawings shall be documented by supplementary as-built drawings supplied by the Contractor.

C. The Contractor shall prepare and deliver five copies of an Electrical Equipment Maintenance Manual for all electrical equipment installed on the project. This manual shall coordinate with and be an integral part of the plant O&M manual set and plant drawings. This manual, along with the plant electrical drawings and the Software Integrator's process control manual shall compose the electrical section of the plant O&M manual set. The Electrical Engineer will provide updated plant electrical drawings at the end of the project which have been revised by the Contractor's Record Drawings. The Contractor shall be responsible for providing all other drawings. The purpose of this manual is to provide one comprehensive document which illustrates and describes all the electrical equipment and instrumentation installed in the plant. The manual shall include but not be limited to drawings and specifications for the following items as applicable to this project:

1. Motor Control Centers and all related controls, protection and appurtenances.
2. All electronic controls and all appurtenances.
3. Instrumentation devices and telemetry equipment.
4. Heating/Ventilating/Lighting equipment furnished under this Division.
5. Thermostats.
6. Electrical panel schedules and modifications to existing electrical equipment.
7. Solenoid valves.
8. Disconnects.
9. Level Controllers/Float Controls.
10. Motor starters, variable frequency drives, reduced voltage starters and similar equipment.
11. Programmable Logic Controls (PLCs) and any other computer devices and their related peripheral equipment.
12. Commented and annotated software listings of any software or programs developed under this Division uniquely for this installation.
13. Commented and annotated documentation of any programmed set points or programmable setup parameters for any programmable equipment (for example, chart recorders, VFDs, instrumentation, telephone dialers, etc.).
14. All electrical control panels supplied by equipment manufacturers.

15. All other electrical equipment or instrumentation, whether provided by the Electrical Contractor or not.

D. The manual shall be assembled in one or more white 3-ring binder notebooks with "D" style rings, each vinyl covered with a clear vinyl pouch on the outside spine and front to receive a cover title. Contractor shall insert printed spine and cover title sheets to match font style and size of the rest of the plant O&M manual set. Coordinate with the General Contractor.

E. The information contained in the manual shall be grouped in an orderly arrangement by category. It shall have a typewritten index and divider sheets between categories with identifying tabs.

F. The information included must be the exact equipment installed, not the complete "line" of the manufacturer. Where sheets show the equipment installed and other equipment, the installed equipment shall be neatly and clearly identified on such sheets. Parts lists shall give full ordering information assigned by the original parts manufacturer. Relabeled and/or renumbered parts information as reassigned by the equipment supplier are not acceptable.

G. It shall contain all information presented in the post bid equipment submittal in addition to: shop drawings, equipment wiring diagrams, operating and maintenance instructions, individual equipment operating and installation manuals, replacement parts lists, and equipment nameplate data for all equipment and systems installed under the project. Electrical and/or electronic equipment data shall contain step-by-step circuit description information and printed wiring diagrams designed to provide electronic service technicians with adequate information to diagnose and repair the components on each circuit board. Electrical and/or electronic equipment submittals shall contain step-by-step signal and control description information designed to provide maintenance personnel with an understanding of equipment operation in each mode of operation. Unit Control and Motor Control Center manuals shall be included with a complete functional description of operation in narrative form for each control center function.

H. Diagrams for each system shall be complete drawings for the specific system installed under the contract. "Typical" line diagrams will not be acceptable unless properly marked to indicate the exact field installation.

I. Manuals and documentation shall include calibration curves of every sensing device and a programming documentation sheet for every programmable device. The programming documentation sheet shall show the final operational value of every programmable parameter of every device. The purpose of this sheet is to provide maintenance personnel with a convenient source of information for programming the parameters of a replacement device should the old device fail.

J. Include all electrical devices provided under all Divisions. Coordinate with other Division Contractors.

1.13 INSTRUCTION OF OWNER EMPLOYEES

A. Instruction of all electrical equipment shall be provided to insure proper use and care as well as firsthand operation of electrical equipment and components.

B. Electrical Contractor shall provide one 8-hour working day of instruction to Owner designated personnel.

C. The time for this instruction shall be scheduled shortly after start-up and at mutually agreed times. Contact Engineer for coordination.

1.14 TESTING

A. Test the entire electrical installation to assure compliance with code and proper system operation.

1. Circuit Tests. The Contractor shall test all wiring and connections for continuity and ground before any fixtures or other loads are connected. Tests shall be made with a 500 volt DC "Megger" type tester. If tests indicate faulty insulation (less than 2 megohms) such defects shall be corrected and tested again. Contractor shall provide all apparatus and material required to make tests and shall bear all expense of required testing.

2. Load Balancing. Checks shall be made for proper load balance between phase conductors and make adjustments as necessary to bring unbalanced phases to within 15% of average load.

3. Ground Testing. Measure the OHMIC value of the Electric Service Entrance metallic "System Ground" with references to "Earth Ground" using the "Multiple Ground Rod" method and suitable instruments. Maximum resistance to ground shall be less than 10 ohms. If this resistance cannot be obtained with the ground system shown, notify the Engineer immediately for further instruction. Certify in writing to the Engineer that the grounding test has been made and that the requirements of this portion have been met for the "System Ground".

4. Motor Tests. Check all motors for proper rotation and for actual load current. Submit tabulation of motor circuits.

B. Materials and instrumentation shall be provided by the Contractor.

C. The Contractor shall notify the Engineer ten (10) working days prior to performance of any test.

D. The Contractor shall certify in writing that the above tests have been completed and shall provide documentation of test data.

1.15 DEMONSTRATION OF COMPLETED ELECTRICAL SYSTEMS AND CONTROLS

A. At the point of substantial completion of the project, the Electrical Contractor shall provide necessary personnel to demonstrate the essential features of the following electrical systems:

1. Service entrance equipment.

2. Motor Control Center and all related items such as controls, alarms, software, PLC and PC equipment, etc.

3. Lighting system.

4. Heating system.

5. Ventilation.

6. Pumps, compressor, blowers, mixers, and related controls and alarm.

7. Instrumentation

B. Demonstrate each system once after all malfunctions have been corrected.

C. Time. Demonstration shall be held upon completion of all systems at a date agreed upon in writing by the Owner or his representative. This time shall be in addition to the instruction allowances provided.

D. Attending Parties. The demonstration shall be held by the Contractor and Electrical Subcontractor in the presence of the Owner or his designated representative, Electrical Engineer, Project Engineer, and the Equipment Manufacturer's representative.

E. Demonstration.

1. Demonstrate by "start-stop operation" and "automatic operation", how to work the controls, how to reset protective devices or replace fuses, and what to do in case of emergency.

2. All systems shall be exercised through operational tests in order to demonstrate achievement of the specified performance. Operational tests depend upon completion of work specified elsewhere in these Contract Documents. The scheduling of tests shall be coordinated by the Contractor among all parties involved so that the tests may proceed without delays or disruption by uncompleted work.

1.16 WARRANTY

A. Warranty materials and workmanship for a period of one year from date of final acceptance for the project or through one entire system operating season if this exceeds year date.

B. Provide written warranty for one year. Submit two written copies with Operation and Maintenance Manual.

C. Warrantee includes all material and labor to repair or replace defective items within any system, and extends to material and labor required to repair adjacent surfaces disturbed by malfunction.

D. Equipment, programming, and materials which do not achieve design requirements after installation shall be replaced or modified by the Contractor to attain compliance at no additional cost to the Owner. Following replacement or modification the Contractor shall retest the system and perform any additional procedures needed to place the complete system in satisfactory operation and attain design compliance approval from the Engineer.

E. All panel lamps shall be guaranteed for 90 days. Guarantee will become effective only after substantial completion of the project.

1.17 ABBREVIATIONS

A. The following is a list of abbreviations and terms most commonly used in the electrical industry.

A	Ampere		KV	Kilovolt
AC	Alternating Current		KVA	Kilovolt-Ampere
ATCC	Automatic Temp.		KV	Kilowatt
CC	Control Contactor		KWH	Kilowatt-Hour
AWG	American Wire Gauge		L	Lumen
BKR	Breaker		LV	Low Voltage
C	Conduit		Ma	Milliamp
CKT	Circuit		Max	Maximum
CT	Current Transformer		MC	Mech. Contractor
DB	Decibel		MCM	Thousand Circular Mils
DC	Direct Current		MECH	Mechanical
DFC	Down From Ceiling		Min	Minimum
DIAM	Diameter		MFR	Manufacturer
DPDT	Double Pole Double Throw		N	Neutral
ELEC	Electric, Electrical		OC	On Center
EC	Electrical Contractor		P	Pole
EMT	Electrical Metallic Tubing		PA	Public Address
EP	Explosion proof		PF	Power Factor
FA	Fire Alarm		PVC	Polyvinyl Chloride
FC	Footcandles		RI	Rough-In
FLR	Floor		SPST	Single Pole Single Throw
HGT	Height		SW	Switch
HP	Horsepower		TELCO	Telephone Company
HPF	High Power Factor		TTB	Telephone Terminal Board
IC	Intercom		V	Volt
ID	Ionization Detection		VFY	Verify
JB	Junction Box		W	Watt
WP	Weatherproof			

B. Reference is made to current editions and publications of the following technical societies, organizations or bodies:

ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
CBM	Certified Ballast Manufacturers
ETL	Electrical Testing Laboratories
NBFU	National Board of Fire Underwriters
NECA	National Electrical Contractor's Association
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protective Association
OSHA	Occupational Safety and Health Act
UBC	Uniform Building Code
UL	Underwriter's Laboratories, Inc.
MFR	Manufacturer
NEC	National Electrical Code / National Board of Fire Underwriters' Publication (latest adopted edition with amendments).

C. Definitions.

1. "Furnish" Deliver to the job site
2. "Install" To enter permanently into the project
3. "Provide" Furnish and install
4. "Contractor" The company responsible for accomplishing Division 16 work.

1.18 BASIC ELECTRICAL SYMBOLS

A. See drawings legend.

PART 2 - BASIC MATERIALS

2.01 GENERAL

A. General requirements for materials.

2.02 PRODUCTS

A. All materials must be of the quality herein specified. All materials shall be new, of the best quality and free from defects. They shall be designed to insure satisfactory operation and operating life in the environmental conditions which will prevail where they are being installed.

B. Each type of material shall be of the same make and quality. The materials furnished shall be of the standard products of manufacturer's regularly engages in the production of such equipment.

C. Fixtures and equipment shall be current models for which replacement items or component parts are readily available. Unless otherwise provided, all electrical items used shall be substantially the same as items of manufacturer which, on the date of opening bids, have been in successful commercial use and operation for not less than one year in projects and units of comparable size. The right is reserved by the Engineer to require the Contractor to submit a list of buildings where they have been in operation, so that such investigation as may be deemed necessary may be made before approval.

D. Capacities of all equipment and material shall be not less than those indicated.

1. Accuracy. Unless otherwise specified, each individual instrument shall have a minimum accuracy of +-0.5 percent of full scale and a minimum repeatability of +-0.25 percent of full scale.

2. Field Tests: The Contractor shall perform whatever tests as may be requested by the Engineer or as may be needed otherwise to demonstrate compliance with the Contract Documents.

3. Calibration. The Contractor shall provide job site visits and services of a manufacturer's technical field representative for calibration, testing and startup of instrumentation and equipment as needed. All instruments and systems shall be calibrated after installation, in conformance with the component manufacturer's instructions. This shall provide that those components having adjustable features are set carefully for the specific conditions and applications of this installation, and that the components and/or systems are within the specified limits of

accuracy. Defective elements, which cannot achieve proper calibration or accuracy, either individually or within a system, shall be replaced. This calibration work shall be accomplished by the technical field representatives of the System Supplier whom the Contractor shall require to certify in writing that for each loop or system all calibrations have been made and that all instruments are ready to operate.

4. Proof of Conformance: The burden of proof of conformance to specified accuracy and performance is on the Contractor using its designated System Supplier. The Contractor shall supply necessary test equipment and technical personnel if called upon to prove accuracy and/or performance, at no separate additional cost to the Owner, wherever reasonable doubt or evidence of malfunction or poor performance may appear.

E. Nameplates. Each major item of equipment shall have the manufacturer's name, address, serial and model numbers on a plate securely attached to the item.

F. Conformance of agency requirements. Where materials or equipment are specified to be constructed and/or tested in accordance with the standards of the following agencies or organizations, the Contractor shall submit proof of such compliance:

1. The Institute of Electrical and Electronics Engineers (IEEE).

2. The National Electrical Manufacturer's Association (NEMA).

3. The Underwriter's Laboratories, Inc. (UL).

G. All meters, instruments, and other components shall be the most recent field proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise specified to match existing equipment.

H. Analog measurements and control signals shall be electrical as indicated herein, and shall vary in direct linear proportion to the measured variable, except as noted. Electrical signals outside control panel(s) shall be 4 to 20 milliamperes dc except as noted.

I. Environmental. All instrumentation shall be suitable for operation if required, in the ambient conditions at the equipment installation locations. Heating, cooling, and dehumidifying devices shall be incorporated with the outdoor instrumentation in order to maintain it within its rated environmental operating ranges. The Contractor shall furnish and install all power wiring for these devices (e.g., heaters, fans, etc.). NEMA 4 rated enclosures shall be furnished in all general purpose areas, unless otherwise specified. Equipment and systems shall be designed and constructed for satisfactory operation and long, low maintenance service under the following environmental conditions:

1. Control Room: Temperature range: 32 degF through 120 degF. Thermal shock: 1.0% (1.8%F) per minute maximum. Relative humidity: 100 percent maximum

2. Remote Site: Temperature range: 0 degF through 135 degF. Thermal shock: 1.0% (1.8%F) per minute maximum. Relative humidity: 100 percent maximum

J. Protection. Materials and equipment delivered to the site shall be stored and protected in such a manner as to effectively prevent damage from climatic conditions, condensation, dust, physical abuse. A location shall be chosen which will not interfere with the operations of other contractors or the Owner. Storage and handling shall be performed in manners which will afford maximum protection to the equipment and materials. It is the

Contractor's responsibility to assure proper handling and on-site storage of instrumentation and control equipment in accordance with the manufacturers' recommendations.

2.03 COMPLETED SYSTEMS

A. All the systems mentioned shall be complete in every detail except where specifically noted otherwise. Mention of certain materials in these specifications shall not be construed as releasing the Contractor from furnishing such additional materials and performing all labor required to provide a complete and operable system.

2.04 NAMEPLATE AND EQUIPMENT LABELS

A. Provide nameplates constructed of plastic laminated material engraved through black surface material to white sub-layer. Exception: Emergency distribution system component labeling - white letters on red background.

B. Service Entrance Label. Refer to appropriate section.

C. Panelboard Labels. Refer to appropriate section.

D. Receptacle Labels. Refer to appropriate section.

E. Motor Starter and Disconnect Labels. Refer to appropriate sections.

F. Special Equipment Outlet Labels. Refer to appropriate sections.

PART 3 - EXECUTION

3.01 INSTALLATION AND WORKMANSHIP

A. Materials and equipment shall be installed in accordance with the approved recommendations of the manufacturer to conform with the contract documents.

B. The installation shall be accomplished by workmen skilled in this type of work.

3.02 CUTTING OF BUILDING CONSTRUCTION

A. Obtain permission from the Engineer prior to cutting. Locate cuttings so they will not weaken structural components. Cut carefully and only the minimum amount necessary. Cut concrete with diamond core drills except where space limitations prevent the use of such drills.

B. All construction materials damaged or cut into during the installation of this work must be repaired or replaced with materials of like kind and quality as original materials by skilled labor experienced in that particular building trade.

3.03 EXCAVATION AND BACKFILLING

A. Provide all necessary excavation and backfilling for installation of underground electrical facilities. Depth per code requirements or as shown.

B. Determine location of all existing underground gas, water, sewer, telephone and electric lines. Locate accurately on ground surface and for depth of same before excavation. Uncover by hand digging. Contractor shall be responsible for any damage or interruptions to these utilities, caused by himself, and other costs incurred by these interruptions.

C. Do not undermine footings or bearing walls.

D. Use power digging equipment only in direction away from existing facilities.

E. Exercise standard safety precautions in excavation near power cables by using insulated handles, rubber gloves and footwear, etc.

F. Do not place backfill until installation to be covered has been tested, inspected and approved.

G. Backfill beneath building slabs, areas to be paved, streets, or sidewalks: 3/4" maximum crushed rock, gravel or sand. Other areas may be backfilled with excavated earth that has all large rocks and foreign matter removed.

H. Backfill in layers not to exceed 6 inches. Compact thoroughly.

I. Dispose of all debris and surplus earth as by the Owner.

3.04 PAINTING

A. Painting in general will be covered under another Division 9 of these specifications, except items furnished under this Division that are scratched or marred in shipment or installation and/or require custom painting.

B. Install equipment with manufacturer's standard finish and color unless otherwise specified. Refinish any marred or oxidized items restored to manufacturer's factory finish.

C. Required surfaces or equipment with no standard finish; clean off grease and scale. Restore to smooth finish. Give one coat of primer, two coats finish.

D. Paint and color as selected by Engineer.

E. All exposed conduits on painted walls shall be painted to match wall and trim colors. Painting to be in accordance with Item (b.) above. Conduit labels shall be neatly affixed and shall not be painted over.

