

SPECIFICATIONS - DETAILED PROVISIONS
Section 11200 - Small Submersible Sewage Lift Station
with Emergency Standby Power Generation

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SECTION 11200
SMALL SUBMERSIBLE SEWAGE LIFT STATION
WITH EMERGENCY STANDBY POWER GENERATION

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION

Contractor shall provide all labor, equipment, and materials necessary to construct a raw sewage lift (pump) station in accordance with the Small Sewage Lift Station Guidelines, the Standard Drawings and Specifications, District's Approved Materials List, and Standards and Specifications for Developer Projects.

1.02 REFERENCES

Publications listed below form part of this Specification to extent referenced in the text by basic designation only. The latest edition of publication governs unless otherwise noted.

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| A. | ANSI | American National Standards Institute |
| B. | AWWA | American Water Works Association Standards |
| C. | ASTM | American Society for Testing and Materials |
| D. | IEEE | Institute of Electrical and Electronics Engineers |
| E. | NEC | National Electric Code |
| F. | NEMA | National Electrical Manufacturers Association |
| G. | Hydraulic Institute | Standard for Centrifugal, Rotary and Reciprocating Pumps |
| H. | SSPWC | Standard Specifications for Public Works Construction |
| I. | CBC | California Building Code |

1.03 SYSTEM DESCRIPTION

A. Design Requirements

Lift station facilities, including materials of construction, pumps, valves and piping, electrical panels and controls, emergency power generator, and automatic transfer switch shall be in accordance with requirements specified herein and shown on the Construction Drawings.

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Principal items of equipment and material shall include two submersible centrifugal sewage pumping units, piping, valves, motor control center, main control panel and ultrasonic level control system, automatic transfer switch, emergency standby power generator, and appurtenances.

B. Performance Criteria

Pumps shall be designed to handle raw, unscreened, domestic sanitary sewage. Pumps shall be selected to meet the capacity and hydraulic performance requirements described in the Small Sewage Lift Station Guidelines.

C. Electrical Power Requirements

Electrical power furnished to the pumping unit motors shall be 3 phase, 60 hertz, 480 volts, maintained within industry standards. Voltage tolerance shall be plus or minus 10 percent.

1.04 SUBMITTALS

A. Product Data and Shop Drawings

1. Prior to commencing construction, Contractor shall submit 6 copies of submittal data for all proposed material and equipment to the District for review and approval. Submittals shall be provided in accordance with the requirements of the District's General Conditions, Section F-Labor and Construction.
2. As a minimum, submittals shall include product data and shop drawings for the following: submersible pumping units, emergency standby power generator, diesel particulate filter (if required), motor control center, main control panel, ultrasonic level control system, automatic transfer switch, piping, valves, pipe joint restraints, wet well precast concrete shaft, wet well access hatch, concrete mix design, and electrical materials.
3. Product data shall include catalog cut sheets reflecting characteristics, performance specifications, and selected options for proposed equipment and appurtenances.
4. Product data for submersible pumping units shall include pump performance curves showing the design duty point capacity (GPM), total dynamic head (TDH), net positive suction head required (NPSHr), efficiency, and hydraulic brake horsepower (BHP).

5. Shop drawings shall be provided for all mechanical and electrical equipment items showing layout of equipment and anchor bolt locations, sizes and minimum embedment requirements.
6. Equipment anchorage calculations for the MCC/MCP and emergency standby power generator set. Equipment anchorage calculations shall be prepared in accordance with the California Building Code (latest edition) for Category IV essential facilities. Calculations shall be prepared by a registered professional civil or structural engineer in the State of California.
7. Shop drawings shall also include lift station control wiring diagrams and interconnection diagrams for the motor control center, main control panel, standby generator, submersible pumping units, automatic transfer switch, and electrical service switchgear. Wire numbers, terminal numbers, and legend symbols shall be shown.
8. Lift station control wiring diagrams (ladder diagrams) shall be prepared in accordance with District standard format, including sequential rung numbering located on the left side of the diagram and device, relay, or contact rung number cross references located on the right side of the diagram.
9. If a diesel particulate filter (DPF) is required, Contractor shall obtain and submit a Purchase Order from the manufacturer or installer of proposed generator set with factory-installed DPF or the non factory-installed DPF. The Purchase Order shall identify:
 - a) The warranty for the generator set with factory-installed DPF or the non factory-installed DPF.
 - b) Procedures for operating and maintaining the proposed generator set with DPF in accordance with the manufacturer's maintenance and operation handbook.
 - c) At least one company with certified technicians to clean and repair DPF when needed.

B. Electrical Short Circuit/Coordination Study

The Contractor shall submit for acceptance an electrical short circuit/coordination study in accordance with District Detailed Provisions, Section 16040 "Electrical Short Circuit/Coordination Study, Arc Flash Hazard Study, and Field Testing of Electrical System".

C. Arc Flash Hazard Study

Contractor shall submit for acceptance an arc flash hazard study in accordance with District Detailed Provisions, Section 16040 "Electrical Short Circuit/Coordination Study, Arc Flash Hazard Study, and Field Testing of Electrical System", except that the Arc Flash Hazard/Risk Categories of the electrical distribution equipment shall be limited to Level 2 or less.

D. Operations and Maintenance Manuals

1. Operation and Maintenance (O&M) Manuals shall be provided in accordance with the requirements of the District's General Conditions, Section F-Labor and Construction, and Detailed Provision Section 01430. O&M Manuals shall be submitted to the District for review and approval at least 30 days prior to equipment startup. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied.
2. Documentation shall be specific to the lift station constructed and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment operation and maintenance. Support data for any equipment shall be provided by those supplying the equipment. O&M Manuals shall include the following as a minimum:
 - a) Functional description of major equipment items.
 - b) Complete instructions for operating and maintaining equipment and components.
 - c) Calibration and adjustment of equipment for initial start-up or as required for routine maintenance.
 - d) Support data for commercially available components not produced by the prime equipment manufacturer, but supplied in accordance with the Specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.
 - e) As-built electrical schematic diagrams (control, wiring, and interconnections) of the pumping units, electrical panels, and emergency standby power generator. Diagrams shall conform to the requirements specified in Section 1.04.A herein.
3. As a minimum, Operations and Maintenance Manuals shall be submitted for the following items:

- a) All electrical components.
- b) Pumping units.
- c) Flowmeter.
- d) Emergency standby generator.
- e) Diesel particulate filter (if so equipped).

1.05 WARRANTY

All pumping equipment shall carry an extended warranty for a two-year period from the date of acceptance. All warranties shall be turned into the District prior to project completion.

1.06 MAINTENANCE BOND FOR PUMPING EQUIPMENT

For District administered contracts, the Contractor or his Supplier shall provide a maintenance bond (see EMWD Standard form C-14 or C-14.1 Maintenance Bond) from a bonding company acceptable to the District equal to 100 percent of the pumping equipment value (including motors, pumps, and pump assemblies) for a two (2) year term starting when the District has accepted the contracted work. Equipment and/or components failing within this period due to deficiency in design, workmanship, or materials shall be removed, replaced, and reinstalled at no cost to the District, and said replacement shall be guaranteed for two years continuous service from the date of replacement. The maintenance bond shall be submitted to the District prior to the performance test of the pump(s).

For contracts not administered by the District (e.g. contracts administered by Developer, or Developer's Engineer), the Developer shall provide the Maintenance Bond for Developer (which is the same as the above referenced maintenance bond except for the wording of the document) to the District. EMWD standard form C14D, Maintenance Bond for Developer, is attached at the end of this Section.

PART 2 - PRODUCTS

2.01 SUBMERSIBLE PUMPING UNITS

A. General

Pumps shall be of the vertical, non-clog, single suction, centrifugal type, rated for continuous duty in a wet-pit environment, and shall be capable of pumping raw, unscreened sewage with fibrous material, and be capable of passing a minimum 3-inch solid (unless otherwise specified) at the specified flow ranges with the specified sump geometry and operating water levels without clogging, surging, cavitation, vibration, subsurface vortexing, or excessive surface vortexing.

All submersible non-clog sewage pumps shall be the product of a single manufacturer. Pumps shall be as manufactured by Wilo-EMU, Fairbanks Nijhuis, Wemco, ESSCO, Flowserve, Xylem-Flygt, or ABS (no substitutes). Proposed pumping units shall comply with these Specifications and performance requirements provided on Construction Drawings.

The pumps shall not overload the motors at any point on the pump performance characteristic curve within the limits of stable pump operation as recommended by the manufacturer. The service factors for the motors shall not be applied when sizing the motors.

To ensure vibration-free operation, all rotative components of each pumping unit shall be statically and dynamically balanced. Excessive vibration shall be sufficient cause for rejection of the equipment.

If the pumping unit does not perform within the requirements specified herein, the pumping unit shall be removed and repaired or replaced at no cost to the District.

B. Materials (Unless Otherwise Specified)

1. Strength

Castings, fabrications, machined parts, and drives shall be rated for continuous duty over the entire operating range. Service factors, where applicable, shall be assumed to be 1.5.

2. Volute Casing

Volute casing shall be of close grained gray cast iron ASTM A48 Class 30 (minimum) and shall be of a single piece, non-concentric design with smooth fluid passages large enough to pass any size solids which can pass through the impeller. Casings shall be accurately machined to fit the mechanical seal and suction cover assemblies. Each volute casing shall be subjected to hydrostatic pressure of not less than 1-1/2 times the maximum shutoff head for two hours without evidence of leakage or seepage. The volute discharge nozzle shall be of the centerline design with an ANSI 125 pound flange and be of the minimum size specified herein.

3. Impellers

Each impeller shall be a non-clog type cast in one piece of gray cast iron, ASTM A48, Class 30 (minimum), and shall be statically and dynamically balanced, with smooth water passage to prevent clogging by stringy or fibrous materials and other matter found in normal sewage applications.

Each impeller shall be keyed to the shaft, and the fastening of the impeller to the shaft shall be made by a special locking device. Impeller shall be sealed from the liquid by means of an "O-ring" and covered and secured to the end face of the shaft by a single bolt with locking device to ensure impeller bolt will not back out if pump is operated backwards.

Unless otherwise specified, impellers shall be enclosed single port, recessed vortex type, or grinder type. Grinder type impellers shall be multi-vane, semi-open with replaceable cutting heads.

District will predetermine the specific impeller type(s) to be used for each project.

4. Volute Wear Ring (not applicable to recessed vortex pumps)

The pump suction shall be fitted with a replaceable stainless steel wear ring with a minimum hardness of 350 BNH.

5. Impeller Wear Ring (not applicable to recessed vortex pumps)

Each impeller shall be fitted with a replaceable stainless steel wear ring with a minimum hardness of 300 BNH to provide efficient sealing between the volute and impeller.

6. Discharge Elbows

Each pump shall be provided with a discharge elbow to be permanently installed with discharge piping in the wet well. The discharge elbow shall be made of close grained cast iron ASTM A48, Class 30 (minimum). The pump shall automatically connect to the discharge connection elbow when lowered into place. Pump shall be easily removed for inspection or service with no need for personnel to enter the wet well. Sealing of the pump to the discharge elbow shall be accomplished by a simple linear downward motion of the pump. Connection shall be machined metal-to-metal, quick disconnect at pump volute, with secondary profile type Elastomer seal or O-ring element for leak proof seal when the pump is in operation.

7. Pump Shaft

Pump shaft shall be high strength 416 stainless steel or carbon steel with 416 stainless steel shaft sleeve and of such diameter that it will not deflect more than 0.002-inch with the largest impeller installed while operating at the maximum design speed, as determined by calculations from the manufacturer.

8. Pump Seals

Each pump shall be provided with two independent mechanical shaft seals. The upper seal shall operate in an oil chamber located just below the stator housing. Upper seal shall contain one stationary tungsten carbide or silicon carbide ring and one positively driven rotating carbon ring functioning as an independent secondary barrier between the pumped liquid and the stator housing. The lower shaft seal shall function as the primary barrier between the pumped liquid and the stator housing. Lower seal shall consist of a stationary ring and a positively driven rotating ring both of which shall be silicon carbide. All metal parts, set screws, and springs of both upper and lower seals shall be 316 stainless steel.

Each interface shall be held in contact by its own spring system supplemented by external liquid pressures. The seals shall require neither maintenance nor adjustment, but shall be easily inspected and replaceable.

The shaft sealing system shall be capable of operating submerged to depths of, or pressures equivalent to, a minimum of 45 feet. No seal damage shall result from operating the pumping unit in its liquid environment. The seal system shall not rely upon the pumped media for lubrication.

9. Guide and Removal System

System shall be designed for pump removal and installation to permit routine maintenance and repair of pumps. Pump supplier/manufacturer shall furnish a reliable, operable system and shall provide technical assistance for installation. Contractor shall demonstrate the use of the system for each pump by removing and reinstalling each pump with the wet well dry. After start-up of pumps, Contractor shall again remove and reinstall each pump then operate pumps again to demonstrate proper installation. The removal system shall be suitable for lifting the pumps with a crane utilizing a stainless steel cable that will be attached to the pump motor lifting bail assembly. The complete guide and removal system shall be furnished with the pumps.

The guide and removal system shall consist of a foot mounted discharge elbow, no less than two 316 stainless steel guide rails, upper rail support bracket, and intermediate rail guide brackets for each pump. Each pumping unit shall be provided with an integral sliding guide bracket. All guide and removal system components, except pump discharge elbow and pump sliding guide bracket, shall be constructed of 316 stainless steel, or better. The pump guide and removal system shall be non-sparking.

10. Electric Submersible Motors

Each pump shall be driven by a vertical, submersible, squirrel cage, induction, shell type motor rated 480 volts, 3 phase, 60 hertz, housed in an air-filled, watertight chamber specifically designed for pumping application as specified herein. Maximum motor speed shall be 1,800 rpm. Electric submersible motor shall be explosion-proof and shall be approved by Factory Mutual (FM) or Underwriters Laboratories (UL) as an Explosion-Proof Unit. The complete unit shall conform to the NEC, Articles 500, 501, and 502 requirements as explosion-proof and suitable for use in Class I, Division 1, Groups C and D hazardous locations. Manufacturers shall coordinate pump motor furnished with electrical switchgear and control equipment.

- a) Stator. The stator winding and stator leads shall be insulated with moisture resistant Class F insulation which will resist a temperature of 155°C, 40°C ambient plus 115°C rise, and designed for continuous duty, capable of sustaining a minimum of ten (10) starts per hour. The stator shall be dipped and baked three times in Class F varnish and shall be heat-shrink fitted into the stator housing. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing shall be rejected. Motors shall be capable of continuous duty operation over the wet well range shown on the drawings including being partially submerged and capable of operating for 15 minutes in air at nameplate horsepower, unless specified for continuous operation in air.
- b) Sensors. Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with bi-metallic thermal switches embedded in the stator winding. Sensors shall be rated 120 VAC with normally closed contacts which open upon high temperature. Dual (2) moisture sensing probes or one positive displacement float activated reed switch and one hydroscopic sensor shall be provided in the oil chamber located between the outer and inner seal and are used to detect the presence of moisture should the outer seal fail. The moisture protection system shall be designed to detect water in the motor chamber and provide a warning signal prior to water levels reaching the bearing or wound stator assemblies. Sensor alarms will be incorporated into the station controls. Control modules, such as Warrick relays, shall be provided by the pump manufacturer for incorporation into the MCC controls.
- c) Service Factor. Unless specified otherwise by specific performance requirements the motor shall be sized to be non-overloading when the pump is operated at any point on the pump performance characteristic curve and shall have a minimum service factor of 1.15. Motor service factor shall not be used in satisfying pumping requirement.

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- d) Lifting Assembly. Lifting assembly (lifting eye or lifting bail) shall be provided on the motor housing and shall be of adequate strength to lift the entire pumping unit. Lifting assembly shall be 316 stainless steel, or better. Lifting assembly shall be provided with a 316 stainless steel clevis and lifting cable. The clevis shall be furnished with a locking mechanism for the clevis bolt, such as a cotter pin. Lifting cable shall be manufactured in the USA and shall be tagged with the lifting capacity per ANSI and Cal/OSHA requirements.
- e) Oil Chamber. Each pump shall be provided with an oil chamber for the shaft sealing system. The oil chamber shall be designed to assure that air remains in the oil chamber to absorb the expansion of the oil due to temperature variations. The drain and inspection plugs, with positive anti-leak seals, shall be easily accessible from the outside.
- f) Bearings. Each pump shaft shall rotate on minimum of two (2) permanently lubricated bearings. The upper and lower bearings shall be a single row deep groove ball bearing with the upper bearing providing for radial thrust. Pump bearings shall be of the anti-friction type designed to give 40,000 hours minimum life by L-10 calculations at maximum speed and operating load in continuous operation.
- g) Cable. Each pump shall be furnished with one or more pump power and control cables as necessary for pump operation and protection. Each cable shall be sheathed in a synthetic jacket suitable for submersible pump application and be designed to prevent moisture from wicking through the cable assembly even if cable jacket has been punctured.

Cable ends shall be protected at all times from moisture. Exposure to moisture shall result in rejection of the cable. The total cable length shall be of sufficient length for direct connection to pump control and electrical power system at junction boxes shown on the Construction Drawings, including an extra 4 feet to be looped around cable supports.

- h) Cable Entry. The cable entry assembly shall be provided to protect the motor from water entering the motor housing either through the cables or around the cables, when the unit is submerged and operating. Adequate strain relief provisions shall be provided to eliminate any mechanical loading of the cable entry seal. Each individual conductor wire shall be cast in resin in such a manner that any water leakage in motor through capillary action, because of external cable damage or other causes, shall be avoided.

11. Protective Coating for Exposed Ferrous Metal Surfaces

Protective coating shall be manufacturer's standard epoxy coating for severe duty, unless specified otherwise on the Construction Drawings.

12. Nameplates

Each pump shall have a Type 316 stainless steel plate permanently attached by stainless steel screws or rivets to the pump frame into which the following information shall be impressed, engraved or embossed, manufacturer's name, pump size, serial number, impeller diameter, capacity, head rating, speed, and bearing numbers. Nameplates shall also include information unique to each item of equipment and device to identify its function as described herein. Function nameplates shall be approximately one inch by 3 inches if made separately. Letters of function titles shall be not smaller than 1/4-inch high.

13. External Hardware

All external nuts, bolts, and washers etc. shall be 316 stainless steel.

14. Pump Spare Parts

Contractor shall furnish spare parts for each pumping unit. Spare parts shall be as specified herein or as recommended by the manufacturer, shall be undamaged and packaged in original containers, and supplied to the District at time of final acceptance of the work.

Contractor shall furnish the following spare parts:

- a) Two spare sets of cable entry grommets and O-rings.
- b) Two spare sets of mechanical seals.
- c) Two spare impellers.

C. Factory Testing

1. Tests shall be performed on the actual assembled unit over the entire operating range on the certified performance curve. Prototype model tests will not be acceptable.
2. All pumps shall be factory-tested in accordance with the above specifications. Certified test results shall be submitted to the District for approval prior to shipment.

3. Pump curves shall reflect data secured during actual test runs and shall be signed by a responsible representative of the pump manufacturer. Test reports and procedures shall conform to applicable requirements of the Hydraulic Institute Standards, except for testing tolerances for the design condition with one pump operating as shown on the pumping unit performance on the Construction Drawings. Testing tolerance for the design condition shall be +5%-0% for the total dynamic head at the discharge capacity. All other pumping unit performance conditions shall be within the limits shown on the Construction Drawings.