3.05 CLEANUP

A. Contractor shall continually remove debris, cuttings, crates, cartons, etc., created by his work. Such clean up shall be done at sufficient frequency to eliminate hazard to the public, other workmen, the building or the Owner's employees. Before acceptance of the installation, Contractor shall carefully clean cabinets, panels, wiring devices, cover plates, light fixtures, etc., to remove dirt, cuttings, paint, plaster, mortar, concrete, etc. Blemishes to finished surfaces of apparatus shall be removed and new finish equal to the original applied.

3.06 WORKMANSHIP AND INSPECTION

A. Workmanship shall be of the best quality and none but competent electricians shall be employed. All shall be under the supervision of a competent foreman. All completed work shall represent a neat and professional appearance.

B. All work and materials shall be subject to inspection at any and all times by representatives of the Engineer.

PART 4 - SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Costs for all items in this Section shall be included within the lump sum price for Electrical Improvements Complete as stated in the Bid Form. No additional payment will be made for this item.

END OF SECTION

SECTION 16060 – GROUNDING SYSTEM

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Work consists of providing the complete grounding system shown on the drawings and specified herein. The requirements of all other sections of the specification are equally applicable to the work to be performed under this section.

1.02 GROUNDING SYSTEM

A. This grounding specification is applicable to this and all other sections of the work. Provide all grounding systems and make connections mechanically secure and electrically continuous. Ground all line voltage electrical systems completely and effectively as required by code and as specified herein.

B. Ground all raceway systems and equipment enclosures. Where not otherwise indicated, grounding conductor size shall conform to the most stringent of the governing codes.

1. Ground the service and transformers in an approved manner.

2. Provide grounding where indicated on the drawings.

3. Grounding conductor connections shall be bolted except at inaccessible ground rods, buried ground conductors and reinforcing steel grounding conductor connections, where connections shall be brazed or crimped.

   Exothermic welded connections may be substituted for brazed connections subject to the Engineer's approval and demonstration on the project with actual test connections that the connections will be successfully made.

4. Ground conductors, unless otherwise noted, shall be insulated and shall be run in conduit. In no case shall the grounding conductors be sized smaller than #12 AWG.

5. Continuity of equipment ground shall be maintained throughout the entire raceway, cabinet and equipment enclosure system. Ground bushings and jumpers shall be used wherever normal conduit termination does not insure continuity. Where nonmetallic conduit is used for distribution or where direct burial cables are employed, install a green insulated equipment ground conductor with each circuit.

6. Metal parts of lighting fixtures not otherwise grounded by bolted fastenings shall be bonded to conduit system with green ground wire. Receptacles shall be grounded to outlet boxes with green ground wire and machine screw.

7. Motors and equipment shall be bonded to the equipment grounding system by a continuous green insulated equipment ground conductor run with each circuit through approved flexible conduit connections as permitted by code. Where flexible conduit size exceeds the code approved limits, provide a separate green grounding conductor inside each flexible conduit, bonded to the inside of the connection box and to the nearest accessible supply end conduit junction box.

8. Where concrete pad is provided for utility-furnished transformers, suitable grounding systems shall be provided under this section, including driven ground

rods. Details on the drawings are to establish the general scope of work, but installation shall conform to the serving utility company requirements.

C. Provide ground system as specified here and shown on Drawings.

PART 2 PRODUCTS

2.01 GROUNDING BUSHINGS/WEDGES

A. On all feeders, install a grounding bushing with set screw connector.

2.02 CONNECTORS

A. Cast, set screw or bolted type.

2.03 GROUND RODS

A. Minimum one uncoated 0.50" #4 reinforcing bar tied into foundation reinforcing grid, per 918-305-0160(3)(a) of 2008 Oregon Electrical Specialty code.

2.04 CONNECTONS

A. Ground rod to ground conductor connections, exothermic weld process. Cadweld.

PART 3 EXECUTION

3.01 INSTALLATION

A. Grounding conductor connectors shall be made up tight and located for future servicing and to insure low impedance.

B. The Grounding System shall comply with Article 250 of the N.E.C.

C. All feeder and service raceways shall be grounded.

D. All plug-in receptacles shall have the grounding stud connected to the insulated green equipment grounding conductor shown in all power system conduits.

E. Connect all insulated green ground conductors on a grounding bus in the respective branch circuit panel. Provide a grounding bus in all existing panels which presently are not so equipped.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Costs for all items in this Section shall be included within the lump sum price for Electrical Improvements Complete as stated in the Bid Form. No additional payment will be made for this item.

END OF SECTION

SECTION 16120 – WIRE AND CABLE

PART 1 - GENERAL

1.01 INTRODUCTION

A. All wire and cable for electric circuits shall conform to the latest requirements for the current edition of the NEC and shall meet all ASTM specifications.

B. Any requirements in this section shall be additional.

C. Provide all wire and cable complete.

D. Provide all wire appurtenances.

E. Size as shown on drawings and/or in panel schedule or as required, if not shown otherwise.

F. All wire and cable to be copper.

G. No aluminum conductors are allowed except Electric Utility provided wire or unless specifically called out.

H. Wiring size is generally standard AWG size. Branch circuit cross hatchings shown indicates minimum number of wires, without ground. Minimum size or as noted on plans, or panel schedules.

PART 2 - PRODUCTS

2.01 WIRE

A. Conductors shall be soft-drawn copper with insulation and outer covering as noted. Conductor sizes shall be standard American wire gauge sizes. Conductors No. 8 and larger shall be stranded. All control wiring below 12 gauge shall be stranded.

B. Minimum branch wiring shall be No. 12, 600 volt and shall have color coded phase wires.

C. #16 and lower AWG shall be type TFF or THHN 600 volt stranded.

D. #14 through #10 AWG shall be type THW, THWN, or THHN 600 volt solid conductor.

E. #8 AWG and larger shall be type THHN 600 volt stranded conductor.

F. Conductors installed in underground conduits shall be THW, THWN or THHN as described above.

G. Direct buried feeder and branch circuit cable shall be Type UF or USE as per NEC Article 338 and 339. Buried conductors shall normally be in PVC conduit. Direct buried conductors shall only be permitted upon prior approval by the Engineer.

H. Conductors installed in the wiring channels or in ballast compartments of continuous row fixtures, and in raceway between junction box and recessed fixture to be RHH, 90 deg. C (194 Deg. F) insulation. Do not reduce branch circuit conductor size below circuit protection in wiring channels. Other fixture wiring shall be Type "AF" or "SFF".

I. Wire size, insulation and manufacturer's name shall be clearly and permanently marked on conductor jacket.

J. Wire Color.

1. Wires shall be factory color-coded by integral pigmentation. Colored plastic tape permitted on #6 and larger where integral pigmentation impractical. Apply tape in spiral half-lap over exposed portions in manholes, boxes, panels, switchboards, and other enclosures.

2. Identify second system voltage conductors with different set of colors at all panels, disconnects, junction boxes and/or equipment with 3ø power supply.

Conductor System Voltage	120/240	277/480	120/208
Phase A	Black	Brown	Black
Phase B	Red	Orange	Red
Phase C	Blue	Yellow	Blue
Neutral	White	Grey	White
Equmt Gnd	Green or bare	Green or bare	Green or bare
Travelers	Grey or tan	Grey or tan	Grey or tan

2.02 CABLE

A. Annealed copper in AWG and type as shown on drawings.

B. All conductors shall have color coded pairs.

C. Labels. All cables shall be labeled with a wire marker. The label shall be of the form "CBLXXX" where XXX is a unique number (for example: CBL132, CBL001, CBL567). The markers shall be permanently marked heat-shrink plastic, such as Kroy "Shrink Tube," or equivalent. All markers shall be shrunk to fit the cable with a manufacturer's approved heat shrinking device.

2.03 PULLING LUBRICANTS

A. UL approved soap type only.

2.04 WIRE MARKERS

A. Pre-marked, heatshrink type. All wires shall be marked. Each conductor shall be designated by a single unique wire number which shall be shown on all drawings. These numbers shall be displayed on all conductors at every terminal or termination using preprinted white wire markers with black numbers. The markers shall be permanently marked heat-shrink plastic, such as Kroy "Shrink Tube," or equivalent. All markers shall be shrunk to fit the wire with a manufacturer's approved heat shrinking device.

2.05 PULL WIRES

A. Dry Location. #12 TW Copper.

B. Damp Locations, Under Slab, or Below Grade. #12 TW Copper.

2.06 WIRE CONNECTION AND APPURTENANCES

A. Wire connections shall be made with pressure-type solderless connectors.

B. Connections Between Aluminum and Copper. No aluminum is allowed.

C. Oxide Inhibiting Compound. Alnox "UG", Idean "NOALOX", Penetrox "A".

D. Inline Splicing Kits. 3M brand "Quick Splice", 5400 series.

E. Waterproof Splicing. 3M Scotchcast.

PART 3 - EXECUTION AND WORKMANSHIP

3.01 DELIVERY, STORAGE AND HANDLING

A. Deliver to site in new standard coils or reels with approved tag denoting length, wire size, insulation type and manufacturer's name.

B. Suitably protect from dirt, weather, and damage during storage and handling.

3.02 WIRE PULLING

A. Do not pull wire until all work of any nature is completed which might damage insulation or fill conduit with foreign material. Conduits shall be clean and dry before pulling wire.

B. Do not use mechanical means to pull #8 or smaller wires.

C. Exercise care in avoiding injury to wire or insulation during pulling.

D. Identify all wires or circuits with wire markers after pulling. For all control wiring and telemetering systems, wire markers in junction boxes and at solenoids shall bear same numbers as terminal blocks. Keep accurate up-to-date as-built records.

3.03 CIRCUITING

A. Conduit may be routed at Contractor's best judgment unless directed otherwise. Home runs are diagrammatic for clarity, and may be grouped as desired. Size conduits accordingly with capacity for 25% fill. See Raceways this Division. All branch circuitry conduit shall have NEC sized ground provided.

B. Any deviation in circuiting that is approved by the Engineer shall be recorded on as-builts and panel schedules in specifications.

3.04 SPLICING

A. No splices or taps permitted in service or feeder circuits. Splices or taps in branch circuits permitted only in junction boxes where circuits divide.

B. Splices to fixtures and equipment shall have a 6-inch minimum pigtail.

3.05 PULL WIRES

A. Provide pull wires in all empty conduits for future use. Identify both ends with labels or tags reading "PULL WIRE" with a number for reference.

3.06 WIRE CONNECTION AND SPLICING

A. Manufacturer's Instructions. Install connectors in strict accordance with manufacturer's instructions for specific conductor size, voltage and type of connection required.

B. Insulation. Cover splices, joints and free ends of conductors with insulation equivalent to that of conductor, using insulating rubber tape and friction tape or plastic tape.

C. Continuity. Where conductors are connected to metallic surfaces, remove any coating and polish surface. Remove lacquer coating of conduits where ground clamps are to be installed.

D. Waterproof Splices. Waterproof splices and connections to fixtures and equipment as designated on drawings shall be Scotchcast, 3M or approved. Leave 18" pigtail for future splices.

E. It is the responsibility of the electrical contractor to utilize proper protective tape as deemed by the equipment or motor and equipment temperature conditions, for a quality craftsmanship type job.

F. No splices are allowed in control cables, telemetering or telephone cables above or below the ground unless in a junction box or control panel without permission from the Engineer.

3.07 ENCLOSURE SIGNAL AND CONTROL CIRCUIT WIRING

A. Wiring installation: All wires shall be run in plastic wireways except (1) field wiring, (2) wiring run between mating blocks in adjacent sections, (3) wiring run from components on a swing-out panel to components on a part of the fixed structure, and (4) wiring run to panel-mounted components. Wiring run from components on a swing-out or front panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties, and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals. Signal and low voltage wiring shall be run separately from power and 120 V control wiring.

B. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and secured to the inside face of the panel using adhesive mounts.

C. Wiring to rear terminals on panel-mount instruments shall be run in plastic wireways secured to horizontal brackets run above or below the instruments in about the same plane as the rear of the instruments.

D. Conformance to the above wiring installation requirements shall be reflected by details shown on the shop drawings for the Engineer's review.

E. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings. These numbers shall be marked on all conductors at every terminal using white numbered wire markers which shall be permanently marked heat-shrink plastic as described above.

3.08 ELECTRICAL TESTS

A. Electrical insulation resistance tests for each of the following items shall be performed with respect to ground and adjacent cables.

1. All new switchboards, control wiring circuits, motor wiring circuits, panel boards and sub-distribution feeders from switchboards to panel boards.

2. Perform continuity test to insure proper connection.

3. Insulation resistance tests shall be performed at 1,000 volts D.C. for one-half minute.

4. Insulation resistance shall in no case be less than following table.

MINIMUM INSULATION RESISTANCE	
Conductor of Circuit Size	Minimum Resistance
No. 14 and 12 AWG	1,000,000 ohms
25 - 50 ampere	250,000 ohms
51 - 100 ampere	100,000 ohms
101 - 200 ampere	50,000 ohms
210 - 400 ampere	25,000 ohms
401 - 800 ampere	12,000 ohms
Over 800 ampere	5,000 ohms

5. These values are determined with all switchboards, panelboards, fuse holder, switches and overcurrent devices in place.

6. Test results shall be documented in an organized typewritten manner documented as "Insulation Resistance Test Report" and submitted to the Engineer in triplicate prior to acceptance.

7. Tests shall be done in the presence of the Engineer or his representative. Seventy-two (72) hour notice shall be given prior to testing.

8. Any circuit not meeting test requirements shall be replaced and retested until it meets test requirements.

PART 4 - SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Costs for all items in this Section shall be included within the lump sum price for Electrical Improvements Complete as stated in the Bid Form. No additional payment will be made for this item.

END OF SECTION

SECTION 16130– RACEWAY AND BOXES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide raceway system complete. All sizes shown on the diagrams shall be considered minimums. All sizes and lengths provided in the conduit or wiring schedules shall be considered minimums and estimates. Contractor shall be responsible for selecting sizes that will properly accommodate all wires and cables. Contractor should assume that not all conduits are shown on the diagrams or in the schedules.

B. All project wiring, including cables, shall be in conduit unless otherwise noted herein or on drawings.

C. Sizes as shown on drawings or as required, if not shown on drawings. Conduit shall be filled no more than 25%. Provide pull wires in all empty conduits for future use. Identify both ends with labels or tags reading "PULL WIRE" with a number for reference.

D. Chases, openings, sleeves, hangers, anchors, recesses, equipment, pads of framing for fixtures provided under other divisions only if specified or shown. Otherwise, provided under this Division. In any event, this Division shall be responsible for correct size and location.

E. Codes and Standards. NEC shall govern use and installation of conduit types. Standards for conduits shall be as defined by ANSI, Federal and UL specifications. Standards for nonmetallic per NEMA TC-2. Any requirements of this section shall be additional.

F. Labels. Any raceway which is not wholly contained in one room and whose full length is not clearly visible shall be labeled at each end, junction, size change, or any other place where a label would clarify its identity. The label shall be of the form "CXXX" where XXX is a unique number (for example: C132, C081, C567). A unique number shall be used for each raceway and shall be displayed and noted on the Record Drawings. The labeling means shall be a machine printed nylon wrap-around wire-tie style tag made for the purpose of labeling pipe or conduit. Other means of labeling may be submitted to the Engineer for approval. Hand-written indelible ink labels are not acceptable.

G. The electrical contractor shall furnish and install all plant raceways, including instrumentation and signal raceways. Contractor is responsible for furnishing and installing all circuits and raceways necessary for a complete, working system, whether or not they are shown or described in the contract documents. The Division 16 Electrical plans do not show all conduits and those that are shown are shown schematically (not necessarily in their correct, installed, positions). Contractor should verify all conduits' location and size by actual manufacturers' data. Contractor shall coordinate with other division contractors to make sure that raceways shall be installed in the proper places and shall be the proper sizes and materials. Electrical Contractor shall also connect all power conductors to 120V/240V/480V plant devices, including instrumentation meters and recording devices furnished under other divisions. Electrical Contractor shall connect all analog 4-20mA current loop signal circuits.

H. Consult the contract drawings for additional information, including the use of stainless steel raceway in many locations. Special study should be given to the manufacturers' equipment plans to assure that appropriate conduits and conductors are installed so that all components are properly connected.

PART 2 - PRODUCTS

2.01 RIGID GALVANIZED STEEL CONDUIT (RGS)

A. Hot dipped galvanized. Required in all concrete or block work unless otherwise specified. Required for all stub-ups. Required for all transitions from underground PVC when passing through concrete.

B. Rigid fittings to be galvanized malleable iron or noncorrosive alloy compatible with galvanized conduit. Erickson couplings, watertight split couplings (OZ or equivalent) permitted.

2.02 ELECTRICAL METALLIC TUBING (EMT).

A. Hot dip galvanized, electrogalvanized or sherardized, steel tubing. Permitted only in specified areas.

B. Couplings and Connectors. Raintight; steel or malleable iron type using a split corrugated compression ring and tightening nut or stainless steel locking disc. Indenter or set screw fittings shall only be acceptable in office and laboratory rooms.

2.03 PVC CONDUIT.

A. Schedule 40 rigid polyvinyl chloride type with ground wire. Generally required for all underground installations. Not permitted in any concrete or block work. Not permitted for stub-ups, even in protected areas (except power pole risers). Not permitted in attics.