D. Installation

The Contractor shall install all pumping equipment in strict accordance with the manufacturer's instructions. Care shall be used in handling to avoid bumping, twisting, dropping, or otherwise damaging the equipment.

All pump manufacturers shall furnish the services of factory-trained personnel as required to examine the installation, supervise start-up of equipment installed, and repair the equipment at no additional expense to the District.

2.02 EQUIPMENT ACCESS HATCH

Furnish and install a single or double leaf equipment access hatch with safety grates and integral cable troughs as shown on the Construction Drawings. The access hatch shall be integrally cast into the concrete wet well roof. The top of the access hatch shall be flush with the top of the concrete roof. The minimum clear hatch opening dimensions shall be as shown on the Construction Drawings. The access hatch shall be pre-assembled from the manufacturer. The manufacturer shall warranty that the assembled access hatch shall be free of defects in material and workmanship for a period of (5) years from date of project acceptance. The access hatch shall be as manufactured by U.S.F. Fabrication, Flygt, Bilco or equal.

The access hatch covers, frame, cable trough, components, and hardware shall be constructed of 316 stainless steel. Hatch covers shall be 3/16" (minimum) thickness with a diamond pattern. Safety grates shall be provided beneath the hatch covers for fall through protection when the covers are open. The hatch covers and safety grates shall be reinforced to support a minimum live load of 300 psf with a maximum deflection of 1/150th of the span. Each safety grate shall be provided with a permanent hinging system that will lock the grates in the 90 degree position once opened. Safety grate hinges shall be specifically designed for horizontal installation and shall be through bolted to the safety grate with tamperproof stainless steel lock bolts and shall be through bolted to the equipment access hatch frame with stainless steel bolts and locknuts. Safety grate openings shall be 5" by 5" to allow for visual inspection of the wet well while the grating is in place. The hatch frame shall be angle type and shall be provided with full anchor flange around the perimeter.

Each cover leaf shall be provided with a lift handle that remains flush with the cover when not in use. A removable exterior turn/lift handle with slam lock shall be provided to open the top leaf. The latch release shall be protected by a flush, gasketed, removable screw plug. The top leaf shall also be provided with a recessed padlock clip and cover box. Each cover leaf shall be equipped with a hold open arm, which automatically locks the covers in the open position.

2.03 UTILITY METERING AND MAIN DISCONNECT

A. Main Electrical Service

As shown on the Construction Drawings, main electrical service shall consist of a commercial pedestal with pull section, service (metering) section, and main disconnect. The service pedestal shall be rated for a minimum of 200A on 480 volt, 3-phase power. The service pedestal shall be UL listed with a short circuit current rating of 42 KAIC (minimum). Equipment shall include a separate, barriered-off, utility metering compartment complete with hinged sealable door and padlock hasp as approved by the utility company. Provide Service Entrance Label and provide necessary applicable service entrance features per NEC, local code requirements, and utility company requirements. Main electrical service shall be as manufactured by Milbank Manufacturing Co., or Cooper B-Line, no substitutes.

The main electrical service and disconnect enclosure shall be provided in accordance with these provisions, and as shown on the Construction Drawings. Unless specified otherwise, the main electrical service enclosure shall be NEMA Type 3R.

B. Main Disconnect

Main disconnect shall be molded case circuit breaker with provisions to lockout the main disconnect switch as shown on the Construction Drawings.

Molded case circuit breakers shall provide circuit overcurrent protection with inverse time and instantaneous tripping characteristics. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy, and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

Circuit breakers shall have a minimum symmetrical interrupting capacity matching the MCC where installed or as shown on the Construction Drawings. Circuit breakers shall be provided with adjustable continuous current and thermal-magnetic trip units and inverse time-current characteristics unless otherwise shown on the Construction Drawings.

C. Arc Flash Limit

Main electrical service shall be designed, manufactured, and supplied such that the Arc Flash Hazard/Risk Categories shall be Level 2 or less within the Arc Flash Protection Boundary.

Circuit breakers used as a main to disconnect utility power shall be provided with microprocessor-based RMS sensing trip units.

The electrical equipment manufacturer shall coordinate with the engineer(s) performing the Short Circuit/Coordination and Arc Flash Hazard Studies per Section 16040 to comply with the Hazard/Risk Category Level 2 or less.

2.04 MOTOR CONTROL CENTER

A. Construction

1. Motor Control Centers (MCCs) shall be provided as shown on the Construction Drawings and specified herein. MCCs shall comply with the requirements of NEMA ICS 2, the NEC, and UL 845. Wiring shall be NEMA Class II, Type B. MCCs shall be as manufactured by General Electric, Eaton/Cutler Hammer, Allen-Bradley, or Schneider Electric/Square D, no substitutes.
2. Structures shall be totally enclosed dead front, free-standing assemblies. They shall be 90± inches high and 21± inches deep. Each structure shall be minimum 20± inches wide and wider where shown on the Construction Drawings, or where required to house components shown on the Construction Drawings. Structures shall contain a horizontal wireway at the top, isolated from the horizontal bus and shall be readily accessible through a hinged cover. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference.

The MCC enclosure shall be provided in accordance with these provisions, Section 2.05 herein, and as shown on the Construction Drawings.

3. A vertical wireway with minimum of 35 square inches of cross sectional area shall be adjacent to each vertical unit and shall be covered by a hinged door. Wireways shall contain steel rod cable supports.
4. All full voltage motor starter units through NEMA Size 5 shall be of the plug-in type. Plug-in provisions shall include a positive guide rail system and stab shrouds to absolutely ensure alignment of stabs with the vertical bus.

Plug-in units shall have a tin-plated stab assembly for connection to the vertical bus. No wiring to these stabs shall extend into the bus compartment. Interior of all units shall be painted white for increased visibility. Units shall be equipped with side-mounted, positive latch pull-apart type control terminal blocks rated 600 volts. Knockouts shall be provided for the addition of future terminal blocks. All internal control wire to be 14 gauge minimum.

5. All plug-in units shall be secured by a spring-loaded quarter turn indicating type fastening device located at the top front of the unit. Each unit compartment shall be provided with an individual front door.
6. An operating mechanism shall be mounted on the primary disconnect of each starter unit. It shall be mechanically interlocked with the unit door to prevent access unless the disconnect is in the OFF position. A defearer shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect. A second interlock shall be provided to prevent removal or re-insertion of the unit while in the ON position. Padlocking facilities shall be provided to positively lock the disconnect in the OFF position with from one to three padlocks with the door open or closed. In addition, means shall be provided to padlock the unit in a partially withdrawn position with the stabs free of the vertical bus.

B. MCC Bus

1. Each structure shall contain a main horizontal copper tin plated or copper silver plated bus, with minimum ampacity rating of 400 amperes or as shown on the Construction Drawings. The horizontal bus shall be rated at 65 degrees C temperature rise over a 40 degree C ambient temperature in compliance with UL standards. Vertical busses feeding unit compartments shall be copper and shall be securely bolted to the horizontal main bus. All joints shall be front accessible for ease of maintenance. The vertical bus shall have a minimum rating of 300 amperes for front mounted units.
2. Isolation of the vertical bus compartment from the unit compartment shall be by means of a full height insulating barrier. This barrier shall be a single sheet of glass reinforced polyester with cutouts to allow the unit stabs to engage the vertical bus. Provide snap-in covers for all unused openings.
3. Busses shall be braced for minimum 42,000 amperes RMS symmetrical, unless shown otherwise on the Construction Drawings.

C. MCC Motor Controllers (Combination Starters)

Motor controllers shall consist of combination starter units with motor circuit protectors and motor starters with thermal bimetallic overload relays. Motor starter control power (120V) shall be provided from the lighting panel included in the MCC assembly as shown on the Construction Drawings.

Combination starter units shall be as specified herein and shall be full voltage non-reversing, rated minimum 42,000 amperes RMS, symmetrical at 480V, unless shown otherwise on the Construction Drawings. Combination starter units shall conform to the following:

1. Motor Circuit Protectors shall be as manufactured by General Electric, Eaton/Cutler Hammer, Allen-Bradley, or Schneider Electric/Square D, (no substitutes).

The motor circuit protection shall provide adjustable magnetic protection and be provided with pin insert to stop magnetic adjustment at 1300 percent motor nameplate full load current to comply with NEC requirements. All combination starter units shall have a "tripped" position on the unit disconnect and a push-to-test button on the motor circuit protector. Motor circuit protectors shall include transient override feature for motor inrush current.

2. Motor starters shall be electrically operated, electrically held, three-pole assemblies with arc extinguishing characteristics and shall have silver-to-silver renewable contacts. They shall accommodate a total of eight N.O. or eight N.C. auxiliary contacts. Overload protection shall consist of thermal bimetallic ambient compensated type overloads. Sizes shall be determined by the Contractor based on characteristics of actual motor furnished.
3. Each starter (unless otherwise shown) shall be equipped with indicating lights, selector switches, elapsed time meter, and auxiliary contacts, as shown on the Construction Drawings. Number of auxiliary contacts shall be as required for specific motor control. In addition, 2NO and 1NC spare contacts shall be provided.
4. All status and alarm lights shall be push-to-test type, and shall be heavy-duty, oil-tight (NEMA 13).

D. Arc Flash Limit

Motor control centers shall be designed, manufactured, and supplied such that the Arc Flash Hazard/Risk Categories shall be Level 2 or less within the Arc Flash Protection Boundary.

Distribution circuit breakers used to disconnect power from motor control centers and motor control center mains shall be provided with microprocessor-based RMS sensing trip units.

The electrical equipment manufacturer shall coordinate with the engineer(s) performing the Short Circuit/Coordination and Arc Flash Hazard Studies per Section 16040 to comply with the Hazard/Risk Category Level 2 or less.