B. Pre-formed PVC elbows and fittings unless otherwise noted on drawings.

2.04 RIGID ALUMINUM CONDUIT.

A. Permitted only in specified areas.

B. Fittings to be copper free cast aluminum.

2.05 FLEXIBLE PVC CONDUIT, WET LOCATIONS AND DRY LOCATIONS.

A. Liquid Tight, PVC weatherproof for damp and wet locations.

B. Fittings Thomas and Betts or approved.

2.06 SURFACE METAL RACEWAY.

A. Formed steel type, standard factory painted finish. Where choice of colors is available, consult Engineer for color selection.

B. All hinged type raceways to have piano type hinges.

C. Surface metal raceways only allowed where specifically called out on drawings, or unless prior approval by Engineer.

2.07 RIGID STAINLESS STEEL CONDUIT (SS)

A. Solid stainless steel. Required in most outdoor environments or as specified.

B. Fittings to be threaded stainless steel. Stainless steel Erickson couplings, watertight split couplings (OZ or equivalent) permitted so long as all components are of the same stainless steel alloy and are water proof.

PART 3 - EXECUTION

3.01 CONCEALED WORK

A. In general, install raceways concealed in construction except where shown otherwise on the Drawings or unless specifically approved by Engineer.

3.02 CLEAN & DRY

A. Install conduit dry and free of debris using approved plugs or caps. Cap and securely support conduits prior to concrete pour.

3.03 ROUTING

A. Conduit in general may be routed at Contractor's best judgment unless directed otherwise. All conduits in or under concrete floors shall be recorded on as-builts as distances from walls in feet or inches. Home runs are diagrammatic for clarity and may be grouped as desired.

3.04 RIGID GALVANIZED STEEL CONDUIT (RGS)

A. All connections shall be watertight. Install RGS for all raceways in concrete or where subject to damage. Running thread or set screw type fittings not approved.

B. Conduit in Slab.

1. Minimum 3" concrete cover. Space not less than 8" on center and as wide as possible where converging at panel, etc.

2. Do not interfere with placement of reinforcing steel. Place conduit between upper and lower layers.

C. Expansion Joints. Install offset or sliding type where embedded conduits cross building expansion joints. Sliding type to have bonding strap and clamp.

D. Floor Stub-Ups - Accessible Floor Areas. Install rigid conduit with threaded coupling set flush with finished floor. Seal with flush, threaded pipe plug.

E. Raceways that stub-up above floor: Install at such depth that the exposed raceway is vertical and no curved section of the elbow is visible.

F. Rigid steel installed in earth including bends to be coated entire length with coal-tar material. Koppers Bitumastic 515 or with 15 mil. PVC Jacket. (Repair abrasions with PVC base paint or PVC). This is not a preferred method; where possible, use PVC conduit underground.

3.05 RIGID ALUMINUM CONDUIT.

A. Do not install aluminum conduit in earth, cinders or concrete.

B. May be used in lieu of steel where conduit is run in attics or above suspended ceilings where not subject to physical damage.

C. Not allowed where attached to concrete or masonry. Not allowed where other adjacent metals might electrolytically react with the aluminum.

3.06 ELECTRICAL METALLIC TUBING (EMT).

A. Install for wiring in frame construction and for wiring in furred ceilings and above suspended ceilings. May be used for exposed work in unfinished areas where not subject to damage, but only upon prior approval by the Engineer.

3.07 PVC RACEWAYS.

A. Use of PVC outside of building 5' and beyond. See Plans for Special Applications.

B. All bends shall be manufactured. Site-made heat bends may be approved by the Engineer on a case by case basis.

3.08 FLEXIBLE CONDUIT.

A. Provide flexible raceway connection to motors and equipment subject to vibration with 90 degrees loop minimum to allow for isolation. Use liquid tight. Provide bonding jumper when required by code.

3.09 SURFACE METAL RACEWAYS.

A. Install parallel to a building surface (i.e., wall, ceiling, floor). Fasten to surface as recommended by manufacturer. Mount so raceway is in the least visible location. Allowed only upon prior approval by Engineer.

3.10 UNDERGROUND CONDUIT.

A. Install with minimum cover of 36" over PVC and 30" over (RGS) finished grade.

B. Install underground marking tape. Bury 6-8 inches below grade, directly above conduit.

C. Install with 3" per 100' downward slope from buildings or section high points toward junction boxes, which are to be provided with drainage facilities.

D. Cap off watertight all conduits stubbed out for future use. Place #12 TW pull wire with tag at both ends.

E. Call for inspection prior to backfilling of any trenches, concrete pours containing conduits, and/or covering of conduits. Give a minimum of 48 hours notice prior to cover up.

F. Keep an accurate up-to-date location record of all underground and under floor conduits with dimensions from wall lines parallel and perpendicular.

G. Underground Marking Tape for all Underground Electrical and Telephone. 6" wide, yellow, low density polyethylene, 4-mil thickness. Imprinted with "CAUTION - STOP DIGGING - BURIED ELECTRIC LINE BELOW" and current date. Somerset "Protect-A-Line". Tape for telephone, network and signal line similar except green. All underground wiring and cabling shall be in conduit.

3.11 RACEWAY BENDS.

A. Conduit Bending. Bends in 1" size and larger shall be factory ells or made with manufactured mechanical bender. All entry ells shall be long radius type.

3.12 BUSHINGS

A. Factory insulated.

B. All panels, junction boxes and metal raceways shall have bushings when entered or exited by a conduit of any type.

3.13 RACEWAY SUPPORT DEVICES.

A. All hardware such as inserts, straps, bolts, nuts, screws and washers shall be galvanized or stainless steel. No cadmium plated steel shall be allowed.

B. Trapeze Hangers, Channel. 1-1/2" x 1-1/2" galvanized or stainless, 12 gauge. Kindorf.

C. Rods. Minimum 3/8" diameter.

D. Beam Clamps. Hardened point set screws. Compatible with structural members.

E. Pipe Strap. Approved type. Perforated plumbers tape not acceptable.

3.14 RACEWAY SUPPORT AND INSTALLATION.

A. Support conduits at intervals not greater than 10' and within 3' of any fitting, outlet or junction box, or cabinet, or as required by the NEC.

B. Secure single runs with pipe strap.

C. Hollow Masonry. Galvanized or stainless toggle bolts.

D. Concrete, Solid Masonry. Expansion shields and galvanized or stainless machine screws or standard preset inserts.

E. Metal Surfaces. Galvanized or stainless machine screws or bolts.

F. Wood Construction. Galvanized or stainless wood screws, or galvanized J-Nail.

G. Suspended from Ceiling. Pipe hanger and rod.

H. Damp Locations. Install clamp backs under each clamp on exposed surface conduits to prevent moisture accumulation.

I. Support multiple runs with trapeze hangers where conduits run exposed and parallel. Attach to structure with hanger rod as follows:

1. Steel Members. Galvanized or stainless beam clamps.

2. Concrete. Concrete inserts set flush with surface, insert reinforcing rod through insert opening where provided.

3. Wood Framing. Ceiling hanger flange, galvanized or stainless wood screws.

J. When more than two conduits would use the same routing, group together on a patented channel support system (such as Unistrut).

K. Damp Locations. Install clamp backs under each clamp on exposed surface conduits to prevent moisture accumulation.

L. Run all exposed conduits parallel and plumb to structure lines. In building interior locations, conduits shall be concealed in walls or ceilings wherever possible and exposed work shall run parallel to building lines. Conduits shall not be routed on floors in areas subject to foot traffic. In exterior locations conduit shall be routed below grade. Where concrete or asphalt slabs exist they shall be saw cut, conduits installed, and the cut repaired to original condition. Exposed conduits and/or raceway shall be installed perpendicular or parallel to building lines.

M. Maintain 6" minimum separation from hot water lines. Do not run conduit beneath boilers or heating units.

3.15 SEALING OF RACEWAY PENETRATION.

A. Exterior Wall Surfaces Above Grade. Seal around all penetrations with caulking approved by Engineer. For concrete construction above ground level, cast raceway in wall or core drill wall and hard pack with a mixture of equal parts of sand and cement.

B. Exterior Surfaces Below Grade. Cast raceway into wall (or floor) or use manufactured seal assembly (such as OZ type "FSK") cast in place.

C. Roofs. Provide mopped, lead, roof jack where raceway penetrates roof membrane.

3.16 SEALING OF RACEWAYS.

A. All conduits to and from hypochlorite generation room shall be sealed on both ends. Pack tightly around conductors in raceway. This includes all light fixture boxes, receptacle boxes, heater junction boxes and chlorinator junction boxes.

B. Both ends of conduits to and from reservoir control boxes shall be sealed on both ends.

C. Seal interior of all raceways which pass through building roof or through outside walls of the building, above or below grade. Seal on the end inside the building, using duct sealing mastic, non-hardening compound type, specially designed for such service. Pack around the wires in the raceways.

D. For exterior wall penetrations below grade, install OZ type "CBS" sealing bushing at interior end of penetrating raceway. Threaded fittings only are permitted in entering raceways ahead of the sealing bushing.

E. Appropriate sealing devices such as "EYS" series fittings shall be used where hazardous locations exist as classified by NEC.

3.17 CLEANUP.

A. At time of final cleanup, thoroughly clean all raceways of any debris. This includes wire ends and pieces of insulation.

3.18 PAINTING.

A. All exposed conduits on painted walls to be painted to match wall and trim colors.

B. See Basic Methods this Division.

PART 4 - SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Costs for all items in this Section shall be included within the lump sum price for Electrical Improvements Complete as stated in the Bid Form. No additional payment will be made for this item.

END OF SECTION

16131 - OUTLET AND PULL BOXES

PART 1 - GENERAL

1.01 PROVIDE AS NEEDED OR SHOWN ON DRAWINGS

A. Provide outlet and pull boxes as required to enclose devices, permit pulling conductors and for wire splices and branches.

B. Provide all outlet and pull box appurtenances.

PART 2 - PRODUCT DESCRIPTION

2.01 OUTLET AND PULL BOX SIZES

A. Flush wall switch or receptacle to be 4 inch square, 1-1/2 inches or more deep, with single or two gang plaster ring mounted vertically except where noted to be mounted horizontally such as possibly counter back splashes. Where three or more devices are at one location, use one piece multiple gang box, with suitable plaster ring. Install not more than one device per gang unless otherwise noted on the plans.

B. Wall bracket and ceiling surface mounted lighting fixture outlet to be 4 inch octagon, 1-1/2 inches deep with 3/8 inch fixture stud where required. Wall bracket outlet to have single gang plaster ring.

C. Surface outlets where exposed conduit is allowed, to be same as flush outlet boxes without plaster ring but with cadmium or galvanized device plate.

D. Junction boxes for branch circuits to be not less than 4 inch square, 1-1/2 inches or more deep. Boxes with 1 inch conduit terminating in same, to be 4-11/16 inches square.

E. Liquid tight outlet and junction boxes to be 4 inches square, 1-1/2 inches or more deep and be fitted with neoprene gaskets. Outlet and junction boxes in filter room shall all be liquid tight.

F. Liquid tight PVC junction boxes shall be "Carlon" high impact gasketed PVC molded box with screwdown cover and stainless steel screws. Catalog No. E989R or equivalent. Exterior junction boxes may be PVC or galvanized as directed by Engineer.

G. Exterior exposed and equipment mounted junction boxes shall be cast galvanized, gasketed and painted to match equipment or left galvanized as directed by Engineer. Exterior junction boxes may be PVC or galvanized as directed by Engineer.

2.02 GREATER THAN 150 VOLTS

A. Device boxes containing multiple devices for system rated over 150 volts to ground are permitted only with steel barrier manufactured especially for the purpose of dividing the box into separate compartments for each device having exposed live parts.

2.03 IN CEILINGS

A. Junction or pull boxes in suspended ceilings shall be supported from structure independently from ceiling suspension system.

2.04 OUTLET BOX GROUNDING

A. All flush outlet boxes serving receptacles (12-V or more) shall be equipped with a green grounding screw.

2.05 DEVICE BOXES CONTAINING EMERGENCY AND NORMAL DEVICES.

A. Permitted only with steel barrier manufactured especially for the purpose of dividing the box into two completely separate compartments.

2.06 DEVICE BOXES CONTAINING POWER AND TELEPHONE OR TELEMETERING.

A. Permitted only with steel barrier manufactured especially for the purpose of dividing the box into two completely separate compartments.

PART 3 - INSTALLATION AND WORKMANSHIP

3.01 PLUMB, SQUARE

A. All boxes to be fastened securely in place at the proper depth plumb with equipment, walls and fixtures for proper installation of switches, outlets and covers.

3.02 HARDWARE

A. All conduits shall be secure and attached to boxes with proper hardware.

3.03 REMOUNT

A. All boxes not meeting the above requirements shall be removed and remounted as directed by the Engineer or his representative.

3.04 FLUSH WITH WALL

A. Except for surface mounted boxes or boxes above accessible ceilings, all boxes shall have flush edge (box or plaster ring) even with the finished surface of the wall or ceiling.

3.05 ELECTRICAL WORK IN COUNTERBACKS, MILLWORK AND CASEWORK

A. Provide as shown and/or specified. Provide templates, where required, to other trades for drilling and cutting to insure accurate location of electrical fixtures (outlets and devices). Provide all wiring, devices, plates and connections as required by said fixtures.

3.06 CONNECTION TO EQUIPMENT

A. Furnished under this or other Divisions of the specifications, or by others. Provide outlet boxes of sizes and at locations necessary to serve such equipment. Outlet box required if equipment has pigtail wires for external connection, does not have space to accommodate circuits wiring or requires a wire different from circuit wiring used. Study equipment details to assure proper coordination.

3.07 BLANK COVERS

A. Provide blank covers or plate over all boxes that do no contain devices or are not covered by equipment.

B. No blank outlet and pull boxes will be allowed in finished walls or ceilings without permission from the Engineer.

3.08 LIGHTING FIXTURE BOXES

A. In ceilings of acoustical material. Locate in accordance with approved ceiling layout plans and so that fixtures replace full size ceiling tiles wherever possible.

3.09 ELECTRICAL OUTLETS

A. Coordinate the work of this Section with the work of other sections and trades. Study all drawings that form a part of this contract and confer with the various trades involved to eliminate conflicts between the work of this Section and the work of other trades. Check and verify outlet locations indicated on Architectural drawings, door swings, installation details and layouts of suspended ceilings and locations of all plumbing, heating and ventilating equipment.

B. Centered on Built-in Work. In the case of doors, cabinets, recessed or similar features, or where outlets are centered between two such features, such as between a door jamb and a cabinet, make these outlet locations exact. Relocate any outlets which are located off center.

C. Vertical and Horizontal Relationships. Where more than one outlet is shown or specified to be at the same elevation or one above the other, align them exactly on centerlines horizontally or vertically. Relocate as directed all such outlets (including lighting, receptacle, power, signal and thermostat outlets) which are not so installed, at no additional cost to Owner.

D. Device Outlet Height. Measure from the finished floor to the centerline, unless otherwise noted.

E. Switches: 4 feet, set vertically

F. Receptacles:12 inches, set vertically or as indicated

G. Other: As shown on the plans or as directed by Engineer

H. Ceiling Location. For acoustical material locate outlet either at the corner joint or in the center of a panel, whichever is closer to the normal spacing. Locate all outlets in the same room in same panel position.

PART 4 - SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Costs for all items in this Section shall be included within the lump sum price for Electrical Improvements Complete as stated in the Bid Form. No additional payment will be made for this item.

END OF SECTION

SECTION 16140– WIRING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Work consists of providing and installing switches, receptacles, and other devices shown on the drawings and specified herein.

B. Furnish and install wiring devices of number, rating and type shown on drawings or called out in these specifications.

C. Devices to include appropriate outlet box, cover, wall plate and other necessary installation materials for a complete and satisfactory operation system.

D. In general, all devices shall be by one manufacturer unless specifically called out otherwise in these specifications or on drawings.

PART 2 - PRODUCTS

2.01 APPROVED DEVICES

A. Manufacturer's with equivalent devices meeting specifications. Bryant, Hubbell, Arrowhart and Leviton. Numbers have been listed as to style, grade and as a guide.

1. Wall Switches. Heavy duty AC quiet type, Federal Specification W.S. 896 (de).

   a. Single Pole. Hubbell; 20 amp, 120/277 VAC.

   b. 3 Way. Hubbell; 20 amp, 120/277 VAC.

   c. 4 Way. Hubbell; 20 amp, 120/277AC.

2. Receptacles. Heavy duty AC, Federal Specification WC-596a.

   a. Single. Hubbell; 20 amp, 125VAC.

   b. Duplex. Hubbell; 20 amp, 125VAC.

3. Combination Devices.

   a. Combination Switch and Receptacle. Hubbell; 20 amp 125VAC receptacle and switch.

   b. Two Single Pole Switches. Hubbell; 20 amp, 120/277VAC.

4. Groundfault Interrupter Receptacle.

   a. Duplex Receptacle, Hubbell 20 amp, 125VAC, GF15 Series.

5. Cover Plates.

a. Nonconductive smooth plastic. All switches and dimmers to be gauged and covered by one plate. All wall plates to be standard size and meeting Federal specification WW-455A noncombustible, supplied with metal mounting screws matching color of plate. Hubbell NP Series - match existing. All switches and devices shall be ganged wherever possible.

b. Engraved Device Wall Plates. Unless shown otherwise, provide engraved plates for panels and devices. Letter height shall be 3/16" (minimum), color of filling to be white or black, as appropriate for contast. Before ordering, submit a sample of the above wall plate with engraving. A name plate schedule will be supplied by Engineer at the time of submittal.

c. Weather Resistant (WP) Cover Plates. Hubbell; self-closing HBL5221, provide appropriate gasket to box.

d. Telephone and TV Cover Plates. Hubbell; NP737 - 5/8" hole.

e. Cover plates in unfinished areas and where exposed conduit is used.

i. Raised galvanized to be used in unfinished areas or where conduits run exposed. Labeling of switch shall be by Melamine Plate attached to cover plate. Verify areas with Engineer prior to installation of cover plates.

2.02 PLUG MOLD

A. Provide plug mold for surface mounting as shown on drawings, with proper number of receptacles as shown. All plug molds to be grounded. Submit plug mold with wiring devices.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Devices and finish plates shall be installed plumb with building lines.

B. Finish plates and devices shall not be installed until final painting is complete. Scratched or splattered finish plates and devices will not be accepted.

C. Wall mounted receptacles shall be installed vertical 48" above floor, or as shown.

D. Receptacles shall be checked for line to neutral, line to ground and neutral to ground integrity.

E. Install GFI receptacle circuits at all locations.

PART 4 - SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Costs for all items in this Section shall be included within the lump sum price for Electrical Improvements Complete as stated in the Bid Form. No additional payment will be made for this item.

END OF SECTION

SECTION 16210 – POWER UTILITY SERVICE

PART 1 - GENERAL

1.01 UTILITY COMPANY

A. See electrical one-line diagrams and electrical site diagrams for additional information.

B. Three phase transformer services will be pole mounted by utility

C. Utility Company Fees, shall be included as part of the contract. The Utility is Pacific Power Corporation and will provide wire, transformers, and the pull box. Contractor is responsible for installation of meter base, pull box, and conduit. Contractor shall transfer utility service over to the City account at end of contract period.

1.02 RELATED SECTIONS

A. Section 16010 - Electrical Introduction

1.03 WORK INCLUDED

A. The Division 16 contractor shall furnish and install all service equipment, raceway, transformers, etc., as shall be required by the power utility company to make a complete, operable power system, as further described in the contract documents.

B. Contractor shall pay all fees, connect charges, permits, etc., as may be required to provide service to the project (but see above).

C. Contractor shall be responsible for ordering service changes and coordinating all service related work with the General Contractor and the operator so as to provide uninterrupted plant processes and smooth transitions from old services to new.

D. Contractor shall be responsible for planning, ordering and paying for all temporary power services as may be needed during construction.

END OF SECTION

DIVISION 16230 – STANDBY GENERATOR

PART 1 - GENERAL

1.01 SCOPE

A. The standby power generator shall be a 4-cycle direct injection, diesel fueled, engine generator set with weatherproof enclosure as a single skid, sized as specified herein. Genset minimum ratings: 50 kW, 63 kVA at 0.80 PF rating, based on site conditions noted below. System voltage of: 480 Volts AC, three phase, four-wire, 60 hertz.

B. The engine generator set shall be capable of producing the rated kW and kVA when operating at 100 feet altitude and an ambient temperature up to 40° C (104° F). The manufacturer shall provide data to verify the set will operate as required in the specified ambient conditions.

C. Provide complete factory built generator set equipment with digital (microprocessor-based) electronic generator set controls, digital governor, and digital voltage regulator.

D. Provide factory test, startup by a supplier authorized by the equipment manufacturer(s), and on-site testing of the system.

E. The generator set manufacturer shall warrant all equipment provided under this section so that there is one source for warranty and product service. Technicians specifically trained and certified by the manufacturer to support the product and employed by the generator set supplier shall service the generator sets.

F. Genset shall include a weatherproof enclosure suitable for an outdoor environment.

1.02 CODES AND STANDARDS

A. The generator set installation and on-site testing shall conform to the requirements of the following codes and standards, as applicable. The generator set shall include necessary features to meet the requirements of these standards.

1. CSA 282, 1989 Emergency Electrical Power Supply for Buildings

2. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications

3. NFPA37 – Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines

4. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.

5. NFPA99 – Essential Electrical Systems for Health Care Facilities

6. NFPA110 – Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.

B. The generator set and supplied accessories shall meet the requirements of the following standards:

1. NEMA MG1-1998 part 32. Alternator shall comply with the requirements of this standard.

2. UL1236 – Battery Chargers

3. UL2200. The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.

C. The control system for the generator set shall comply with the following requirements.

1. CSA C22.2, No. 14 – M91 Industrial Control Equipment.

2. EN50082-2, Electromagnetic Compatibility – Generic Immunity Requirements, Part 2: Industrial.

3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.

4. FCC Part 15, Subpart B.

5. IEC8528 part 4. Control Systems for Generator Sets

6. IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.

7. UL508. The entire control system of the generator set shall be UL508 listed and labeled.

8. UL1236 – Battery Chargers.

D. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.03 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers include Cummins, Kohler, and Caterpillar. Other manufacturers capable of producing equipment equal to or greater in quality than that described herein shall be pre-approved by the Engineer.

1.04 SUBMITTALS

A. The generator proposed for this project must be preapproved through the pre-bid submittal process as outlined in Section 01300.

B. Submittal shall include: prototype test certification showing all standard and optional accessories to be furnished, schematic wiring diagrams, dimensional drawings, installation instructions, interconnection diagrams identified by terminal number, and each required interconnection between the generator set, and the transfer switch.

PART 2 - PRODUCTS

2.01 GENERATOR SET

A. Ratings

1. The generator set shall operate at 1800 rpm and at a voltage of: 480 Volts AC, three phase, 60 hertz.

2. The generator set shall be rated at minimum 50 kW, 63 kVA at 0.8 PF, standby rating, based on site conditions of: Altitude 1,200 ft, ambient temperatures up to 40° C (104° F).

3. The generator set rating shall be based on standby service.

B. Performance

1. Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load for both parallel and non-parallel applications. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.

2. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.

3. The engine-generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.

4. Motor starting capability shall be a minimum of 221 kVA. The generator set shall be capable of sustaining a minimum of 90% of rated no load voltage with the specified kVA load at near zero power factor applied to the generator set.

5. The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic. Telephone influence factor shall be less than 40.

C. Construction

1. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.

2. All switches, lamps, and meters in the control system shall be oil-tight and dust-tight, and the enclosure door shall be gasketed. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.

D. Connections

1. The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.

2. Power connections to auxiliary devices shall be made at the devices, with required protection located at a wall-mounted common distribution panel.

3. Generator set control interfaces to other system components shall be made on a common, permanently labeled terminal block assembly.

2.02 ENGINE AND ENGINE EQUIPMENT

A. The engine shall be diesel fueled, radiator and fan cooled. The horsepower rating of the engine at it's minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Engine accessories and features shall include:

B. Complete engine fuel system, including all pressure regulators, strainers, and control valves. The fuel system shall be plumbed to the generator set skid for ease of site connections to the generator set.

1. The generator set engine shall be diesel fired.

C. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous or parallel states.

D. Skid-mounted radiator and cooling system rated for full load operation in 104 degrees F (40 degrees C) ambient as measured at the generator air inlet, based on 0.5 in H2O external static head. Radiator shall be sized based on a core temperature that is 20F higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange. The equipment manufacturer shall fill the cooling system with a 50/50-ethylene glycol/water mixture. Rotating parts shall be guarded against accidental contact.

E. Electric starter(s) capable of three complete cranking cycles without overheating.

F. Positive displacement, mechanical, full pressure, lubrication oil pump.

G. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.

H. Replaceable dry element air cleaner with restriction indicator.

I. Engine mounted battery charging alternator, 40-ampere minimum, and solid-state voltage regulator.

J. Coolant heater

1. Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL499 listed and labeled.

2. The coolant heater shall be installed on the engine with high temperature silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall be installed using quick disconnect couplers

to isolate the heater for replacement of the heater element. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.

3. The coolant heater shall be provided with a thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.

4. The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 100F (40C) in a 40F ambient, in compliance with NFPA110 requirements, or the temperature required for starting and load pickup requirements of this specification.

K. Provide vibration isolators, spring/pad type or as recommended by the manufacturer, quantity as recommended by the generator set manufacturer. Isolators shall include seismic restraints if required by site location.

L. Starting and Control Batteries shall be calcium/lead antimony type, sized as recommended by the engine manufacturer, complete with battery cables and connectors.

M. Provide exhaust silencer(s) for each engine of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer. Exhaust system shall be installed according to the engine manufacturer's recommendations and applicable codes and standards.

N. BATTERY CHARGER – Provide a minimum 10 amp battery charger for each generator set battery bank. Generator sets incorporating two battery banks shall be provided with two chargers connected together and operating in parallel, with alarm output(s) connected in parallel. The charger(s) shall include the following capabilities:

1. Chargers shall be UL 1236-BBHH listed and CSA or CUL certified for use in emergency applications.

2. The charger shall be compliant with UL991 requirements for vibration resistance.

3. The charger shall comply with the requirements of EN61000-4-5 for voltage surge resistance; EN50082-2 for immunity; EN61000-4-2 for ESD; EN61000-4-3 for radiated immunity; ANSI/IEEE C62.41 category B and IN61000-4-4 for electrically fast transient; EN61000-4-6 for conducted emissions; and FCC Part 15 Class A for radiated emissions.

4. The charger shall be capable of charging a fully discharged battery without damage to the charger. It shall be capable of returning a fully discharged battery to fully charged condition within 24 hours. The charger shall be UL-labeled with the maximum battery amp-hour rating that can be recharged within 24 hours.

5. The charger shall incorporate a 4-state charging algorithm, to provide trickle charge rate to restore fully discharged batteries, a bulk charge rate to provide fastest possible recharge after normal discharge, an absorption state to return the battery to 100 percent of charge, and a float stage to maintain a fully charge battery and supply battery loads when the generator set is not operating. In addition, the charger shall include an equalization timer. Charge rates shall be temperature compensated based on the temperature directly sensed at the battery.

6. The DC output voltage regulation shall be within plus or minus 1%. The DC output ripple current shall not exceed 1 amp at rated output current level.

7. The charger shall include the following features:

   a. two line alphanumeric display with programming keys to allow display of DC output ammeter and voltmeters (5% accuracy or better), display alarm messages, and perform programming;

   b. LED indicating lamp(s) to indicating normal charging condition (green), equalize charge state (amber), and fault condition (red);

   c. AC input overcurrent, over voltage, and undervoltage protection;

   d. DC output overcurrent protection;

   e. Alarm output relay;

   f. Corrosion resistant aluminum enclosure.

2.03 AC GENERATOR

A. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 105° C.

B. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.

C. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.

D. The subtransient reactance of the alternator shall not exceed 15 percent, based on the standby rating of the generator set.

E. The alternator shall be configured with 12-lead, upper broad range wiring.

2.04 GENERATOR SET CONTROL

A. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.

B. The control shall be mounted on the generator set, or may be mounted in a free-standing panel next to the generator set if adequate space and accessibility is available. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.

C. The generator set mounted control shall include the following features and functions:

1. Control Switches

a. Mode Select Switch. The mode select switch shall initiate the following control modes. When in the RUN or MANUAL position the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. A separate push-button to initiate starting is acceptable. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.

b. EMERGENCY STOP switch. Switch shall be Red "mushroom-head" push-button. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.

c. RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.

d. PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.

2. Generator Set AC Output Metering. The generator set shall be provided with a metering set including the following features and functions:

a. Digital metering set, 1% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three-phase voltages (line to neutral or line to line) simultaneously.

b. Analog voltmeter, ammeter, frequency meter, power factor meter, and kilowatt (KW) meter. Meter scales shall be color coded in the following fashion: green shall indicate normal operating condition, amber shall indicate operation in ranges that indicate potential failure, and red shall indicate failure impending. Metering accuracy shall be within 1% at rated output. Both analog and digital metering are required.

c. The control system shall monitor the total load on the generator set, and maintain data logs of total operating hours at specific load levels ranging from 0 to 110% of rated load, in 10% increments. The control shall display hours of operation at less than 30% load and total hours of operation at more than 90% of rated load.

d. The control system shall log total number of operating hours, total kWH, and total control on hours, as well as total values since reset.

3. Generator Set Alarm and Status Display

a. The generator set control shall include LED alarm and status indication lamps. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. Functions indicated by the lamps shall include:

i. The control shall include five configurable alarm-indicating lamps. The lamps shall be field adjustable for any status, warning, or shutdown function monitored by the genset. They shall also be configurable for color, and control action (status, warning, or shutdown).
ii. The control shall include green lamps to indicate that the generator set is running at rated frequency and voltage, and that a remote start signal has been received at the generator set. The running signal shall be based on actual sensed voltage and frequency on the output terminals of the generator set.
iii. The control shall include a flashing red lamp to indicate that the control is not in automatic state, and red common shutdown lamp.
iv. The control shall include an amber common warning indication lamp.

b. The generator set control shall indicate the existence of the warning and shutdown conditions on the control panel. All conditions indicated below for warning shall be field-configurable for shutdown. Conditions required to be annunciated shall include:

low oil pressure (warning)
low oil pressure (shutdown)
oil pressure sender failure (warning)
low coolant temperature (warning)
high coolant temperature (warning)
high coolant temperature (shutdown)
high oil temperature (warning)
engine temperature sender failure (warning)
low coolant level (warning)
fail to crank (shutdown)
fail to start/overcrank (shutdown)
overspeed (shutdown)
low DC voltage (warning)
high DC voltage (warning)
weak battery (warning)
low fuel-daytank (warning)
high AC voltage (shutdown)
low AC voltage (shutdown)
under frequency (shutdown)
over current (warning)
over current (shutdown)
short circuit (shutdown)
over load (warning)
emergency stop (shutdown)
(4) configurable conditions

c. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above-specified conditions. The non-automatic indicating lamp shall be red,

and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

4. Engine Status Monitoring

a. The following information shall be available from a digital status panel on the generator set control:

engine oil pressure (psi or kPA)
engine coolant temperature (degrees F or C)
engine oil temperature (degrees F or C)
engine speed (rpm)
number of hours of operation (hours)
number of start attempts
battery voltage (DC volts)

b. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.

D. Engine Control Functions

1. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.

2. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.

3. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.

4. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.

5. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.

E. Alternator Control Functions

1. The generator set shall include a full wave rectified automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase line to neutral RMS sensing and shall

control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate, and be capable of being curve-matched to the engine torque curve with adjustments in the field. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.

2. Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445. The protection for this function shall be 3rd party certified to very performance.

3. Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445. The protection for this function shall be 3rd party certified to very performance.

4. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.

5. An line to neutral sensing AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

6. When required by National Electrical Code or indicated on project drawings, the control System shall include a ground fault monitoring relay. The relay shall be adjustable from 3.8-1200 amps, and include adjustable time delay of 0-10.0 seconds. The relay shall be for indication only, and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set, and provide relay that will function correctly in system as installed.

7. The generator set control shall include a 120VAC-control heater.

F. Other Control Functions

1. The generator set shall be provided with a network communication module to allow LonMark compliant communication with the generator set control by remote devices. The control shall communicate all engine and alternator data, and allow

starting and stopping of the generator set via the network in both test and emergency modes.

2. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage are outside preset limits. During engine cranking (starter engaged), the low voltage limit shall be disabled, and DC voltage shall be monitored as load is applied to the battery, to detect impending battery failure or deteriorated battery condition.

G. Control Interfaces for Remote Monitoring

1. The control system shall provide four programmable output relays. These relay outputs shall be configurable for any alarm, shutdown, or status condition monitored by the control. The relays shall be configured to indicate: (1) generator set operating at rated voltage and frequency, (2) common warning, (3) common shutdown, (4) load shed command.

2. A fused 10 amp switched 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.

3. A fused 10 amp 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.

4. The control shall be provided with a direct serial communication link for the LonWorks communication network interface as described elsewhere in this specification and shown on the drawings.

2.05 OTHER EQUIPMENT TO BE PROVIDED WITH THE GENERATOR SET

A. The generator set shall be provided with a mounted main line circuit breaker, sized to carry the rated output current of the generator set. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or a thermal-magnetic trip with other overcurrent protection devices that positively protect the alternator under overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.

B. Outdoor Weather-Protective Enclosure

1. The generator set shall be provided with an outdoor enclosure, with the entire package listed under UL2200. The package shall comply with the requirements of the National Electrical Code for all wiring materials and component spacing. The total assembly of generator set, enclosure, and sub-base fuel tank (when used) shall be designed to be lifted into place using spreader bars. Housing shall provide ample airflow for generator set operation at rated load in an ambient temperature of 100F. The housing shall have hinged access doors as required to maintain easy access for all operating and service functions. All doors shall be lockable, and include retainers to hold the door open during service. Enclosure roof shall be cambered to prevent rainwater accumulation. Openings shall be screened to limit access of rodents into the enclosure. All electrical power and control interconnections shall be made within the perimeter of the enclosure.

2. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturers standard color using a two step electrocoating paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating that meets the following requirements:

   Primer thickness, 0.5-2.0 mils. Top coat thickness, 0.8-1.2 mils.

   Gloss, per ASTM D523-89, 80% plus or minus 5%. Gloss retention after one year shall exceed 50%.

   Crosshatch adhesion, per ASTM D3359-93, 4B-5B.

   Impact resistance, per ASTM D2794-93, 120-160 inch-pounds.

   Salt Spray, per ASTM B117-90, 1000+ hours.

   Humidity, per ASTM D2247-92, 1000+ hours.