2.05 ELECTRICAL PANEL ENCLOSURES AND HEATING

A. Enclosures

MCC enclosures shall be as specified on the Construction Drawings and shall be suitable for the proposed location. Unless noted otherwise on the Construction Drawings, the specified electrical equipment and switchgear shall be housed in NEMA 1 gasketed enclosures with NEMA 3R wrappers. Enclosures shall have NEMA 3R wrap roofs sloping downward towards the rear. Outer sections shall be the same widths as indoor structures, except each end of the outdoor assembly shall have an end trim. The enclosures shall be provided with bolt on rear covers for each section.

Enclosures shall be provided with ANSI 61 gray baked enamel exterior, and white baked enamel interior. As a minimum, each enclosure section shall be furnished with a convenience receptacle, overhead fluorescent light activated manually by inside mounted switch, and padlockable door handle.

Nameplates shall be provided for all electrical enclosures, stations, and equipment furnished by the Contractor. Nameplates shall be engraved laminated plastic, with 1/4" high white lettering on black background. Nameplates shall indicate equipment and its function. Nameplates shall be securely fastened with stainless steel drive screws or escutcheon pins.

B. Heating

MCC enclosures shall be provided with thermostatically controlled space heaters to prevent condensation. Heating shall be as designed by the manufacturer, unless shown specifically on the Construction Drawings.

Control power transformers with primary and secondary fuse protection shall be provided as required for proper operation of the heating equipment, unless shown otherwise on the Construction Drawings. Supply voltage shall be 120 volts, 60 Hz.

2.06 CONTROLS AND INSTRUMENTATION

A. Main Control Panel

1. General

The Main Control Panel (MCP) shall be housed in the MCC line up as shown on the Construction Drawings. The MCP shall consist of all relays, timers, switches, pushbuttons, lights, and components as shown on the Drawings and specified herein. The MCP shall control the pumping units in the automatic mode and provide alarm output to the RTU.

Control power to the MCP shall be 120 volt, 60 Hz, single phase from the lighting panel and shall be provided with a fuse for short circuit protection. The MCP shall also be provided with a 120 volt, auxiliary duplex receptacle, protected with a 20A thermal magnetic breaker within the MCP.

Selection of the "lead" pumping unit shall be controlled by District RTU.

Alarm lights for wet well level alarm conditions shall be located at the MCP. Alarm lights shall be push-to-test type, and shall be heavy-duty, oil-tight (NEMA 13).

2. Terminal Blocks

Terminal blocks shall be molded plastic with barriers and box lug terminals, and shall be rated 15 amperes at 600-Volts. White marking strips, fastened securely to the molded sections, shall be provided, and wire numbers or circuit identifications shall be marked thereon with permanent labels.

3. Signal and Control Circuit Wiring

- a) Wire Type and Sizes. Where conductors are within the control panel, they shall be flexible stranded copper machine tool wire; these shall be UL listed Type MTW and shall be rated 600-Volts minimum 14 AWG. Where conductors are run to MCC sections or to field locations, they shall be stranded copper minimum 12 AWG of the UL listed Type THWN.
- b) Wire Termination. Conductors from field components or from MCC sections shall terminate in the MCP at terminal blocks. Control circuit wiring shall connect from terminal blocks to relays, timers, lights, and switches.
- c) Wire Marking. Each signal, control, alarm, and indicating circuit conductor connected to a given electrical terminal point shall be designated by a single unique number which shall be shown on all shop drawings.

Status, alarm, and control signal (IO) conductors to and from the RTU terminal strips shall be identified at both ends using the District's labeling designation shown on Drawing E-4, "RTU Status/Alarm Signal Wiring Diagram" (i.e. 4-6, 5-2, etc.). These numbers shall be marked on all conductors at every terminal using white numbered wire markers which shall be permanently marked heat-shrink plastic. Font shall be sized to be legible after shrinking.

B. Ultrasonic Level Control System

Each ultrasonic level control system shall include an ultrasonic level transducer and an ultrasonic controller. Each controller shall be flush mounted on the MCP door.

The transducer shall be capable of submergence without degradation. Transducer shall function over an ambient temperature range of -40°F to 200°F, and shall be rated by FM and CSA for Class I and II hazardous environments.

The transducer shall be provided with integral temperature sensor for speed-of-sound compensation and shall be Model Echomax XPS-15 as manufactured by Siemens, no substitutes.

Unit shall operate on 120V, 60 Hz power, unless otherwise specified, and provide 4-20 mA DC output, current isolated, into a maximum of 600 ohms (return to ground).

Controller shall function over an ambient temperature range of 15°F to 122°F. The controller shall be a single point, three relay type controller with auto-false echo suppression for fixed obstruction avoidance, Hydro Ranger 200 Series as manufactured by Siemens, no substitutes.

Interconnecting cable between transducer and controller shall be supplied with unit, and shall be suitable for a maximum system length of 300'. Contractor shall verify length of cable required for each specific installation. Cable shall be installed in a single run with no splices. Cable shall be installed in continuously grounded PVC-coated Rigid Galvanized Steel conduit. Conduit shall be installed a minimum of 8' from 480V conduits.

C. Wet Well Level Float Switches

Float switches shall be designed for operation in raw sewage and shall be hermetically sealed in high impact corrosion resistant polypropylene or polyurethane. Cables shall be minimum 16 gauge multi-strand polyvinylchloride (PVC) jacketed cable (oil and water resistant) suitable for underwater use and heavy flexing service. Float switches shall be rated minimum 4 amps at 120 VAC. Float switches shall be provided with stainless steel clamps and appurtenances suitable for mounting switches to a vertical 3/4-inch pipe.

Float switches shall be as manufactured by Flygt Corporation, Warrick Controls, Anchor Scientific Inc., Consolidated Electric Co., or equal.

Each float switch shall be provided with an intrinsically safe relay complete with reduced voltage transformer and contacts. Relays shall be specified for use in NEC, Class I, Division 1 (hazardous) locations, and shall be Factory Mutual or UL listed for explosion proof service. Intrinsically safe relays shall be as manufactured by Warrick (no substitutes).

D. Magnetic Flow Meter

Contractor shall provide a magnetic flow meter as specified hereinafter.

1. Meter Design and Construction

The magnetic flow meter shall use characterized electromagnetic induction to produce a voltage linearly proportional to the average flow rate. Each magnetic flow meter shall be microprocessor based, and utilize D.C. bipolar pulsed coil excitation, automatically re-zeroing after every cycle. The sensor shall be a Type 304 stainless steel tube, carbon steel flanged, and polyurethane lined, with a nominal diameter as shown on the Construction Drawings.

External surfaces shall be factory finished with a high build epoxy paint or better for corrosion prevention. The flow meter electrodes and built in grounding electrodes shall be Type 316 stainless steel. If built in grounding is not provided, Type 316 stainless steel grounding rings shall be mounted in each end of the meter.

The preamplifier input impedance shall not be less than 10^{11} ohms and shall be capable of operating with a power supply of 24 volts ± 10 percent. The sensor shall be NEMA 4X and certified for use in Class 1, Division 1, Groups B, C, and D.

Accuracy of the flow meter system shall be ± 1 percent of rate above 1 fps and ± 0.1 percent of full scale below 1 fps. Accuracy shall be verified by calibration in a flow laboratory traceable to the National Institute of Standards and Technology. The meter shall incorporate an empty pipe detection feature which shall cause the meter to register zero flow when the sensor is not full.

2. Signal Converter/Transmitter

Signal converter shall be mounted remotely from the meter in the Main Control Panel (MCP). Signal converter shall be flush mounted on the MCP door as shown on the Construction Drawings. Contractor shall provide door cut-out, support brackets, and bezel as required for flush door mounting.

Signal converter shall provide a 16-character alphanumeric display indicating flow units as specified herein and total flow in Gallons X 100.

Features allowing menu selection, calibration, and program changes to be made from outside the housing shall be incorporated.

It shall produce a 4-20 mA DC output signal into a minimum load of 800 ohms, linear to flow, and a scaled pulsed output.

3. Manufacturer

Magnetic flow meters shall be the product of ABB, Endress & Hauser, or Siemens (no substitutions). Manufacturers shall modify or supplement standard equipment to provide features as specified herein. Manufacturers shall guarantee equipment against defects in material and workmanship for a period of two years from date of project acceptance.

E. Operator Interface Terminal (OIT)

OIT shall have a 5.7" TFT 65,536 color screen with resistive type touch screen and 270 cd/m² brightness. OIT shall require 24 VDC power and comply with EN50081-2, EN50082-2, and FCC Class A standards. OIT shall be connected to District's Kingfisher RTU via 8-conductor flat communications cable and software shall be compatible with District's RTU. OIT shall be C-More Touch Panel Part No. EA7-T6CL-R as manufactured by Koyo Electronics (no substitutes).

2.07 BASIC CONSTRUCTION MATERIALS AND COMPONENTS

A. General

Specification requirements for basic construction materials and components utilized in sewage lift station construction are provided hereinafter. Not all construction materials and components required for lift station construction are included herein.

Contractor shall refer to the District's Approved Materials List, Engineering Standard Detailed Provision Sections, and the SSPWC for items not included in this Specification.

B. Valves

1. General

All interior non-working ferrous surfaces other than stainless steel shall be given an epoxy coating.

All valve interiors shall be fusion bonded epoxy coated (8 to 12 mils) in accordance with AWWA C550 (latest). District shall approve epoxy coating materials and methods before application. Completed coating shall be free from all defects and shall be inspected by use of low voltage holiday detecting and non-destructive thickness gauges.

Where the manufacturer demonstrates in writing that it would be impossible to use the powder epoxy method without causing damage to the valve components, the use of a liquid epoxy will be permitted upon approval by the District.