   Water Soak, per ASTM D2247-92, 1000+ hours.

3. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.

4. Enclosure shall be constructed of minimum 3.2mm aluminum panels. All hardware and hinges shall be stainless steel.

5. A factory-mounted exhaust silencer shall be installed inside the enclosure. The exhaust shall exit the enclosure through a rain collar and terminate with a rain cap. Exhaust connections to the generator set shall be through seamless flexible connections.

6. The enclosure shall include the following maintenance provisions:

   a. Flexible coolant and lubricating oil drain lines that extend to the exterior of the enclosure with internal drain valves;

   b. External radiator fill provision.

PART 3 - OPERATION

3.01 SEQUENCE OF OPERATION

A. Generator set shall start on receipt of a start signal from remote equipment. The start signal shall be via hardwired connection to the generator set control and a redundant signal over the required network connection.

B. The generator set shall complete a time delay start period as programmed into the control.

C. The generator set control shall initiate the starting sequence for the generator set. The starting sequence shall include the following functions:

   1. The control system shall verify that the engine is rotating when the starter is signaled to operate. If the engine does not rotate after two attempts, the control

system shall shut down and lock out the generator set, and indicate "fail to crank" shutdown.

2. The engine shall fire and accelerate as quickly as practical to start disconnect speed. If the engine does not start, it shall complete a cycle cranking process as described elsewhere in this specification. If the engine has not started by the completion of the cycle cranking sequence, it shall be shut down and locked out, and the control system shall indicate "fail to start".

3. The engine shall accelerate to rated speed and the alternator to rated voltage. Excitation shall be disabled until the engine has exceeded programmed idle speed, and regulated to prevent over voltage conditions and oscillation as the engine accelerates and the alternator builds to rated voltage.

D. On reaching rated speed and voltage, the generator set shall operate as dictated by the control system in isochronous, synchronize, load share, load demand, or load govern state.

E. When all start signals have been removed from the generator set, it shall complete a time delay stop sequence. The duration of the time delay stop period shall be adjustable by the operator.

F. On completion of the time delay stop period, the generator set control shall switch off the excitation system and shall shut down.

1. Any start signal received after the time stop sequence has begun shall immediately terminate the stopping sequence and return the generator set to isochronous operation.

PART 4 - OTHER REQUIREMENTS

4.01 FACTORY TESTING

A. The generator set supplier shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be provided. Equipment supplied shall be fully tested at the factory for function and performance.

B. Factory testing may be witnessed by the owner and consulting engineer. Costs for travel expenses will be the responsibility of the owner and consulting engineer. Supplier is responsible to provide two weeks notice for testing.

C. Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and function of safety shutdowns.

4.02 INSTALLATION

A. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with

manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

B. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

C. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.

D. Equipment shall be initially started and operated by representatives of the manufacturer.

E. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to final testing of the system.

4.03 ON-SITE ACCEPTANCE TEST

A. The complete installation shall be tested for compliance with the specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests.

B. Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two hour full load test, and a one step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.

C. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

4.04 TRAINING

A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

4.05 SOFTWARE

A. If proprietary software is required to program generator, Contractor shall provide a copy of the software and any applicable licenses required.

4.06 SERVICE AND SUPPORT

A. The manufacturer of the generator set shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

B. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of

critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

C. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

4.07 WARRANTY

A. The generator set and associated equipment shall be warranted for a period of not less than 5 years from the date of commissioning against defects in materials and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

4.08 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Cost of all work and materials specified in this Section shall be included within the lump sum bid amount for the Standby Generator and Transfer Switch as stated on the Bid Form. Payment shall include compensation for furnishing and installing the specified generator set and automatic transfer switch as well as any associated items necessary for a complete installation.

END OF SECTION

SECTION 16270 – TRANSFORMERS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Work includes providing and installing the transformer(s) as shown on the drawings and specified herein.

1.02 REFERENCE SECTIONS

A. ANSI C37.47 - Specifications for Distribution Fuse Disconnecting Switches, Fuse Supports, and Current-Limiting Fuses.

B. ANSI/IEEE C57.13 - Requirements for Instrument Transformers.

1.03 SUBMITTALS

A. Submit shop drawings under provisions of SECTION 16050, and meeting the requirements of Section 01300.

B. Submit shop drawings indicating outline dimensions, connection and support points, weight, specified ratings and materials.

C. Submit product data under the provisions of SECTION 16010.

D. Submit product data indicating standard model design tests and options.

E. Submit manufacturer's installation instructions under provisions of SECTION 16010.

PART 2 PRODUCTS

2.01 DRY TYPE TRANSFORMERS

A. General: Provide all power transformer equipment as shown on the drawings in conformance with the following specification. All transformers shall be built in accordance with the latest revised IEEE, ANSI and NEMA standards.

B. Temperature rating: On all transformers, case temperature shall not exceed 30° C rise above an ambient temperature of 40° C. Terminal compartment shall be located to ensure termination of cable leads in temperature levels not to exceed 60° C. Transformers shall be designed for full load operation at a maximum temperature rise of 115° C.

C. Enclosure: For general application, enclosures shall be drip-proof and rodent-proof. Ventilating openings shall be louvered; screening will not be acceptable. Design shall incorporate a built-in vibration dampening system. Finish shall be ANSI 60. Conform to the limited access requirements where applicable.

D. Taps: Furnish four taps, two above and two below rated voltage, each 2 1/2 percent, for ratings above five (5) kVA.

E. Tests: Provide routine tests as listed and described in ANSI specification No. C57.12.00, latest edition. Sound level tests shall be performed on the complete transformer

assembly in accordance with the latest NEMA standards. Transformer 0-50 kVA shall conform to NEMA standards.

F. Transformer to be placed within Filter and Control Building shall be:

1. 277/480 Volts Wye Primary, 120/208 Volts Wye Secondary
2. 15 kVA
3. 115° C temperature rise
4. Wall mounted
5. Minimum K-Factor of 13.
6. Three Phase
7. Federal Pacific Catalog T4T15BK13E; or equal.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements are as shown.

B. Verify that required utilities are available, in proper location and ready for use.

C. Beginning of installation means installer accepts conditions.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install safety labels to NEMA 260.

C. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

3.03 FIELD QUALITY CONTROL

A. Test transformer to ANSI/IEEE C57.12.90.

3.04 ADJUSTING

A. Adjust primary taps so that secondary voltage is within 2 percent of rated voltage.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Unless otherwise specified on the Bid Form, all items specified in this section are to be included within the lump sum bid for Electrical Improvements as stated on the Bid Form. No additional payment will be made for items in this section.

END OF SECTION

SECTION 16410– ENCLOSED SWITCHES AND BREAKERS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide all disconnects, fused and unfused, required by code for equipment furnished under this and other Divisions of these specifications.

PART 2 - PRODUCTS

2.01 DESCRIPTION

A. Switch shall be heavy duty type, shall be quick-make, quick-break and shall be horsepower rated. Switch shall have copper blades as required to open all ungrounded conductors and shall be single throw unless noted.

B. Enclosure shall have interlocking cover to prevent opening door when switch is closed. Interlock shall include a defeating scheme.

C. Enclosure shall be suitable for location in which mounted.

D. Fusible disconnects shall be as above with addition of fuse space and clips to accept only Class R fuses.

E. Enclosure shall have provisions for a padlock.

F. Labels.

1. All labels shall be laminated plastic and attached directly to the cover.

2. Include the following information on the labels: Load served, proper voltage and phase.

G. Main disconnect for new Control Building shall be:

1. Minimum 480 VAC, 200 amp rated.

2. NEMA Type 3R.

3. Non-fusible.

4. Three Phase w/ Neutral

5. Siemens Catalog Number HF364NR; or equal.

PART 3 - EXECUTION AND WORKMANSHIP

3.01 MOUNTING

A. Secure solidly to wall or approved mounting frame. Disconnects supported only by raceway are not acceptable.

PART 4 - SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Costs for all items in this Section shall be included within the lump sum price for Electrical Improvements Complete as stated in the Bid Form. No additional payment will be made for this item.

END OF SECTION

SECTION 16411– FUSES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide all fuses as required. Fuses shall be UL Class R rejection type with characteristics noted below unless otherwise noted in the diagrams.

PART 2 - PRODUCT

2.01 DESCRIPTION

A. Fuses. All fuses shall be current limiting type unless specified otherwise. Class K1 for all except motor circuits; Class K5 motor load type for motors. Provide 10% spare fuses, but not less than ten (10) of any one size and type.

B. Provide a laminated plastic label and attach directly to the cover of fused enclosures.

PART 3 - EXECUTION

3.01 DESCRIPTION

A. Fuses. Install in all fusible devices provided under this contract.

PART 4 - SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Costs for all items in this Section shall be included within the lump sum price for Electrical Improvements Complete as stated in the Bid Form. No additional payment will be made for this item.

END OF SECTION

DIVISION 16415 – AUTOMATIC TRANSFER SWITCH (ATS)

PART 1 - GENERAL

1.01 SCOPE

A. Provide complete factory assembled power transfer equipment with field programmable digital electronic controls designed for fully automatic operation and including: surge voltage isolation, voltage sensors on all phases of both sources, linear operator, permanently attached manual handles, positive mechanical and electrical interlocking, and mechanically held contacts for both sources.

B. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for all the products provided. Technicians specifically trained to support the product and employed by the generator set supplier shall service the transfer switches. Technicians shall have passed qualification examinations on the product, and be certified by the manufacturer as capable of effectively servicing the equipment provided.

1.02 RELATED SECTIONS

A. Section 16230 – Standby Generator

B. Division 16 – Electrical

1.03 CODES AND STANDARDS

A. The automatic transfer switch installation and application shall conform to the requirements of the following codes and standards:

1. CSA 282, Emergency Electrical Power Supply for Buildings.

2. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.

3. NFPA99 – Essential Electrical Systems for Health Care Facilities

4. NFPA110 – Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems.

5. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.

6. NEMA ICS10-1993 – AC Automatic Transfer Switches.

B. The transfer switch assembly shall comply with the following standards:

1. CSA C22.2, No. 14 – M91 Industrial Control Equipment.

2. EN55011, Class B Radiated Emissions

3. EN55011, Class B Conducted Emissions

4. IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity.

5. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity

6. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity

7. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity

8. IEC 1000-4-6 Conducted Field Immunity

9. IEC 1000-4-11 Voltage Dip Immunity.

10. IEEE 62.41, AC Voltage Surge Immunity.

11. IEEE 62.45, AC Voltage Surge.

12. UL1008 – Transfer Switches. Transfer switches shall be UL1008 listed. UL1008 transfer switches may be supplied in UL891 enclosures if necessary to meet the physical requirements of the project.

C. The transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.04 ACCEPTABLE MANUFACTURERS

A. The Automatic Transfer Switch shall be provided by the same supplier that supplies the onsite generation equipment as a package.

B. Acceptable manufacturers of automatic transfer switches include Cummins, Onan, Caterpillar, Kohler or preapproved equal.

PART 2 - PRODUCTS

2.01 POWER TRANSFER SWITCH

A. Ratings

1. Refer to the project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, number of poles, voltage and ampere ratings, enclosure type, and accessories.

2. Main contacts shall be rated for 600 Volts AC minimum.

3. Transfer switches shall be rated to carry 100 percent of rated current continuously in the enclosure supplied, in ambient temperatures of 40 to +60 degrees C, relative humidity up to 95% (non condensing), and altitudes up to 10,000 feet (3000M).

4. Transfer switch equipment shall have withstand and closing ratings (WCR) in RMS symmetrical amperes greater than the available fault currents shown on the drawings and at the specified voltage. The transfer switch and its upstream protection shall be coordinated. The transfer switch shall be third party listed and labeled for use with the specific protective device(s) installed in the application.

B. Construction

1. Transfer switches shall be double throw, electrically and mechanically interlocked, and mechanically held in the source 1 and source 2 positions. The transfer switch shall be specifically designed to transfer to the best available source if it inadvertently stops in a neutral position.

2. Transfer switches rated through 1000 amperes shall be equipped with permanently attached manual operating handles and quick break, quick make over center contact mechanisms. Transfer switches over 1000 amperes shall be equipped with manual operators for service use only under de-energized conditions.

3. Main switch contacts shall be high pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.

4. Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism.

5. Power transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with components that could be operating at line voltage levels.

6. Transfer switches designated on the drawings as 4 pole shall be provided with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a common crossbar. Substitute equipment using overlapping neutral contacts is not acceptable.

7. Enclosures shall be UL tested and NEMA 1 type rated. The enclosure shall provide NEC wire bend space when both sources and the load are all connected from either the top or bottom of the transfer switch. The cabinet door shall be key-locking.

C. Connections

1. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.

2. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.

2.02 TRANSFER SWITCH CONTROL

A. Operator Panel. Each transfer switch shall be provided with a control panel to allow the operator to view the status and control operation of the transfer switch. The operator panel shall be a sealed membrane panel rated NEMA 3R/IP53 or better (regardless of enclosure rating) that is permanently labeled for switch and control functions. The operator panel shall be provided with the following features and capabilities.

1. High intensity LED lamps to indicate the source that the load is connected to (source 1 or source 2); and which source(s) are available. Source available LED

indicators shall operate from the control microprocessor to indicate the true condition of the sources as sensed by the control.

2. High intensity LED lamps to indicate that the transfer switch is "not in auto" (due to control being disabled or due to bypass switch (when used) enabled or in operation) and "Test/Exercise Active" to indicate that the control system is testing or exercising the generator set.

3. "OVERRIDE" pushbutton to cause the transfer switch to bypass any active time delays for start, transfer, and retransfer and immediately proceed with its next logical operation.

4. "TEST" pushbutton to initiate a preprogrammed test sequence for the generator set and transfer switch. The transfer switch shall be programmable for test with load or test without load.

5. "RESET/LAMP TEST" push-button that will clear any faults present in the control, or simultaneously test all lamps on the panel by lighting them.

6. The control system shall continuously log information on the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. This information shall be available via a PC-based service tool and an operator display panel.

7. Analog AC meter display panel, to display AC Amps, AC Volts, Hz, KW load level, and load power factor. The display shall be color-coded, with green scale indicating normal or acceptable operating level, yellow indicating conditions nearing a fault, and red indicating operation in excess of rated conditions for the transfer switch.

8. Vacuum fluorescent alphanumeric display panel with push-button navigation switches. The display shall be clearly visible in both bright (sunlight) and no light conditions. It shall be visible over an angle of at least 120 degrees. The Alphanumeric display panel shall be capable of providing the following functions and capabilities:

    a. Display source condition information, including AC voltage for each phase of normal and emergency source, frequency of each source. Line to neutral voltages shall be displayed.

    b. Display source status, to indicate source is connected or not connected.

    c. Display load data, including AC voltage, AC current, frequency, KW, KVA, and power factor. Voltage and current data for all phases shall be displayed on a single screen.

    d. The display panel shall allow the operator to view and make the following adjustments in the control system, after entering an access code:

        i. Set nominal voltage and frequency for the transfer switch.
        ii. Adjust voltage and frequency sensor operation set points.
        iii. Set up time clock functions.
        iv. Set up load sequence functions.
        v. Enable or disable control functions in the transfer switch, including program transition.

vi. Set up exercise and load test operation conditions, as well as normal system time delays for transfer time, time delay start, stop, transfer, and retransfer.

e. Display Real time Clock data, including date, and time in hours, minutes, and seconds. The real time clock shall incorporate provisions for automatic daylight savings time and leap year adjustments. The control shall also log total operating hours for the control system.

f. Display service history for the transfer switch. Display source connected hours, to indicate the total number of hours connected to each source. Display number of times transferred, and total number of times each source has failed.

g. Display information for other transfer switches in the system, including transfer switch name, real time load in KW on the transfer switch, current source condition, and current operating mode.

h. Display fault history on the transfer switch, including condition, and date and time of fault. Faults to include controller checksum error, low controller DC voltage, ATS fail to close on transfer, ATS fail to close on retransfer, battery charger malfunction, network battery voltage low, network communications error.

B. Internal Controls

1. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600VAC. Provide RMS voltage sensing and metering that is accurate to within plus or minus 1% of nominal voltage level. Frequency sensing shall be accurate to within plus or minus 0.2%. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.

2. Transfer switch voltage sensors shall be close differential type, providing source availability information to the control system based on the following functions:

a. Monitoring all phases of the normal service (source 1) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of normal voltage level).

b. Monitoring of the emergency service (source 2) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of pickup voltage level).

c. Monitoring of the normal service (source 1) and emergency service (source 2) for voltage imbalance.

d. Monitoring of the normal service (source 1) and emergency service (source 2) for loss of a single phase.

e. Monitoring of the normal service (source 1) and emergency service (source 2) for phase rotation.

f. Monitoring of the normal service (source 1) and emergency service (source 2) for over voltage conditions (adjustable for dropout over a range of 105 to 135% of normal voltage, and pickup at 95-99% of dropout voltage level).

g. Monitoring of the normal service (source 1) and emergency service (source 2) for over or under frequency conditions.

h. Monitoring the neutral current flow in the load side of the transfer switch. The control shall initiate an alarm when the neutral current exceeds a preset adjustable value in the range of 100-150% of rated phase current for more than an adjustable time period of 10 to 60 seconds.