2. Swing Check Valves

Each pump shall be equipped with a full flow type swing check valve, minimum 4" size, with flanged body and be fitted with external lever and spring. Swing check valves shall be provided in accordance with AWWA C508. Valves shall be fully opening, have a flanged cover piece to provide access to the disc, and be designed for minimum water-working pressure of 150 psi. The valve body and cover shall be ductile iron or cast iron conforming to ASTM A-126, Class B, with flanges conforming to ANSI B 16.1, Class 125. The valve disc shall be cast iron, ductile iron, or bronze conforming to ASTM B 62. Valve seat and rings shall be bronze conforming to ASTM B 62. The hinge pin shall be of bronze or stainless steel. Swing check valves shall be the product of a single manufacturer and shall be APCO, Clow, Mueller, M&H, Kennedy, or Stockham, no substitutes.

3. Plug Valves

Plug valves shall be of the non-lubricated eccentric type with cylindrical/rectangular port design. The port area shall be 100% of the standard pipe area. The valve body and plug shall be constructed of cast iron meeting the requirements of ASTM A-126, Class B. Valve bearing shall be constructed of corrosion resistant stainless steel. The entire plug shall be completely encapsulated with Buna N rubber. The valves shall be flanged with dimensions, facing, and drilling in full conformance with ANSI B 16.1, Class 125.

With the plug in the full open position, valve shall have no cavities where debris can collect, have minimal head loss and be capable of passing a clean out pig with the same nominal diameter as the adjacent pipe. Valves shall be equipped with worm gear operators conforming to AWWA C504, Section 3.8. All eccentric plug valves shall have a pressure rating of not less than 150 psi, for bubble tight shut off. Valves shall be the product of a single manufacturer and shall be DeZurik Corporation PEF, or equal.

Valves shall be installed in strict accordance with the manufacturer's written instructions and as specified in the District's Detailed Provisions Section 15105, Part 3.

4. Combination Sewage Air and Vacuum Valves

a) General

Combination sewage air and vacuum valves shall have an elongated body and be of the type that automatically exhausts large quantities of air during filling of the system, allows air to re-enter during draining of the system, and allows accumulating air to escape while in operation and under pressure.

b) Stainless Steel Combination Sewage Air and Vacuum Valves

Each valve unit shall be supplied with isolation valve (solid wedge gate). Backflush shutoff valve and supply hose are not required. The unit shall be designed for an operating pressure of not less than 125 psi. The body and cover shall be Type 316L stainless steel. Anti-surge orifice float, upper float, and lower float assembly shall be high density polyethylene. O-ring seats shall be EPDM rubber and seat hardness shall be selected by the manufacturer for actual operating pressure of the system. Stainless steel combination sewage air and vacuum valves shall be Vent-O-Mat Series RGX, no substitutes.

C. Piping and Fittings

1. Ductile iron pipe shall conform with AWWA C 150 and C 151. Unless specified otherwise on the Construction Drawings, ductile iron pipe shall be minimum Class 53 thickness.
2. Flanged ductile iron pipe shall conform to AWWA C 115 and grooved ductile iron pipe shall conform to AWWA C 606. Flanges shall be ductile iron Class 125, ANSI B16.1.
3. Ductile iron fittings shall be Class 250 and shall conform to AWWA C 110. Ductile iron mechanical joint fittings shall be Class 350 and shall conform to AWWA C104.
4. All ductile iron pipe and fittings shall have an interior cement mortar lining of standard thickness in accordance with AWWA C 104.
5. Below grade ductile iron pipe and fitting shall be provided with an exterior asphaltic coating in accordance with AWWA C 151 and polyethylene encasement in accordance with AWWA C 105.

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6. Stainless steel pipe shall conform with ANSI B36.19 and ASTM A312. Unless specified otherwise on the Construction Drawings, stainless steel pipe shall be Grade 316, Schedule 40.
7. Stainless steel fittings 2 inches and smaller shall be ASTM A351, Grade 316, ANSI B16.3, Class 150, threaded.
8. Stainless steel fittings 2 1/2 inches and larger shall be ASTM A403 and A774, Grade 316, ANSI B16.9, B36.19. Schedule 40, standard weight, smooth-flow (mitered fittings are not acceptable).
9. Stainless steel flanges shall be ANSI A182, Grade 316, slip-on or weld neck ANSI B16.5, Class 150.
10. All stainless steel piping, fittings, and flanges shall be shop welded (field welding not permitted). All welds shall be pickled and passivated in accordance with Part 2.11 "Stainless Steel Passivation".

D. Concrete

Unless specified otherwise on the Construction Drawings, all concrete shall be Class AA per District Detailed Provisions, Section 03300. Cement shall be Type V per ASTM C 150. Prior to commencing construction, Contractor shall submit the proposed concrete mix design to the District for review and acceptance.

All concrete construction shall be in accordance with District Detailed Provisions, Sections 03150, 03200, and 03300.

E. Miscellaneous Metals

1. Steel

Rolled shapes, plates, and bars shall conform to AISC "Manual of Steel Construction" and ASTM Specification A-36, latest editions.

- a) Stainless Steel. Unless otherwise designated or approved, Contractor shall use Type 316 stainless steel alloy conforming to ASTM A-167 and ASTM A-276, latest editions, for plates and bars.
- b) Steel Pipe. Material shall conform to ASTM A-53, Grade B seamless galvanized as required, Schedule 40.

2. Cast Iron

Material shall conform to ASTM A-48, Class 30, except as specifically designated otherwise.

3. Ductile Iron

Material shall conform to ASTM A-536 using grade 60-40-18 or better, except as specifically designated otherwise.

4. Aluminum

- a) All plate, pipe, and structural shapes shall be new and shall conform to ASTM B209 (Plate), B308 (Shapes), B429 (Pipe and Tubing), B211 (Bar Stock), and applicable Federal Specifications for 6061-T6 alloy, unless otherwise designated.
- b) Aluminum pipe rail shall be of 6061-T6 alloy and be Schedule 40 or greater.
- c) Alloys and tempers for various members where not otherwise designated, shall be as required for proper forming and fabrication to meet or exceed structural requirements, and shall be of alloys specially produced to best achieve specified color anodized finishes. Contractor shall provide supporting printed recommendations from parent aluminum producer. For sheet fabricated members, Contractor shall use only homogenous aluminum products and no clad products.
- d) Contingent upon alloys being welded, Contractor shall use only inert gas shielded arc or resistance welding process with filler alloys as specified in the UBC. Contractor shall not use any process requiring a welding flux.

5. Stainless Steel Bolts

Except as otherwise designated or specified, all bolts, anchor bolts, cap screws, studs, and fasteners shall be Type 316 conforming to ASTM F-593; nuts shall conform to ASTM F-594.

6. Flange Hardware

With the exception of stainless steel flanges, all flange bolts, nuts, and fasteners shall be A325. Nuts shall be heavy hex cold-press semi-finished steel per ASTM A194-2,2H. Threads shall be lubricated with an approved anti-seize compound.

7. Deferred Bolting Devices

Deferred bolting devices are noted on the Construction Drawings as wedge anchors, expansion anchors, or epoxy anchors. Deferred bolting devices shall be used in lieu of anchor bolts only where specifically noted or detailed. Unless noted otherwise on the Construction Drawings, deferred bolting devices shall be 316 stainless steel, shall be installed in accordance with current I.C.B.O. Research Report Approval, and shall consist of the following:

- a) Wedge anchors or expansion anchors shall be ITW Ramset/Redhead Trubolt Anchors, Hilti Kwik Bolt II Anchors, Simpson Strong-Tie Strong-Bolt 2 Anchors, or equal.
- b) Epoxy anchors shall be ITW Ramset/Redhead Epcon C6+ Epoxy Anchors, Hilti HIT-RE 500-SD Adhesive Anchors, Simpson Strong-Tie Set XP Epoxy Anchors, or equal.
- c) Wedge anchors or expansion anchors shall not be used inside the wet well or for anchorage of any vibrating machinery or equipment.

8. Galvanizing

- a) Iron and Steel. Galvanizing shall conform to ASTM A123, with minimum weight per square foot of 1.25 ounces.
- b) Ferrous Metal Hardware Items. Galvanizing shall conform to A153, with average coating weight of 1.25 ounces per square foot.
- c) Touch-Up Material for Galvanized Coatings. Galvanized coatings marred or damaged during erection or fabrication shall be repaired by use of DRYGALV as manufactured by the American Solder and Flux Company, Galvalloy, Galvion, or equal, applied in accordance with the manufacturer's instructions.

F. Electrical Conduit and Conductors

1. Conduit

- a) PVC-Coated Rigid Galvanized Steel Conduit. Conduit shall be Schedule 40 steel, pipe size, finished inside and out by hot-dipped galvanizing, and shall conform with ANSI C80.1 and UL. A PVC coating of 40 mils (minimum) thickness shall be bonded to the outer galvanized surface of the conduit and a urethane coating shall be applied to the interior surface of the conduit. The bond between the PVC coating and conduit surface shall be greater than the tensile strength of the plastic.

A PVC jacketed coupling shall be furnished with each length of conduit. PVC-coated Rigid Galvanized Steel conduit and fittings shall be manufactured by Robroy, Occidental, or equal.

- b) Rigid Non-Metallic Conduit. Conduit shall be UL listed, sunlight resistant, Schedule 40 PVC conduit, rated for 90 degrees C conductors, and manufactured to NEMA TC-2 standards. Couplings and connectors shall be of the same manufacturer as the conduit and shall be joined as recommended by the manufacturer. All PVC conduits shall be terminated with approved connectors or end bells.

2. Conductors

- a) General

Cables and wires shall be new, stranded conductors, solid copper, not smaller than #12 AWG (except shielded control wires and internal control wires in MCCs and control panels) unless otherwise shown on Drawings. Insulation shall bear manufacturer's trademark, insulation designation, voltage rating, and conductor size at regular intervals. Each type of cable or wire shall be the product of a single manufacturer.

Conductors for power service, power feeders, power circuits, and lighting feeders, lighting circuits, and external control circuits shall be stranded copper, rated 600 volt, with 75 degrees C THWN insulation, UL approved, for installation underground, in concrete, in masonry, or in wet locations.

- b) Color Coding

System conductors shall be factory color coded by integral insulation pigmentation with a separate color as specified herein. Conductors #6 AWG and larger may be color coded with an approved colored marking tape at all terminations and in all junction boxes, pull boxes, and manholes. Each voltage system shall have a color coded system that shall be maintained throughout the project. Approved conductor colors are as follows:

<u>Power System</u>	<u>Service</u>	<u>Color</u>
480V, 3 Phase, 4 Wire	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow
	Neutral	White
120/208/240V, 3 Phase, 4 Wire	Phase A	Black

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	Phase B	Red
	Phase C	Blue
	Neutral	White
All Equipment	Ground	Green
All System	Ground	Bare Copper
	<u>Control System</u>	<u>Service</u>
		<u>Color</u>
PLC (Status and Control)	Digital Input	Blue
	Digital Output	Brown
120V	Positive	Red
	Negative	White
24V	Positive	Yellow
	Negative	Blue
12V	Positive	Red
	Negative	Black
120V	Switched Leg	Not Black, Red or Blue
480V	Switched Leg	Not Brown, Orange, or Yellow

G. Device Boxes, Junction Boxes, and Fittings

1. Device Boxes (Only Permitted for Locations Beyond 20' of Wet Well)

Unless otherwise noted on the Drawings, device boxes shall be malleable iron constructed with zinc or cadmium plating and enamel finish, minimum single gang size, deep box type, with treaded hubs and solid gasketed cover. Device boxes shall be properly sized for required circuitry or splicing. Surface mounted boxes shall be furnished with mounting lugs. Where located outdoors, device boxes shall be waterproof. Device boxes shall be Crouse-Hinds FD, Appleton FD, or equal.

2. Junction Boxes (Only Permitted for Locations Beyond 20' of Wet Well)

Unless otherwise noted on the Drawings, junction boxes shall be malleable iron constructed, rain tight, dust tight, minimum size 4"x4"x3", drilled and tapped or field installed with slip holes (alternate hub plates are acceptable). Junction boxes shall be properly sized for the number and sizes of conductors and conduit entering the box and required splicing. Provide feet where necessary for surface mounting. Junction boxes shall be Crouse-Hinds WAB, Appleton RS, or equal.

3. Device Boxes (Required for Locations Within 20' of Wet Well)

Where specified on the Drawings, device boxes shall be constructed of 316 stainless steel, minimum single gang size, deep box type, with gasket and 316 stainless steel solid cover. Device boxes shall be properly sized for required circuitry or splicing. Surface mounted boxes shall be furnished with mounting lugs or feet. Device boxes shall be NEMA 4X as manufactured by BEL Products, Inc., Cushing Manufacturing Co., or equal.

4. Junction Boxes (Required for Locations Within 20' of Wet Well)

Where specified on the Drawings, junction boxes shall be constructed of 316 stainless steel, with gasket and 316 stainless steel solid cover. Junction box minimum size shall be 4"x4"x3". Junction boxes shall be properly sized for required circuitry or splicing. Provide feet where necessary for surface mounting. Junction boxes shall be NEMA 4X as manufactured by BEL Products, Inc., Cushing Manufacturing Co., or equal.

5. Fittings

Conduit fittings shall be provided where shown on the Drawings or required to facilitate installation of the electrical conduit and equipment.

- a) Conduit fittings shall be PVC coated metallic fittings and furnished by the same manufacturer as the PVC coated conduit to provide a complete and compatible protective system. PVC coated fittings and couplings shall have specially formed sleeves to tightly seal to conduit PVC coating. The sleeves shall extend beyond the fitting or coupling a distance equal to the conduit outside diameter or two inches, whichever is greater.
- b) Non-metallic fittings shall be compatible with the non-metallic conduit used and shall be of the same manufacturer.
- c) Fittings shall be of the shapes, sizes, and types required to facilitate installation or removal of conductors and cables from the conduit.
- d) Connectors, couplings, locknuts, bushings, and caps used with PVC-coated Rigid Galvanized Steel conduit shall be threaded and thoroughly galvanized. All exposed surfaces shall be PVC coated. Bushings shall be insulated and shall be threaded malleable iron with thermoplastic liner. Insulated grounding bushings shall be provided with threaded malleable iron body, insulated thermoplastic liner throat, and "lay-in" ground lug with compression screw.

- e) Metallic conduit unions shall be "Erickson" couplings, or approved equal. Running threads are not acceptable.

H. Channel (Unistrut) Supports

Unless otherwise specified, support channel (Unistrut) shall be single strut type, 1-5/8" x 1-5/8", 12 gauge ASTM A240, Type 316 stainless steel.

I. Protective Coatings

1. General

- a) All coating materials supplied under this provision shall be manufactured by Tnemec, PPG (Ameron), or Carboline, no substitutes. Products specified herein are those which have been evaluated and recommended by the manufacturers for the specific service. Only replacement product recommended by said manufacturers will be considered for substitutions.
- b) All materials shall be brought to job site in original sealed containers. Contractor shall provide coating material name, formula or specification number, batch number, color and date of manufacture to the District. Coating materials shall not be used until the District has inspected contents and checked information on containers or label. Materials exceeding storage life recommended by the manufacturer shall be rejected.
- c) All coatings and paints shall be stored in enclosed structures to protect them from weather and excessive heat or cold. Flammable coatings or paints must be stored to conform with city, county, state, and federal safety codes for flammable coating or paint materials. Water based coatings or paints shall be protected from freezing.
- d) Contractor shall use products of same manufacturer for all coating systems unless approved in writing by the District.
- e) All coatings shall comply with local, state, and federal air pollution control regulations including, but not limited to, SCAQMD Rule 1113 and Rule 1107. These regulations change frequently. If a listed coating does not meet local, state, and federal air pollution control regulations at the time the work is actually performed, the Contractor shall provide the manufacturer's compliant, recommended substitute coating at no additional cost to the District.
- f) All colors and shades of colors of all coats of protective coating material shall be as selected by the District.

g) Finish and Protective Coating

Coatings shall be applied in accordance with the table below:

Item	Coating
Exterior Concrete Surfaces	No coating required.
Wet Well Below Grade Exterior Concrete Wall Surfaces	No coating required.
Wet Well Interior Concrete Wall Surfaces or Slabs	Coat per Service Condition D.
Concrete Masonry Surfaces	No coating required, unless shown on Drawings.
Exposed Ferrous Metal Piping, Valves, Fittings, and Appurtenances	Coat per Service Condition A. Color coat and label per Specification requirements.
Below Grade Ferrous Metal	Coat per Service Condition C.
Equipment and Motors	Factory coating. Touch up where damaged per manufacturers requirements.
Miscellaneous Ferrous Metal (Exterior)	Coat per Service Condition A.
Hot Dipped Galvanized Steel	No coating required.
Stainless Steel	No coating required.
Exposed PVC and CPVC Piping	Coat per Service Condition E.
Aluminum	No coating, except where bearing against or embedded in concrete.
NEMA 1, 12, or 3R Electrical Panels	Factory coating, baked enamel. Touch up where damaged.
Electrical Device Boxes	Factory PVC coating.

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Item	Coating
Pipe Supports	Hot dipped galvanized or stainless steel as noted.
Exposed Electrical Conduit	No additional coating required.
Below Grade Copper Tubing and Brass Pipe	25 mil (min.) Aqua Shield or Stream Line Protec.

h) Pipe Color Code and Labeling

All exposed and/or unburied pipe, including steel, copper and brass tubing, galvanized pipe, polyvinyl chloride pipe, fiberglass reinforced pipe, and stainless steel pipe shall be identified by color to show its use/function. Color bands of an approved tape type may be used on PVC, FRP, and stainless steel

pipe and all other pipe not readily susceptible to painted finish. Bands shall be adhesive type with extra strength and suitable for continuous duty at 250°F. All markers shall have a protective silicone film. Color shall be as specified in the table below:

Duty	Color Code	Label
Air Vent	Gray	AV
Air Valve Drain	Gray	AVD
Drain	Gray	D
Four Air	White	FA
Potable Water	Safety Blue	PW
Raw Sewage Backflush	Brown	RSB
Raw Sewage Discharge	Brown	RSD
Raw Sewage Forcemain	Brown	RSF
Sanitary Drain	Brown	SD
Seal Water	Gray	SW

Both the direction of the fluid flow and the duty label of the pipe shall be stenciled on all above grade or exposed pipe (in Safety Yellow) at least once every twenty-five (25) feet and at every change of direction. Color bands (if used) shall be spaced at fifteen (15) foot intervals and every change in direction. The size of the letters and color bands shall be as specified in the table below:

Outside Diameter of Pipe or Covering (Inches)	Width of Color Band (Inches)	Height of Label Letters (Inches)
1/4 to 1-1/4	1	1/2
1-1/2 to 2	1	3/4
2-1/2 to 6	6	2

Outside Diameter of Pipe or Covering (Inches)	Width of Color Band (Inches)	Height of Label Letters (Inches)
8 to 10	6	2-1/2
Over 10	6	3-1/2

i) Stencil Valve Tag Numbers on Piping

After the painting of process piping is complete, the Contractor shall stencil the tag numbers, as supplied by the District, of all valves on the pipe adjacent to the valve for pipe 2 inches and over. Characters shall be 1 inch high minimum and shall be oriented to be visible from the valve operating position. When the valve has extended operator shaft or chain operator, the number shall be placed both at the operating position and at the valve, if practicable. The latter requirement does not apply if the valve is buried or in a pit. Valves in pipes under 2 inches shall have characters as large as the pipe will permit or at the District's option, on an adjacent surface. Characters shall be preferably white; however, if this would not provide sufficient contrast to the pipe, the District may select another color. Paint used shall be of the same type and quality as used for painting the pipe.