3. All transfer switch sensing shall be configurable from a Windows PC-based service tool, to allow setting of levels, and enabling or disabling of features and functions. Selected functions including voltage sensing levels and time delays shall be configurable using the operator panel. Designs utilizing DIP switches or other electromechanical devices are not acceptable. The transfer control shall incorporate a series of diagnostic LED lamps.

4. The transfer switch shall be configurable to control the operation time from source to source (program transition operation). The control system shall be capable of enabling or disabling this feature, and adjusting the time period to a specific value. A phase band monitor or similar device is not an acceptable alternate for this feature.

5. The transfer switch shall incorporate adjustable time delays for generator set start (adjustable in a range from 0-15 seconds); transfer (adjustable in a range from 0-120 seconds); retransfer (adjustable in a range from 0-30 minutes); and generator stop (cooldown) (adjustable in a range of 0-30 minutes).

6. The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device to prevent transfer to the generator service.

7. The transfer switch shall provide a relay contact signal prior to transfer or retransfer. The time period before and after transfer shall be adjustable in a range of 0 to 50 seconds.

8. The control system shall be designed and prototype tested for operation in ambient temperatures from -40C to +70C. It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.

9. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.

10. The transfer switch network monitoring equipment, when supplied, shall be provided with a battery based auxiliary power supply to allow monitoring of the transfer switch when both AC power sources are non-operational. The battery power supply shall be monitored for proper condition, and the transfer switch shall include an alarm condition to indicate low battery condition.

C. Control Interface

1. The transfer switch will provide an isolated relay contact for starting of a generator set. The relay shall be normally held open, and close to start the generator set. Output contacts shall be form C, for compatibility with any generator set.

2. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.

3. The transfer switch shall provide relay contacts to indicate the following conditions: source 1 available, load connected to source 1, source 2 available, source 2 connected to load.

4. The transfer switch shall be provided with an Ethernet port for SCADA monitoring and control of the Generator set.

2.03 ENCLOSURE

A. Enclosures shall be UL listed. The enclosure shall provide wire bend space in compliance to the latest version of NFPA70. The cabinet door shall include permanently mounted key type latches.

B. Transfer switch equipment shall be provided in a NEMA 1 or better enclosure.

C. Enclosures shall be the NEMA type specified. The cabinet shall provide code-required wire bend space at point of entry as shown on the drawings. Manual operating handles and all control switches (other than key operated switches) shall be accessible to authorized personnel only by opening the key locking cabinet door. Transfer switches with manual operating handles and/or non key operated control switches located on outside of cabinet do not meet this specification and are not acceptable.

PART 3 - OPERATION

3.01 OPEN TRANSITION SEQUENCE OF OPERATION

A. Transfer switch normally connects an energized utility power source (source 1) to loads and a generator set (source 2) to the loads when normal source fails. The normal position of the transfer switch is source 1 (connected to the utility), and no start signal is supplied to the genset.

B. Generator Set Exercise (Test) With Load Mode. The control system shall be configurable to test the generator set under load. In this mode, the transfer switch shall control the generator set in the following sequence:

1. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.

2. The transfer switch shall issue a compatible start command to the generator set, and cause the generator set to start and run at idle until it has reached normal operating temperature.

3. When the generator set has reached normal operating temperature or after an adjustable time period (whichever is shorter), the control system shall accelerate the generator set to rated voltage and frequency.

4. When the control systems senses the generator set at rated voltage and frequency, it shall operate to connect the loads to the generator set by opening the normal source contacts, and closing the alternate source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.

5. The generator set shall operate connected to the load for the duration of the exercise period. If the generator set fails during this period, the transfer switch shall automatically reconnect the loads to the normal service.

6. On completion of the exercise period, the transfer switch shall operate to connect the loads to the normal source by opening the alternate source contacts, and closing the normal source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.

7. The transfer switch shall operate the generator set unloaded for a cooldown period, and then remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

C. Generator Set Exercise (Test) Without Load Mode. The control system shall be configurable to test the generator set without transfer switch load connected. In this mode, the transfer switch shall control the generator set in the following sequence:

1. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.

2. The transfer switch shall issue a compatible start command to the generator set, and cause the generator set to start and run at idle until it has reached normal operating temperature.

3. When the generator set has reached normal operating temperature or after an adjustable time period (whichever is shorter), the control system shall accelerate the generator set to rated voltage and frequency.

4. When the control systems senses the generator set at rated voltage and frequency, it shall operate the generator set unloaded for the duration of the exercise period.

5. At the completion of the exercise period, the transfer switch shall remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

PART 4 - OTHER REQUIREMENTS

4.01 FACTORY TESTING.

A. The transfer switch manufacturer shall perform a complete operational test on the transfer switch prior to shipping from the factory. A certified test report shall be available on request. Test process shall include calibration of voltage sensors.

4.02 SERVICE AND SUPPORT

A. The manufacturer of the transfer switch shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

B. The transfer switch shall be serviced by a local service organization that is trained and factory certified in both generator set and transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

C. The manufacturer shall maintain model and serial number records of each transfer switch provided for at least 20 years.

D. The manufacturer shall supply to the facility owner two (2) complete sets of service and maintenance software for use in properly supporting the product. The software shall be provided at a training class attended by the user, to qualify the user in proper use of the software. The software shall have the following features and capabilities:

1. The software shall be Windows compatible.

2. The software shall use the Windows "Explorer" format, for ease of use and commonality with other software in use at the facility.

3. The software shall allow adjustment of all functions described herein via the tool; adjustment of operating levels of all protective functions; and programming of all optional functions in the controller. Adjustments shall be possible over modem from a facility that is remote from the generator set.

4. The software shall allow simulation of fault conditions, to verify operation of all protective devices

5. The software shall include the ability to store and display data for any function monitored by the generator set control. This data shall be available in common file formats, and on graphical "strip chart" displays.

6. The software shall automatically record all control operations and adjustments performed by any operator or software user, for tracking of changes to the control.

7. The software shall display all warning, shutdown, and status changes programmed into transfer switch controller. For each event, the control shall provide information on the nature of the event, when it last occurred, and how many times it has occurred.

8. The software shall include detailed operation and service information on the specific generator set supplied, so that no other documentation (other than schematic and wiring diagram drawings) is necessary for service of the product.

E. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

4.03 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Cost of all work and materials specified in this Section shall be included within the lump sum bid amount for the Standby Generator and Transfer Switch as stated on the Bid Form. Payment shall include compensation for furnishing and installing the specified generator set and automatic transfer switch as wall as any associated items necessary for a complete installation.

END OF SECTION

SECTION 16420 – ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide a complete control system, including motor controls, PLC, HMI, autodialer, relay controls and running software. The running software (ladder logic, screen setups, etc., shall be provided by the Software Integrator under another Section). Provide the PLC hardware and assemblies consisting of all the components shown in the diagrams along with manuals, cables, program development software, O&M manuals, etc., to implement the control system.

B. System shall operate on an Ethernet based system to allow future integration into a city-wide SCADA system as describe in the SCADA Master Plan.

C. Provide a Master Control Panel (MCP) as shown on the drawings, for housing the PLC and general control circuits.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. The City requires that the PLC, HMI, and associated equipment be manufactured by Allen-Bradley, model and series as specified. No substitutions or schematic changes will be accepted without approval by the Engineer.

B. The Contractor shall provide an integrated control system which shall be the product of one manufacturer who has had at least five years experience in furnishing similar equipment. It shall be completely tested and inspected prior to shipment. All equipment shall be guaranteed against defects of materials and workmanship for a period of one year from date of job acceptance. Manufacturer shall maintain a service organization in Oregon with factory trained personnel available, and who shall stock parts for this equipment. Control system shall be UL508 labeled.

2.02 COMPONENTS

A. Provide all controls and automation equipment necessary to make a completely functional system.

B. Provide all equipment shown on the contract drawings.

C. Provide loop isolators as may be required, whether shown on the drawings or not.

D. Provide intrinsically safe barriers and relays as may be required. See drawings.

E. Laminated nameplates shall indicate all controller operations and shall label all panels and enclosures. See the electrical drawings for the ID tag schedule.

1. Panel Nameplates. Material shall be laminated plastic fastened to the panel with stainless steel screws. Letters ½" white on black background.

2. Component Nameplates. Material shall be laminated plastic fastened by adhesive. Letters 3/16" white on black background.

F. Stainless Steel Equipment ID Tags shall identify miscellaneous equipment. See the electrical drawings for the ID tag schedule. Devices shall be tagged with engraved or embossed stainless steel tags attached by stainless steel beaded chain.

G. All painting shall be in a first class craftsmanship manner. Paint finish shall be smooth and free from rough surfaces such as sand, dust and scratches.

H. Panels arriving to job site shall be inspected for scratches, dents, etc. Any panel found unacceptable shall be returned to panel manufacturer for repainting at panel suppliers and manufacturer's expense.

I. Components shall be DIN rail mountable.

J. A panel mounted MOV surge protector shall be installed to protect all electronics.

K. Battery backup in the form of a UPS (Uninterruptable Power Supply) shall be provided and shall maintain 10 Amps of current at 24 Volts for 15 minutes. It is acceptable to provide a UPS integrated into the power supply. Supply must have a MTBF of 200,000 hrs minimum according to MIL-HDBK-217F.

2.03 PLC MODULES. SEE DIAGRAMS.

A. PLC manufacturer shall be Allen Bradley, model series CompactLogix 1769-L23E-QBFC1B; or approved equal.

B. PLC shall communicate with a minimum of one Ethernet/IP port and one RS-232 port.

C. A minimum of 8 analog inputs (4-20mA), 32 digital inputs (24V), 16 digital outputs (24V), 2 analog outputs shall be provided. Contractor shall provide expansion modules as needed to meet the requirements of the control system.

D. PLC modules shall operate on 24V DC power. Power supplies of the same manufacturer shall be provided to meet the power consumption of all panel components and the PLC.

E. A minimum of 512KB of user memory shall be available.

2.04 AUTODIALER

A. Autodialer shall be Express II as manufactured by Sensaphone.

B. Autodialer shall be capable of communicating over landline phone..

C. Upon receipt of one or more critical alarm trips, electronic system will automatically dial out onto phone system (up to 48 specified telephone numbers from one of 3 phone lists) with pre-programmed messages.

D. System shall continue calling until call completed and acknowledged.

E. Physical Inputs: Units requiring physical inputs shall be field upgradeable to incorporate from 8 to 40 dry contacts or analog inputs in any combination. Any input in violation of a normal condition shall cause the unit to go into alarm status and begin the dial-out sequence.

F. The dialer shall be covered by a one(1) year warranty covering parts and labor performed at the Factory.

G. Dialer shall have a 12 hour battery backup.

H. Unit shall have an RS232 port for printer or datalogging connections.

I. A user shall be able to view the current status of the remote unit through the Internet, request an immediate update of the status and set pre-defined times that the status should automatically be transferred and stored on the Internet.

J. Mandatory Alarm Sets:

1. Wetwell Overflow
2. Wetwell Hi Level
3. Wetwell Lo Level
4. Pump Failure
5. PLC Failure
6. Power Failure
7. Generator Failure
8. Intrusion Alarm

K. Alarms can be communicated from PLC outputs but Wetwell Hi Level and Wetwell Overflow must also be hardwired to alarms in case of PLC failure

2.05 HMI DISPLAY

A. HMI Display shall be Allen Bradley, model Panelview Plus 1000; or approved equal.

B. Display shall be touch style color screen with a minimum display size of 10".

C. Display resolution shall be a minimum of 640x480 with 16 bit color depth.

D. HMI shall be mounted to the front of the PLC enclosure for access by operators.

E. Screen shall have a field replaceable backlight

F. A battery backup real time clock shall be supplied and timestamp critical data.

G. Memory shall be supplied through flash RAM.

2.06 PLC SOFTWARE PROGRAMMING. SEE SECTION 16421.

PART 3 - EXECUTION

3.01 COORDINATION W/ SOFTWARE INTEGRATOR

A. Electrical Contractor shall coordinate with and provide assistance to the Software Integrator (programmer) (see Section 16421).

END SECTION

SECTION 16421 – PLC, HMI, AND SCADA PROGRAMMING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Complete System. The Contractor shall provide a complete, functioning, finished control system, including ladder logic programs for the PLC, custom designed operator interface screens for the HMI, and a tags memory space in the PLC for transferring status and alarms over the radio telemetry system. The finished work shall be operator-friendly and acceptable to the Engineer and Customer.

1.02 WORK INCLUDED

A. Program the PLC and all PLC modules.

B. Program the HMI.

C. Program the Autodialer.

D. Produce a basic users manual.

E. Program the system so that in the future it is ready to connect to a SCADA system.

1.03 PAYMENT FOR WORK.

A. Payment for work under this Division shall be covered and included as part of the lump sum for Electrical on the project, or as outlined under any schedules.

PART 2 - PRODUCTS

2.01 PURCHASED MATERIALS

i. The Contractor shall supply all cables, manuals, etc., necessary for the completion of the work. The Software Integrator will not be responsible for purchasing any materials.

PART 3 - EXECUTION

3.01 DELIVERED DOCUMENTATION.

A. Provide (3) binders, each containing the following:

1. CD w/ copies of all the files developed under this section

2. Control Manual, describing how to use the controls and a listing of alarm messages and their meanings w/ troubleshooting tips.

3. PLC ladder logic listings, fully annotated and commented.

4. HMI screen shots and configuration listings.

5. Autodialer configurations and manual.

3.02 HMI OPERATIONS

A. Operator Interface Terminals (HMI). The HMIs shall display information in a graphic, pictorial, format. Status and set-point screens shall be available by intuitive screen navigation buttons.

B. Processes Monitored. The PLCs shall be programmed to monitor and display on the operator interface terminal wet well levels, flows, pump status, running times, alarms, etc.

3.03 PLC OPERATIONS

General. The PLC shall be programmed to automatically resume plant operations after a power interruption and to bring all plant loads online in a sequential fashion so as to prevent high peak power loading. This timed startup shall be executed on each load that has its MCC selector switch set to AUTO (or REMOTE). Loads which are in HAND or MANUAL shall not be under PLC control. The PLC shall keep track of running time of all monitored loads and present that information on appropriate HMI screen(s) even if there is a physical elapsed time meter connected to the load. Each load that is running in AUTO (or REMOTE) and is therefore under PLC control shall be automatically stopped if the PLC detects a loss of phase or overload.

A. Effluent Pumps. The PLC shall control the effluent pumps as described in Section 17500: "Operational and Alarm Strategy."

3.04 PLC ALARM FUNCTIONS.

A. General. The PLC shall monitor the status of the pumps and equipment and report phase loss failures, overloads, failure to run, high or low wet wells, power outages, last pump is running, overflow, loss of standby pump, etc. When an alarm condition is detected the PLC shall display the alarm status screen on the HMI, turn on the horn (if available) and the ALARM light.

B. Scope. Alarms shall be processed for all pertinent inputs available to the PLC.

3.05 COMPLETE SYSTEM.

A. This Division contains a rudimentary description of the PLC, HMI and PC software. The Contractor shall be responsible for designing a complete software system that is documented, operator-friendly and acceptable to the Customer and Engineer.

END OF SECTION

SECTION 16424 – VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.01 SCOPE

A. Provide variable frequency drives (VFDs) for devices as indicated on drawings or other Sections of Specifications. Locate as per drawings.

1.02 CODES AND STANDARDS

A. The Drive manufacturing facility shall be ISO 9001 and 14001 certified.

B. The VFD shall be UL listed.

1.03 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers are Allen Bradley Powerflex 400.

1.04 SUBMITTALS

A. The Variable Frequency Drive proposed for this Section must be pre-approved through the pre-bid submittal process as outlined in Section 01300.

1.05 TESTING AND QUALITY ASSURANCE

A. All printing circuit boards shall be completely testing and burned-in before being assembled into the completed Drive. The Drive shall then be subjected to a preliminary functional test, minimum one hour burn-in and computerized final test. The burn-in shall be at 104°F, at full rated load, or cycled load. Drive input power shall be continuously cycled for maximum stress and thermal variation.

B. Drive manufacturer shall conduct complete electrical testing, component x-ray, component decap or delamination and failure analysis by qualified individuals in the case of drive component failure.

PART 2 - PRODUCTS

2.01 DRIVE GENERAL REQUIREMENTS

A. Drive shall be solid state, with a Pulse Width Modulated (PWM) output. The drive shall be a Sensorless Vector AC to AC converter utilizing isolated gate bipolar transistor (IGBT) technology. Drive shall employ a Sensorless Vector inner loop torque control strategy that mathematically determines motor torque and flux. The drive must also provide an optional operational mode for V/Hx or closed loop Flux Vector Operation. Drive shall be supplied with integral input disconnect switch and fast acting, current limiting fuses.

B. Control Function and Adjustment

1. Start up data entries shall include motor nameplate power, speed, voltage, frequency and current.

2. A motor parameter ID function shall automatically define the motor equivalent circuit used by the sensorless vector torque controller.

3. Independent PID speed/torque loop regulators shall be provided with an auto-tune function as well as manual adjustments.

4. Carrier frequency shall be adjustable between 1 and 12 kHz. The VFD shall automatically adjust to the highest carrier frequency based on drive temperature and load.

5. The VFD shall be capable of starting into a coasting load (forward or reverse) and accelerate or decelerate to reference without safety tripping or component damage (flying start). The VFD shall also be capable of flux braking at start in order to stop a reverse spinning motor prior to ramp.

6. The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.

7. Accel/Decel control functions shall include two sets of ramp time adjustments with linear and two s-curve ramp selections.