2. Service Condition A

Ferrous metals (excluding stainless steel) subject to outdoor exposure such as outdoor tanks, piping, valves, and equipment, etc. shall receive the following surface preparation and coating:

- a) Surface Preparation. All surfaces shall be field sandblasted in conformance with Steel Structures Painting Council Specifications SSPC-SP10 and National Association of Corrosion Engineers Surface Finish NACE No. 2 (Near-White Blast Cleaning) to achieve a 1.5-2.5 mil (40-60 micron) blast profile.
- b) Application. Application shall be in strict accordance with manufacturer's recommendations. The minimum and maximum required times between coats shall be per the manufacturer's product data sheet. Written requests for shop surface preparation and application of the prime coat shall be reviewed and approved by District on a case-by-case basis. If approved by District, shop applied prime coat surface shall be field scarified by brush-blasting prior to application of intermediate coat.

- c) Coating System. Except as otherwise noted, the prime coat shall have a minimum dry film thickness (MDFT) of 4.0 mils. The intermediate coat shall have a MDFT of 4.0 mils and the finish coat shall have a MDFT of 2.0 mils. The total dry film thickness of the complete system shall be 10.0 mils, minimum.

PPG System Primer - Amerlock 2VOC
 Intermediate - Amerlock 2VOC
 Finish - Amershield VOC

Carboline System Primer - Carboguard 890VOC
 Intermediate - Carboguard 890VOC
 Finish - Carbothane 134 MC

Tnemec System Primer - Series L69 Epoxyline
 Intermediate - Series L69 Epoxyline
 Finish - Series 1080 Endurashield

3. Service Condition B

Ferrous metals (excluding stainless steel) submerged or intermittently submerged in sewage or similar corrosive liquid, including all ferrous metal located within the lift station wet well, shall receive the following surface preparation and coating:

- a) Surface Preparation. All surfaces shall be field sandblasted in conformance with SSPC-SP5 and NACE No. 1 (White Metal Blast Cleaning) to achieve a 3 mil (75 micron) angular anchor blast profile.
- b) Application. Application shall be in strict accordance with manufacturer's recommendations. If recoating is required to correct pinholes, holidays or insufficient coating thickness; surfaces shall be scarified by brush-blasting prior to recoat.
- c) Coating System. Except as otherwise noted, one or two coats shall be applied at a MDFT of 30.0 mils.

PPG System Sigma Novaguard 840

Carboline System Carboguard 954HB

Tnemec System Series 435 Perma-Glaze

4. Service Condition C

Buried metal surfaces shall receive the following surface preparation and coating:

- a) Surface Preparation. All surfaces shall be cleaned in conformance with SSPC-SP10/NACE 2 (Near White Blast Clean) with a 2 mil anchor blast profile.
- b) Application. Application shall be in strict accordance with manufacturer's recommendations. The minimum time required between coats and prior to backfilling shall be per the manufacturer's product data sheet.
- c) Coating System. Except as otherwise noted, two or more coats shall be applied to a minimum total dry film thickness of 30 mils.

PPG System	Sigma Novaguard 840
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Carboline System	Carboguard 954HB
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Tnemec System	Series 435 Perma-Glaze
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5. Service Condition D

Concrete subject to continuous or intermittent submergence in sewage, including all interior surfaces of the wet well, shall receive the following surface preparation and coating:

- a) Surface Preparation. All surfaces shall be thoroughly cleaned by sandblasting in conformance with SSPC–SP13/NACE 6, ICRI CSP 5 surface preparation of concrete or other approved methods, removing all traces of previous materials. Remove all loose concrete by chipping, etc. to leave only sound firmly bonded concrete. All cracks and voids shall be filled with the specified epoxy filler and surfacer. Final surface shall be smooth and free of voids, cavities, dirt, dust, oils, grease, laitance or other contaminants.
- b) Application. Application shall be by spray-on and/or trowel method and shall be in strict accordance with manufacturer's recommendations. The minimum and maximum required times between coats shall be per the manufacturer's product data sheet. If recoating is required to correct pinholes or insufficient system coating thickness, surfaces shall be brush-blasted prior to recoat.

- c) Coating System. The coating system shall be specifically manufactured for highly corrosive environments caused by immersion and intermittent immersion in municipal wastewater. Minimum total dry film thickness of the coating system shall be 125 mils.

Carboline System	Finish - Plasite 5371
Tnemec System	Filler/Surfacer - Mortar Clad – Series 218 Lining – Perma-Shield H2S – Series 434 Finish – Perma-Glaze – Series 435
Sauereisen System	Filler/Surfacer - Resto Krete No. 209 Epoxy Lining - Sewergard No. 210X

6. Service Condition E

Exposed PVC and CPVC piping shall receive the following surface preparation and coating (coating to be used for this category shall be certified by the PVC and CPVC piping manufacturer to be completely acceptable and non-injurious to the material):

a) Surface Preparation

Surface preparation shall consist of hand sanding to remove gloss. All remaining dust shall be removed with vacuum brushing or tack rag. Sanded surfaces shall not be washed with either solvent or water.

b) Application

Application shall be in strict accordance with manufacturer's recommendations.

c) Coating System

Except as otherwise noted, two coats shall be applied at 2.0 mils per coat to a total 4.0 mil MDFT for the system.

Carboline System	Carbothane 134 MC
PPG System	Amershield VOC
Tnemec System	Series 80 Endurashield

7. Architectural Paint Finishes

Concrete Masonry Paint on Concrete

Frazer Paint System: First Coat - 203 Duratec II Exterior
100% Acrylic Flat

Second Coat - 203 Duratec II
Exterior 100% Acrylic Flat

Sherwin Williams System: First Coat – Loxon Concrete
Masonry Primer

Second Coat – Loxon Acrylic
Coating

Vista Paint System: First Coat - Vista 4600 Uniprime II
Masonry Primer

Second Coat- Vista 2000 Duratone
100% Acrylic Flat

Third Coat - Vista 2000 Duratone
100% Acrylic Flat

Dunn Edwards System: First coat - Eff Stop Premium
Primer (ESPR00)

Second Coat - Evershield 100%
Acrylic (EVSH10)

Third Coat - Evershield 100% Acrylic
(EVSH10)

8. Aluminum Metal Isolation

All aluminum bearing on, or embedded in, concrete shall be coated with a wash primer (0.5 mils) followed by one coat (8 mils) of heavy bodied bituminous paint, Carboline Bitumastic Super Service Black or Tnemec 46-465.

J. Asphalt Concrete Pavement

Unless specified otherwise on the Construction Drawings, all asphalt concrete pavement shall be per District Detailed Provisions, Sections 02201 and 02513 and as specified hereinafter.

Asphalt concrete pavement shall be hot placed to 4" thickness minimum placed over 6" of crushed miscellaneous base (per SSPWC Section 200-2.4) and compacted to 95 percent relative compaction minimum. Pavement shall be placed in two lifts. The first lift shall be C1-PG64-10 and the second lift shall be D2-PG64-10.

Unless specified otherwise, prior to placing crushed miscellaneous base, the subgrade shall be scarified to a minimum depth of 6" and then compacted to 95 percent relative compaction.

K. Danger and Warning Signs

Equipment Danger Signs and Warning Signs shall be provided as specified herein. Signs shall be constructed of 40-mil aluminum with rounded corners and mounting holes at each corner. Signs shall resist fading in direct sunlight and be suitable for temperatures ranging from -40°F to 176°F. Manufacturer shall submit a list of all print and background color combinations for confirmation by District. Unless noted otherwise, text size shall be 3/4" tall and signs shall be sized accordingly. Indoor/outdoor signs shall be Style No. M0719 by Seton, or approved equal.

Typical Danger Sign (sign shall be stenciled directly on access hatch, or mounted to access hatch with stainless steel rivets, as directed by District):

Line 1	"DANGER" Yellow letters on black background
Line 2	"CONFINED SPACE" black letters on yellow background
Line 3	"PERMIT REQUIRED"
Line 4	"PRIOR TO ENTRY"
Location	Mount on wet well access hatch

Danger Sign (One (1) required):

Line 1	"DANGER" white letters on red background
Line 2	"EQUIPMENT" black letters on white background
Line 3	"STARTS" black letters on white background
Line 4	"AUTOMATICALLY" black letters on white background
Location	Mount on generator enclosure

Submersible Lift Station with Standby Power
Section 11200 – 40

Danger Sign (One (1) required):

Line 1	"DANGER" white letters on red background
Line 2	"EAR" black letters on white background
Line 3	"PROTECTION" black letters on white background
Line 4	"REQUIRED" black letters on white background
Location	Mount on generator enclosure

Danger Sign (Three (3) required):

Graphic Symbol	Hazmat label in compliance with NFPA No. 704
Line 1	"DANGER" white letters on red background
Line 2	"DIESEL" black letters on white background
Line 3	"FUEL" black letters on white background
Location	Mount on generator enclosure and both gates

Typical Warning Sign:

Line 1	"WARNING" white letters on red background
Line 2	"DO NOT DRINK" black letters on white background
Location	Mount adjacent to each hose bib

2.08 EMERGENCY STANDBY POWER GENERATOR SET

Contractor shall furnish and install a 4-cycle, 1800 rpm, diesel engine generator set as manufactured by Olympian (supported by Caterpillar), Caterpillar, Cummins, or Generac, (no substitutes). Generator set shall be capable of starting and operating all motor loads and low voltage transformer loads shown on the Construction Drawings. Maximum allowable instantaneous voltage dip as defined per NEMA MG1 shall be 20 percent. As a minimum, the generator set standby power rating shall be as shown on the Construction Drawings and shall be based on site conditions noted below.

System Voltage: 480 Volts AC, three phase, four-wire, 60 hertz.

Site Conditions: Altitude 1500 ft. (minimum - Contractor shall confirm for actual project site), and ambient temperature of 110 degrees F.