8. Drive shall be controlled by a remote PLC over network communication for normal operation. In addition manual controls shall be initiated by an emergency bypass float and relay control system as shown in Contract drawings.

9. Drive shall be mounted in a UL listed Nema 12 gasketed enclosure provided with cooling fans. The enclosure shall include line reactors, contactors, hand/off/auto controls, a bypass and test mode and house additional controls needed for emergency functions.

10. Drive cabinet shall be hinged with a latching handle mechanism to access the drive and electrical connections.

11. Drive shall include a main circuit breaker disconnect with a rating according to manufacturers recommendations.

12. Bypass Switch, Hand/Off Auto Switch, Main Breaker Disconnect, Operator Interface, and mode indicating lights shall be accessible from exterior of drive enclosure without opening the cabinet.

C. Ratings and Protective Functions

1. Drive shall be rated to operate from 3-phase power at 480 VAC and 60 Hz. Drive shall employ a full wave rectifier to prevent input line notching and operate at a fundamental (displacement) input power factor of 0.95 at all speeds and loads. Drive efficiency shall be 96% or better at full speed and load.

2. Drive shall be sized to power a 25HP motor in 3-phase applications..

3. An internally mounted, 5% impedance AC line reactor or DC choke shall be provided to reduce input current harmonic content, provide protection from power transients and reduce RFI emissions. DC choke shall be swinging choke design and shall provide a minimum of 5% impedance.

4. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute out of 10 minutes, 180% overload for 2 seconds out of 1 minute, with an instantaneous over-current trip at 350% or higher. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.

5. The VFD shall include internal MOV's for phase to phase and phase to ground line voltage transient protection.

6. Open loop static speed regulation shall be 0.5% to 1% of rated motor speed. When motor speed feedback is provided from a suitable encoder, closed loop speed regulation shall be 0.01% or better. Dynamic speed accuracy shall be 3%-sec or better open loop and 0.3%-sec or better closed loop.

7. Torque response time shall be 10 ms or less. In the torque regulating mode, torque regulating accuracy shall be 5% or better.

8. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and audible motor noise.

9. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows the highest carrier frequency without derating the VFD or operating at high carrier frequency only at low speeds.

10. The drive shall include electronic motor overload protection qualified per UL508C.

11. Protection shall be provided for AC line or DC bus over-voltage at 130% of maximum rated or under-voltage at 65% of minimum rated and input phase loss.

12. A power loss ride through feature shall allow the drive to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor and load.

13. Over-temperature protection shall provide a warning if the power module temperature is less than 5°C below the over-temperature trip level.

14. The VFD shall be capable of sensing a loss of load (broken coupling) and signal a loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, and relay output. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false under-load condition.

15. A drive input contactor and a drive output contactor shall open and close the connection between the drive and motor.

D. Adjustments and I/O

1. Two programmable analog inputs, each selectable for 0 VAC to 10 VAC or 4mA to 20mA and independently programmable with at least ten input function selection. Analog input signal processing functions shall include scaling adjustments, adjustable filtering and signal inversion. If the input reference is lost, the VFD shall give the user the option of the following:

   a. Stopping and displaying a fault

   b. Running at a programmable preset speed

   c. Hold the VFD speed based on the last good reference received

d. Cause a warning to be issued

The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communication bus.

2. At least two programmable digital inputs shall be available for calling the drive into emergency operation or emergency stop. The inputs shall be capable of receiving a 24 volt signal supplied by the internal supply of the drive.

3. Two analog outputs providing 4 mA to 20 mA signals. Outputs shall be independently programmable to provide signals proportional to at least 12 output function selections including output speed, frequency, voltage, current and power.

4. The drive shall be provided with an Ethernet communications port for default operation and control by station PLC.

5. The VFD shall have two independently adjustable accel and decel ramps with 1 – 1,800 seconds adjustable time ramps.

6. The VFD shall have programmable "Sleep" and "Wake up" functions to allow the drive to be started and stopped from the level of a process feedback signal.

E. Operator Interface (Control Panel)

1. The Keypad shall include a backlit LCD display. The display shall be in complete English words or standard English abbreviations for parameter names, warnings, programming and fault diagnostics (alpha-numeric codes are not acceptable). The keypad shall utilize the following assistants:

   a. All applicable operating values shall be capable of being displayed in engineering (user) units. The display shall be in complete English words (alpha-numeric codes are not acceptable).

2. EMI / RFI filters. All VFDs shall include EMI/RFI filters. The onboard filters shall allow the VFD assembly to be CE Marked and shall meet product standard EN 61800-3 for the First Environment restricted level.

3. The control panel shall provide a real time clock for time stamping events and fault conditions.

4. The standard operator panel shall provide a start-up, maintenance and diagnostic assistants that guides a new user through initial start-up and commissioning of the drive as well as provide indications for maintenance and help to diagnose a fault.

5. Enclosure exterior shall include a 24V mechanical hour meter connected to a drive output and record all pump run times when not in bypass mode.

6. A Hand/Off/Auto switch with indicator light lamps and a Bypass/Test/Run switch with mode indicator lamps shall be provided. Switches and lamps shall be clearly labeled.

7. Operator Interface shall be mounted on exterior of enclosure/MCC for operator use without opening control enclosure.

2.02 SPECIFIED DRIVE MODEL

A. Drive will accept three phase 480VAC input and output to a 3-phase 20Hp motor.

B. Allen Bradley Powerflex 400 Model 22C-D022N103 base drive model.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install as per the contract drawings, manufacturers' recommendations, and in accordance with all applicable code and ordinance.

3.02 START-UP

A. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the Owner and a copy to be kept on file at the service center.

B. Manufacturer's certified personnel shall program the VFDs to match the pump load characteristics to integrate with other systems.

3.03 SUPPORT

A. Factory trained application engineering and service personnel that are thoroughly familiar with the Drive products offered shall be locally available at both the specifying and installation locations.

3.04 WARRANTY

A. Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment. The warranty shall include all parts, labor, travel time and expenses. There shall be 365/24 support available via a toll free phone number.

PART 4 - SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Cost of all work and materials specified in this Section shall be included within the lump sum bid amount for bid item Electrical as stated on the Bid Form. No separate measurement or payment for items in this Section will be allowed.

END OF SECTION

SECTION 16440– SWITCHBOARDS, PANELBOARDS AND MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.01 WORK INCLUDES

A. Provide all equipment shown on the drawings.

B. Provide complete assemblies with main breakers, distribution circuit breakers, sub-distribution panels, motor controls, starters relays, time clocks, switches, controls, etc., in a complete assembly as shown on drawings and outlined in specifications for motor control center assemblies. The Motor Control Center (MCC) shall be manufactured by Siemens/Furnas (Model Tiastar), Allen-Bradley, or as approved by Engineer.

C. Provide circuit breakers with sufficient interrupting capacity per the utility company service available fault current estimate (see drawings for rating).

1.02 REFERENCES

A. Study the contract drawings carefully, including elevation views as well as the one-line drawing.

PART 2 - PRODUCTS

2.01 GENERAL PANEL REQUIREMENTS

A. Main electrical control panels shall be housed in a NEMA 12 gasketed enclosure of the size shown on the contract drawings. Panels shall, in general, be made up of manufacturer's standard depth modules, not to exceed 20", as shown on plans. Deviations may be permitted if uniform panel appearance is presented. All sections of modules including switchgear sections shall be perfectly aligned to look like one complete unit when assembled. Wiring terminal Class II Type C. Panels shall be designed, manufactured, assembled at the factory, and tested in accordance with the latest applicable standard of NEMA, ATEE, and ASA. The vertical sections and the individual units shall bear a UL label as evidence of compliance with UL Standard 845. Service equipment shall be UL labeled as suitable for the application.

B. Laminated nameplates shall indicate all controller operations and the panel shall be primed and painted with Dupont Dulux Alkyd Enamel or approved paint, with custom color. The back panels of draw out units shall be painted white enamel. All painting shall be in a first class craftsmanship manner. Paint finish shall be smooth and free from rough surfaces such as sand, dust and scratches. Custom color selection shall be by Engineer.

C. Panels arriving to job site shall be inspected for scratches, dents, etc. Any panel found unacceptable shall be returned to panel manufacturer for repainting at panel suppliers and manufacturer's expense.

D. The main electrical characteristics of the motor control centers for the project shall be suitable to operate at the voltages, phase and frequency as outlined on the electrical drawings. Electrical characteristics of lighting and distribution panels shall be as shown on drawings. All MCC bus shall be braced to withstand a fault current at the motor control center terminals of 65,000 amperes RMS symmetrical. All bus shall be copper.

E. See electrical drawings for motor control centers layouts and positioning of pilot and other devices. Provide door latches and key locks on full-section doors and others as may be shown on the drawings.

F. Main breaker panel for new Control Building shall be:

1. UL listed for 60/75° C conductors.
2. Copper bus.
3. NEMA Type 12, gasketed.
4. 277/480 VAC, 3-phase, 4-wire, 100 amp rated.
5. Designed for a minimum of 30 single-pole or 10 three-pole branch circuits.
6. Siemens Catalog Number P2E30BL100CBS; or equal.

G. Sub breaker panel for new Control Building shall be:

1. UL listed for 60/75° C conductors.
2. Copper bus.
3. NEMA Type 12, gasketed.
4. 120/208 VAC, 3-phase, 4-wire, 100 amp rated.
5. Designed for a minimum of 18 single-pole or 6 three-pole branch circuits.
6. Siemens Catalog Number P2C18BL100CBS; or equal.

H. Outdoor wetwell panel shall be:

1. UL listed 508 listed.
2. NEMA Type 4X, 316 Stainless, 14 gauge
3. Installed with a interior divider to separate DC and AC signals.
4. Concealed Hinges and ¼ turn latches
5. 24" X 24"x8" in size.
6. 3 point 316SS padlocking handle
7. Termination lugs for the various level and alarm signals as well as the pump power cabling shall be installed inside the panel.
8. Wiegmann Catalog Number N412242408SS3PTC; or equal.
9. Back panel Weigmann Catalog Number NP2424SSC

2.02 PANEL LIGHTING AND DISTRIBUTION BOARDS

A. Panelboards shall have as a minimum the number of branch spaces as listed on the riser diagram or panel schedules listed in this Division or on the diagrams.

B. Panelboards shall be an integral part of the main distribution and MCC unless remote mounted, where they shall be of conventional, wall mounted type. Any mounted outdoors shall be of type and design so as to be protected in that location.

C. Electrical characteristics shall be as listed on Riser Diagram or panel schedule listed in this Division.

D. All breakers shall be bolt in quick-make, quick-break, ambient compensating with a minimum of 10,000 amp interrupting capacity, and as required by code and the interrupting current requirements of the source. General Electric, Square D, Westinghouse, Siemens, Cutler Hammer, or ITE.

E. Identification cards in panel doors shall be machine printed to identify all circuits. Spare blank cards shall also be provided in each door. Panels shall be fitted with flush lift latches and shall have hinges on the side rather than on the top. Outdoor enclosures shall have full piano hinges and shall be gasketed.

F. Ground fault circuit interrupters (GFCI) designed to protect against hazards caused by ground faults shall be compatible with other adjacent breakers in the panel. GFCI shall be used where required by code or where indicated on drawings and in panel schedules. GFCI breakers shall have the same characteristics as breakers described above.

G. Door and key lock. Panels inside lockable buildings shall not require locking doors. All other panels shall require locking doors, keyed alike with the MCC doors.

H. Master keying for cabinet door locks.

I. Engraved nameplate for panelboard.

J. Color to match main distribution panel or adjacent walls. Consult with Engineer.

2.03 CURRENT TRANSFORMER AND METERING CABINETS

A. Acceptable to the serving power company as to size, style, etc.

B. Bar type current transformer cabinet shall be utilized in all cases unless specifically called out differently by serving utility.

C. Single meter cabinet required for Control Building. Cabinet shall be:

1. Designed to receive watt-hour meters that meet ANSI C12.10

2. NEMA 4X construction

3. 600 Volt, 3-phase, 4 wire, 200 amp rated

4. Cooper B-Line, Catalog No. 117SS; or equal.

2.04 CONTROL CENTER CABINETS

A. Acceptable for housing PLC, HMI, control relays, DC power supplies and all communication equipment.

B. Integrated Unit-strut mounting channels welded to body interior for positioning of back panels.

C. Single cabinet required for Control Building. Cabinet shall be:

1. UL 508 listed

2. NEMA 12 construction

3. Single Locking Door floor mounted

4. 60 inches high, 24 inches wide, 18 inches deep

5. Fabricated from 12 gauge steel

6. Wiegmann, Catalog No. WA602418FS; or equal.

PART 3 - EXECUTION

3.01 SUBMITTAL

A. Panelboards shall be ordered which comply with both the one-line drawings and the elevation drawings depicting section assignments. Contractor shall provide a detailed submittal to the Engineer and obtain Engineer's approval of the proposed motor control centers before ordering them. Submittal shall be included in the post-bid submittal package discussed elsewhere in these documents.

3.02 CONDUIT ACCESS

A. Provide proper conduit terminations at locations shown in the drawings or as required for workmanlike routing of conduit runs.

PART 4 - SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Costs for all items in this Section shall be included within the lump sum price for Electrical as stated in the Bid Form. No additional payment will be made for this item.

END OF SECTION

SECTION 16478 – TRANSIENT VOLTAGE SURGE SUPPRESSOR

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The work required under this division shall include all materials, labor and auxiliaries required to and install one surge suppressor for the protection of building electrical and electronic systems from the effects of line and electromagnetic induced transient voltage surges and coupled lightning discharged transients as indicated on drawings or as specified in this section.

1.02 REFERENCE SECTIONS

A. UL 1449 3rd Ed. Sept 2009 – Standard for Safety for Transient Voltage Surge Suppressors

B. ANSI/IEEE C62.41 – Recommended Practice for Sure Voltages in Low Voltage AC Power Circuits

1.03 SUBMITTALS

A. Submit shop drawings under provisions of SECTION 16050, and meeting the requirements of Section 01300.

B. Submit product data under the provisions of SECTION 16010.

C. Submit product data indicating standard model design tests and options.

D. Submit manufacturer's installation instructions under provisions of SECTION 16010.

1.04 QUALIFICATIONS

A. Equipment certification: Items shall be "Listed" by Underwriters Laboratories, Inc. and shall exhibit the UL Listing Mark for the category "Transient Voltage Surge Suppressors" or TVSS. UL Listing Card under category TVSS shall be provided to confirm compliance to UL1449 Second Edition Standard and assigned Suppressed Voltage Ratings.

B. Surge Protective Devices shall be installed and located in accordance with the requirements of all applicable National Fire Protection Association (NFPA) codes. The device shall be installed on the load-side of the main service disconnect per the scope of UL 1449 Standard for Safety for Transient Voltage Surge Suppressors.

C. Manufacture shall have a minimum of ten (10) years of experience in the manufacture and service of TVSS devices.

PART 2 PRODUCTS

2.01 TVSS Surge Protector

A. General: Provide primary service panel TVSS devices as shown on the drawings in conformance with the following specification. All surge devices shall be built in accordance with the latest revised IEEE, ANSI and NEMA standards.

B. Temperature rating: Shall be designed to have an operating temperature from -10 to +60 degrees C.

C. Enclosure: Shall be NEMA 12, or 4X rated.

D. Operating Voltage: Surge Protectors shall be designed for the specific type and voltage of the electrical service as indicated in drawings, and provide suppression for L-L, L-G, L-N of 1000 volts and shall be configured to operate at 277/480 Volt 3-phase Wye.

E. Short circuit rating: 100kA RMS symmetrical amps.

F. Testing: Shall be UL 1449 listed.

G. Diagnostics: Shall include LED lights to indicate operation and alarm. Include dry contact for monitoring

H. Manufacturer: Shall be model RCHW as manufacturer by Meter-Treater; or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions. One single device shall be installed.

B. Install in position as shown in Contract Drawings, connected to the top of the primary service panel, where the transfer switch connection is made.

C. Properly ground connection to conduct surges from the main bus. Wire leads should be short as possible and avoiding tight bends.

D. Use 60 amp 3-pole breaker for panel connection.

E. Installation of this device shall not be construed to eliminate other secondary surge suppression, such as that providing by other equipment, in the control panel, or provided by motor drives.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Unless otherwise specified on the Bid Form, all items specified in this section are to be included within the lump sum bid for Electrical as stated on the Bid Form. No additional payment will be made for items in this section.

END OF SECTION

SECTION 16490 – COMPONENTS AND ACCESSORIES

PART 1 - GENERAL

1.01 WORK INCLUDES

A. Provide the following components and accessories.

PART 2 - PRODUCTS

2.01 WATER LEVEL FLOATS

A. Wet well floats that are installed in the same well as a submersible level sensor are redundant backup devices. They will only be acted upon if the PLC or sensor fails.

B. Wet well floats, meter vault flood float, and check valve vault float shall be suspended, mercury, avocado style and shall open on liquid rise and close on liquid fall. They shall be UL rated, 120/240VAC. Each float shall include be tie-wrapped to a tether as shown on the drawings. Contractor shall also furnish one spare float. Floats shall be Roto-Float Type S or equivalent.

2.02 WET WELL WATER LEVEL SENSOR

A. Provide an Endress Hauser Waterpilot FMX167 submersible level sensor for measuring wet well level. This device shall have a large 42mm anti-fouling diaphragm. The sensor shall have a range of 0-15 psi (0-34.65'). It shall be a two-wire 4-20mA device.

B. Install the transducer per manufacturer's recommendations using stainless steel hardware and a long stainless steel conduit "stinger" as shown on the drawings.

C. Provide the transducer with a cable long enough that it does not have to be spliced.

D. Install sensor and transducer as per the location in the drawings.

E. All outdoor connections shall be water proof and gasketed.

2.03 VAULT SWITCHES

A. Each of the two check valves will be equipped with microswitches to indicate a closed valve condition. Connect these switches as shown on the drawings.

2.04 OUTLET PRESSURE TRANSDUCERS

A. Provide two combination pressure transmitter / gauges in the valve vault, as shown on the drawings.

B. Devices shall be Ashcroft 2279 series stainless combination pressure gauge/transmitter. Pressure range shall be 0/60 psi. 4-20ma output with waterproof cable connector.

C. Install the pressure gauge so that it can be removed without disconnecting the wiring connection. This will require ordering the gauge with a waterproof connector (included in the above part number). All wiring splices shall be in the junction box in the vault and shall be by grease filled compression connectors.

2.05 DIGITAL PRESSURE DISPLAY

A. Provide two combination digital pressure display meters flush mounted to the door of the main control panel.

B. Device shall input a 4-20ma 24VDC signal and convert it to a 3.5 digit display.

C. Display digits shall be a minimum of 14.2mm tall.

D. Display shall be have digital and potentiometer calibration control to allow tuning of the pressure range to the display.

E. Device shall be Weidmuller DI350 with current inputs, or equal.

F. Contractor shall install and calibrate to pressure gauges installed on force main headers.

G. Device shall be connected in parallel to the PLC to allow reading of gauges in event of PLC failure.

2.06 PUMP HOUR METERS

A. Provide mechanical run time meters for each pump. Meters shall be flush mounted to the door of the VFD cabinets.

B. Meters shall operate from a 24VDC output on the VFD whenever the drive is in operation.

C. Meters shall be capable of displaying a minimum of 10,000 hours plus tenths.

D. Meters shall be UL listed, sealed, quartz driven.

E. Meters shall be 85001 by Hobbs or equal.

2.07 BREAKER LOCKOUT STATION

A. Provide an OSHA approved circuit breaker lockout station, wall mounted within view of the panelboards. The station shall contain a selection of lockout hasps and color coded padlocks with keys. Each kit shall contain devices for locking out actuator handles as well as individual panelboard circuit breakers. Approved manufacturers are Brady, Master Lock, and Prinzing, or equal.

2.08 SOFTWARE

A. Provide a sealed package of the Power Flex 400 configuration software for Windows XP/VISTA, along with two programming cables for configuring the VFDs by laptop.

B. Provide the following unopened packages. Allen-Bradley model#

1. 9324-RLD300NXxxE, RSLogix5000 Standard Edition with NetWorx

2.09 EQUIPMENT ID TAGS

A. Provide equipment ID tags, both laminated plastic and embossed stainless steel, as described in the tag schedules on the electrical drawings and as described in these specifications (especially the Enclosed Controllers specifications).

2.10 ETHERNET SWITCH

A. The City requires that the Ethernet switch in the MCP be manufactured by Hirschmann, model RS2-TX. Eight RJ45 ports, 10/100MB, 24VDC power.

B. Provide one spare.

2.11 MAGNETIC TRIP SENSORS

A. Provide magnetic trip sensors on entrances required to be alarmed.

B. Sensors shall remain closed when entrances are closed, and open upon separating. They shall be rated for 24VDC.

2.12 RELAYS

A. Provide relays where necessary or indicated on plans

B. Relays shall be Form C having both normally closed and normally open contacts with proper AC or DC coil as necessary.

C. All relays shall meet NEC Class I, Division II, Groups A, B, C & D for hazardous locations.

2.13 TELEPHONE SERVICE

A. Provide one standard phone jack RJ11 inside building for autodialer communication.

B. Coordinate with Telephone company to install service to control building

2.14 SPARES

A. Contractor shall furnish various spare parts as required in the drawings and specifications. For example, Contractor shall furnish:

1. One of each of the different types of floats used in the project.
2. Two of each of the different types of relays.
3. Twelve spares of each of the different types of terminal blocks
4. Four of each type and color of indicator lamp bulbs
5. Six spares of each of the different types of fuses
6. Four spares of each type of luminaire lamp used
7. Ethernet switch

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install per manufacturer's recommendations and instructions.

B. Installation shall be performed in the arrangement and position as shown on the drawings.

PART 4 - SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Cost for items specified in this section shall be included as a portion of the lump sum price for the project for Electrical as indicated on the Bid Form. No separate measurement for these quantities will occur.

2. Payment and installation for Telephone service shall be provided by Contractor. Contractor shall arrange for transfer of service into City's account.

END OF SECTION

SECTION 16500 – LIGHTING

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The work consists of providing a complete lighting system as specified herein and shown on the drawings.

1.02 SUBMITTALS

A. Fixture construction details, photometric data, and ballast type shall be supplied as part of the submittal procedure.

1.03 QUALITY ASSURANCE

A. The Contractor shall test all lighting installations and demonstrate satisfactory operation of switching controls upon completion of the installation. The Contractor shall replace all defective lamps and/or ballasts prior to occupancy by the Owner. All fixtures shall be cleaned and visible labels removed.

B. Fluorescent lamps and ballast shall be designed to work together as a system. Shall be OSRAM-Sylvania or approved equal.

PART 2 PRODUCTS

2.01 FIXTURES

A. The Contractor shall be responsible for the complete equipment of all fixture types called for. All standard fixtures shall be approved by UL and shall have UL inspecting labels attached thereto. Fixtures shall be grounded in accordance with the NEC.

1. Interior Control Building – 4 lamp, T-8, fluorescent fixtures

2. Outdoors– Down facing HID Lighting

2.02 INTERIOR FLUORESCENT LIGHTS

A. BALLASTS --Cooper Lighting Metalux High Efficiency Systems with WS-432A EB-8 Energy Saving ballasts with less than 10% THD. CBM/ETL Class P with UL/CUL listing, suitable for damp locations.

B. LAMPS – Sylvania Octron 32 Watt 48" T-8 Extended Performance Ecologic Fluorescent or approved equal.

C. MATERIALS – Metal parts shall be die-formed from code gauge steel. Ballast cover to be removed without tools. Diffuser shall be 100% acrylic. No asbestos shall be used in this product. Diffuser shall be wraparound style.

D. FINISH – Painted parts shall be finished with high-gloss, baked white enamel.

E. LISTING – Fixtures shall be UL listed and labeled.

F. FIXTURE – Shall be Model WS-432A-120V-EB81-U from Cooper Lighting; or approved equal.

2.03 EXTERIOR AREA LIGHTING – DOOR ENTRY LIGHT

A. CONSTRUCTION – Die-cast aluminum housing meeting NEMA specifications and dimension standards. Wall mounted. Cut off visor to minimize light spread.

B. ELECTRICAL – 277V, 250 Watt.

C. OPTICAL SYSTEMS – Thermal and shock resistant tempered glass with aluminum reflector.

D. LAMPS – High Pressure Sodium, 250W

E. LISTING – UL listed for wet locations.

F. FIXTURE – TWR2C as manufactured by Lithonia Lighting; or equal.

2.04 ACCESSORIES

A. Fixtures shall be furnished complete with all lenses, trims, hangers, nipples and extensions necessary for a complete installation. All light diffusing media shall be free of scratches or cracks. In general, diffusers shall be of acrylic material unless otherwise noted.

PART 3 EXECUTION

3.01 INSTALLATION

A. Supports

1. All supports for fixtures shall be furnished. All stem lengths shall be adjusted to meet conditions. Mounting heights to bottom of fixtures are given as accurately as possible and shall be adjusted to conform to job conditions.

2. Clean all fixture lenses prior to final acceptance.

B. Grounding

1. Lighting systems shall be securely grounded. For rigid conduit, a threaded hub or double locknut and bushing connection shall be considered adequate. For systems employing flexible conduit feeds, a green insulated No.12 AWG solid wire shall be run with the phase conductors, and bonded to the box and fixture at each end of the flexible conduit. The ground connection shall be accomplished by means of cadmium plated round head machine screws, lockwasher and nut.

C. Coordination

1. The Contractor shall provide adequate fixture attachment to ceiling members in accordance with NEC. The Contractor shall inspect the mechanical plans and the actual site to verify that no interferences occur with diffusers, grilles or duct work or piping.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Costs for all items in this Section shall be included within the lump sum price for Electrical as stated in the Bid Form. No additional payment will be made for this item.

END OF SECTION

SECTION 16740 – ETHERNET NETWORK

PART 1 - GENERAL

1.01 WORK INCLUDES

A. Provide all cables, conduit, junction boxes, routers, switches, hubs, patch cables, and appurtenances as required for the network system.

B. Provide the network as shown on the drawings.

PART 2 - PRODUCTS

2.01 DETAILS

A. All wiring and connectors shall be to Category 5e standards.

B. Cables, 10/100BaseT: Provide all ethernet cables needed to network a computer.

C. Receptacles shall be modular 10Base-T style. Cables shall be Category 5e. All components of the network shall be approved for Category 5e Ethernet Network use.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Permanent network routing, such as between PLC and Transfer Switch, shall be to Category 5e specifications and shall be contained in raceway and terminated in permanently mounted panels.

PART 4 - SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Schedule I – Pump Station No. 4 Replacement

1. Costs for all items in this Section shall be included within the lump sum price for Electrical Improvements Complete as stated in the Bid Form. No additional payment will be made for this item.

END OF SECTION

DIVISION 17- OPERATION
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SECTION 17500 – OPERATIONAL AND ALARM STRATEGY

PART 1 PURPOSE

1.01 PURPOSE

A. The purpose of this Section is to provide a description of the operating and control strategy for Pump Station 4.

B. The pump station will be equipped with two pumps, one pumps running will be capable of delivering at least 700 gpm at 57 feet total dynamic head.

PART 2 SYSTEM DESCRIPTION AND OPERATING STRATEGY

2.01 SYSTEM DESCRIPTION

A. Operational strategy of the pump station is based on a maximum wastewater level in the wetwell of 7 feet (relative to the bottom of the wetwell) which corresponds to a level approximately 4 inches above the influent pipe invert. This level corresponds to the high water alarm level of -1 feet (see sheet M2). The minimum water level in the wetwell is 2 feet above the bottom of the wetwell. This minimum level corresponds to the pumps off elevation of -8 feet.

2.02 OPERATING STRATEGY

A. When the water level in the wetwell reaches 5.65 feet (-2.35 feet elevation), the lead pump will start at an initial pumping rate of 500± gpm to provide a flushing velocity of 3.5 ft/sec in the forcemain. This velocity will be maintained until the pumps off level of -6 feet elevation is reached, which corresponds to approximately 4.35-feet of draw-down in the wetwell.

B. If the water level in the wetwell drops after the initial flushing rate of 500 gpm, then the pumping rate shall be ramped down to a minimum pumping rate of 280 gpm, corresponding to the minimum allowable forcemain velocity. The pump shall continue pumping at 280 gpm until the water drops to the pump shut off elevation of -6 feet.

C. If, after the lead pump starts at the initial flushing rate of 500 gpm, the water level continues to rise, the pump shall ramp up the maximum velocity of 700 gpm. The pump shall continue at the higher velocity until the level drops below the initial start point and begin to ramp down until the wetwell reaches the pump shut off elevation.

D. As the water level drops in the wetwell, the pumping rate shall be ramped down prior to reaching the pump shut off elevation to avoid a sudden shut down and corresponding water hammer.

E. If the water level in the wetwell rises to 6.5 feet (-1.5 feet elevation), a manual float shall be triggered which bypasses the controller and turns the pump one VFD on at maximum speed. The pump shall remain on until the wetwell shut off elevation is reached and triggers a backup shut off float.

F. If the water level in the wetwell rises to 7 feet, (-1 foot elevation), a manual float shall trigger the high water alarm and turn the pump two VFD on at maximum speed. Both pump one and pump two shall remain on at maximum speed until the wetwell shut off elevation is reached and triggers a backup shut off float.

G. If the water level in the wetwell drops to 1.5 feet (-6.5 foot elevation), a manual float shall disable all VFD's, controls to pumps and signal a low water level alarm on the dialer. The pumps shall remain disabled until the alarm stops or is overridden manually by the user.

H. If the water level in the wetwell has signaled a low water level alarm and concurrently signals a pump one bypass elevation of 1.5 feet, the pumps shall remain off from the low water level alarm.

I. If the water level in the wetwell has signaled a low level water alarm and concurrently signals both a pump one bypass and high level alarm pump two bypass, the pumps shall override the low water alarm and separately engage the motor drives to each pump until the high water alarm ceases.

J. At least once per 7 day period the pump station shall maintain at least 550 gpm flow for a minimum of 3 minutes to completely flush the forcemain. This process will prevent solids build-up in the forcemain. During summer months when system flows are low, the wetwell shall be allowed to fill during the night to 0 feet elevation to provide a total volume of 1,700 gallons, which is sufficient to flush the forcemain.

PART 3 CONTROLS AND ALARMS

2.01 CONTROLS

A. Pump controls will include variable frequency drives (VFDs) for each pump.

B. All of the pumps will be governed by a single pump control unit. Pump control unit shall be as specified in Division 16.

C. The control unit will integrate inputs from level sensor(s), float switches and flow meter along with outputs to the VFDs.

D. The control unit will alternate each of the two pumps as lead pumps so as to keep the total running hours on each pump approximately equal.

E. Pump start and stop functions will be based on a continuous signal from the level transmitter.

F. If the high level float switch is activated, the pump controller shall ramp up pumps to maximum capacity and the high level alarm shall be activated.

G. If the pump off switch is activated, the pump controller shall ramp down the pumps to zero. If the low level alarm switch is activated then pumping shall stop immediately and the low level alarm shall be activated.

H. Each pump shall be equipped with a mechanical hour meter located on the drive panel. The meter shall increment from a VFD signal whenever the pump is operated. Each meter shall be clearly and permanently labeled.

I. Each pump shall have an H-O-A switch on the panel. Each switch shall be clearly and permanently labeled. The operation in each mode shall be as follows:

1. H – Hand: In hand operation the pumps will run manually.
2. O – Off: Turns off the pump.
3. A – Auto: Pumps run in automatic mode and start when the controller energizes the VFDs. The controller will follow the strategy as outlined below.

J. Each pump shall have an Bypass/Test/Run switch on the panel. Each switch shall be clearly and permanently labeled. The operation in each mode shall be as follows:

1. Bypass: VFD controls are bypasses and the pumps will run at full speed controlled by the PLC
2. Test: Used for function testing and troubleshooting
3. Run – Auto: Pumps run in normal mode and start when the controller energizes the VFDs. The controller will follow the strategy as outlined below.

2.02 CONTROL STRATEGY

A. One pump will be required to meet the pumping requirement of 500 gpm. The pump should start at approximately 66% speed (40 Hz) and ramp up to the speed required to produce the desired flow rate within approximately 15 to 20 seconds.

B. Peak design capacity will be met with a single pump. When greater flow occurs, it should the pump shall quickly ramp up to maximum speed.

C. During periods of low flow the initial pumping rate of 500 gpm shall be maintained for approximately one minute and then ramped down to the minimum flow rate of 280 gpm.

D. Flushing cycle shall occur at least once per 7 day period. Flush cycle shall occur at night to avoid odor complaints. Minimum flow during flush cycle shall be 550 gpm. Higher flows are acceptable. Minimum flush volume shall be 1,700 gallons, larger volume flush is acceptable. Pumps shall quickly ramp up to required speed and quickly ramp down at the end of the cycle. Flow and run time shall be sufficient to move a full 1,700 gallons at a flow meeting or exceeding the specified flush flow of 550 gpm.

1. Flushing cycle will override emergency floats using the PLC output during fill cycle.

2.03 ALARMS

A. System alarms will include:

1. High wet well level (float switch)
2. Low wet well level (float switch)
3. Pump One float override alarm (float switch)
4. Pump motor moisture (integral pump moisture sensor)
5. Pump over temperature (integral pump temperature sensor)
6. Power loss, phase loss (automatic transfer switch)
7. Door security alarm
8. Wetwell security alarm
9. Smoke detector
10. VFD Failure
11. Pump Fail to Start/Stop
12. PLC Fault
13. UPS Trouble/Failure
14. Flowmeter Vault Flooding
15. Level Sensor Failure
16. Generator Excessive Runtime
17. Additional Generator Alarms
18. Overflow Alarm
19. Check Valve Fail to Open/Close

2.04 CONTROL / ALARM SUMMARY

Point Description	Level Above Bottom of Wetwell	Water Surface Elevation (ft)	Time Delay
Low Level Alarm	1.5 ft	-6.5	n/a
Pumps Off	2.0 ft	-6.0	n/a
Pump On	5.65 ft	-2.35	n/a
Emergency Pump On	6.5 ft	-1.5	n/a
High Level Alarm	7 ft	-1.0	n/a
Overflow Alarm	15.75 ft	7.75	n/a

PART 3 EXECUTION

3.01 FIELD ADJUSTMENT

A. Engineer and other City representatives at the City's option shall be present during start up and testing. Changes and adjustments to operational strategy and level alarms will be allowed during start-up and testing as directed by the Engineer.

END OF SECTION