A. Permits and Requirements for South Coast Air Quality Management District (SCAQMD)

1. Permits

A permit to construct and to operate is required from the SCAQMD for any emergency standby generator set with a rated brake horsepower greater than 50 (>50 bhp). Permit must be obtained prior to construction of the generator facilities and generator installation. Time is of the essence in providing generator

submittals for District's approval and for the permit applications. The emergency standby power system shall conform to all requirements of SCAQMD for standby generators. Manufacturer shall equip the engine generator with the necessary devices (such as a Level 3 diesel particulate filter verified by California Air Resources Board (CARB)) to meet the current SCAQMD regulations for the operation of a diesel emergency standby generator. Engine generator set shall be "pre-certified"/"pre-approved" by SCAQMD for emergency standby power service. Engine generator set shall have the highest available tier rating, in accordance with EPA Tier Certification Requirements.

Manufacturer shall be responsible for providing all engine data required as part of the SCAQMD permit process. Contractor shall provide District with application forms for the SCAQMD Permit to Construct and Operate. Application forms shall be complete except for District information and signature. District shall execute application and return same to Contractor to submit to SCAQMD for approval. Developer shall pay all required permit fees. The genset shall be constructed and operated in accordance with the conditions of the SCAQMD Permit to Construct and Operate.

2. SCAQMD Rule 1470

The generators shall meet all requirements and emissions standards set forth in SCAQMD Rule 1470.

If required by SCAQMD Rule 1470 to install a diesel particulate filter (DPF), the generator shall be furnished with a DPF to reduce the diesel PM in accordance with SCAQMD Rule 1470. The DPF shall meet the following requirements:

- a) The DPF shall utilize active regeneration technology or a low temperature passive DPF may be used. Please note for a low temperature passive DPF to be used, it must operate at exhaust temperatures that are low enough not to require a load bank for regeneration.
- b) The DPF shall be manufactured by Johnson Matthey, Clear Air System, Miratech, or Rypos Inc.
- c) The DPF shall be at least a California Air Resources Board (CARB) Level 3 verified for the specific make/model engine that will be installed with a particulate matter (PM) reduction greater than 85%.
- d) The CARB Executive Order for the DPF shall either list compatibility to the generator engine family name or approval shall be granted by SCAQMD.

- e) The engine must be a certified CI engine that meets the following standards:
 - (i) PM emission standards specified in SCAQMD Rule 1470 Part (c)(2)(C)(iv) or (c)(2)(C)(v) or (c)(2)(C)(vi).
 - (ii) Emission standards specified in SCAQMD Rule 1470 Part (c)(2)(C)(vii) for other pollutants.
- f) Regeneration shall be automatic and shall keep the filter cartridges functioning at low exhaust temperature and generator load level.
- g) Differential pressure sensors to initiate and control regeneration process as a function of back pressure shall be provided if an active DPF is used. For active and passive DPFs, back pressure must not exceed 90% of engine manufacturer's specification and shall be coordinated with other exhaust system components (e.g. silencers, piping, etc.). A Backpressure monitor shall be provided for active and passive DPFs to notify District when high backpressure limit is reached. A N.O. dry contact that closes if the backpressure limit is reached shall be provided for District use.
- h) If an active DPF is used, an alarm shall be provided if there is no power from the generator to the DPF. A N.O. dry contact that closes if there is a loss of power to the DPF shall be provided for District use.
- i) Suitable for horizontal mounting with flanged inlets and outlets.
- j) Housing and flanges shall be stainless steel.
- k) Remote status panel with LED visual indication and dry contact customer alarms.

B. Performance

Voltage regulation shall be +/- 1.0 percent for any constant load between no load and rated load.

An electronic governor system shall provide automatic isochronous frequency regulation 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 percent.

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

C. Engine

The engine shall be diesel, 4 cycle, radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable. The engine shall be manufactured by Caterpillar, Cummins, John Deere, or Perkins, no substitutes. Engine accessories and features shall include:

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

The generator set shall be equipped with a skid-mounted, engine-driven radiator with blower fan and all accessories. The cooling system shall be sized to operate at full rated load and 110 degrees F ambient air entering the generator set enclosure. The cooling system shall be filled with 50/50 ethylene glycol/water mixture by the equipment supplier. Rotating parts shall be guarded against accidental contact per OSHA requirements. The generator set supplier shall be responsible for providing a properly sized cooling system based on the enclosure static pressure restriction.

A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be as recommended by the engine manufacturer. The electric starter shall be capable of a minimum of three complete cranking cycles without overheating.

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

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

An engine driven, mechanical, positive displacement fuel pump. Fuel filter with replaceable spin-on canister element.

Replaceable dry element air cleaner with restriction indicator.

All fuel piping shall be black iron, or flexible fuel hose rated for this service. Flexible fuel lines rated 300 degrees F and 100 PSI.

Engine mounted battery charging alternator and solid-state voltage regulator.

D. AC Generator

The synchronous generator shall be a single bearing, self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly connected to the engine flywheel housing with a flex coupling. The insulation material shall meet NEMA standards for Class H insulation and be impregnated in a polyester varnish or vacuum impregnated with epoxy varnish to

be fungus resistant. Temperature rise of the rotor and stator shall not exceed NEMA class F (130 °C rise by resistance over 40 °C ambient). The excitation system shall be of brushless construction.

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.

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 percent of rated current for ten seconds during a fault condition.

E. Voltage Regulator

An automatic voltage regulator (AVR) shall be provided to maintain generator output voltage within +/- 1.0 percent for any constant load between no load and full load. The regulator shall be a totally solid state design, which includes electronic voltage buildup, volts per Hertz regulation, over-excitation protection, loss of sensing protection, temperature compensation, shall limit voltage overshoot on startup, and shall be environmentally sealed.

F. Engine-Generator Set Control

Provide a generator set mounted control panel for complete control and monitoring of the engine and generator set functions. Panel shall include automatic start/stop operation, cycle cranking, digital AC metering (0.5 percent true rms accuracy) with phase selector switch, shutdown sensors and alarms with horn and reset, adjustable cool down timer and emergency stop push-button.

Critical components shall be environmentally sealed to protect against failure from moisture and dirt. Components shall be housed in a NEMA 1/IP22 enclosure with hinged door. The panel itself shall be mounted on a separate support stand isolated from the engine / generator arrangement. Panel / breaker arrangements mounted on the generator set in such a way that access to the AC Generator terminal box is restricted in any way whatsoever are not acceptable.

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

1. Generator Set Metering

The generator set shall be provided with a metering set with the following features and functions:

- a) Engine oil pressure
- b) Coolant temperature
- c) Engine RPM
- d) System DC volts
- e) Engine running hours
- f) Generator AC volts
- g) Generator frequency
- h) Generator AC amps

2. Local Alarm and Status Indicators

The generator set shall be provided with the following alarm and status indicating lamps for protection and diagnostics according to NFPA 110, Level 1:

- a) Low oil pressure
- b) High water temperature
- c) Low coolant level
- d) Overspeed
- e) Overcrank
- f) Emergency stop depressed
- g) Approaching high coolant temperature
- h) Approaching low oil pressure
- i) Low coolant temperature
- j) Low voltage in battery
- k) Control switch not in auto position
- l) Low fuel main tank
- m) Battery charger ac failure
- n) High battery voltage
- o) Generator set main circuit breaker open
- p) DPF back pressure (or spare if DPF not required)
- q) Loss of power to DPF (or spare if DPF not required)
- r) One (1) spare

3. Control Functions / Interfaces

Provide the following control functions:

- a) Terminals located inside the control panel for REMOTE EMERGENCY STOP
- b) ON / OFF / AUTO control switch
- c) GENERATOR RUN form "C" dry contact set rated 2A @ 30VDC (one N.O., one N.C.).
- d) COMMON ALARM form "C" dry contact set rated 2A @ 30VDC to indicate existence of any alarm or shutdown condition on the generator set (one N.O., one N.C.).
- e) A fused 20 amp 12VDC 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.

G. Generator Set Auxiliary Equipment and Accessories

1. Water Jacket Heater

An engine mounted, thermostatically controlled, circulation type water jacket heater shall be provided for each engine. The heater shall be sized by the generator set manufacturer to maintain jacket water temperature at 90 degrees F, and shall be 120 or 240 volt, single phase, 60 hertz. Provide proper power supply circuits for the heater as required for the voltage and load of the heater, connected to a lighting panel circuit as shown on the Construction Drawings.

2. Space Heater

Provide a generator mounted space heater, 120 VAC, 1 phase.

3. Vibration Isolation

Provide vibration isolators, pad type, quantity as recommended by the generator set manufacturer and suitable for mounting to a concrete equipment base that are IBC Certified for seismic (Zone 4) applications. Generator set manufacturer shall provide the required type, size, location, and embedment depth of generator set anchor bolts. Manufacturer shall provide equipment anchorage calculations prepared by a registered professional civil or structural engineer in the State of California. Calculations shall be prepared in accordance with the Uniform Building Code (latest edition) for Seismic Zone 4 essential facilities.

4. Exhaust System

Engine shall be provided with a properly sized critical or hospital type silencer (or a diesel particulate filter (DPF) that incorporates a critical or hospital type silencer, if required), companion flanges, and flexible stainless steel exhaust fitting. The silencer (or DPF) and exhaust piping shall be factory mounted so that their weight is not supported by the engine nor will exhaust system growth due to thermal expansion be imposed on the engine. Exhaust pipe size shall be sufficient to ensure that exhaust backpressure does not exceed the maximum limitations specified by the engine manufacturer. The exhaust pipe outlet shall be provided with a removable rain cap (sized the same diameter as the outlet).

5. Starting and Control Batteries

A lead-acid storage battery set of the heavy-duty diesel starting type shall be provided. Battery voltage shall be compatible with the starting system. The battery set shall be rated no less than 75-ampere hours. All necessary battery cables and clamps shall be provided.

Battery tray(s) shall be provided for the batteries and shall conform to NEC 480-7(b). Battery tray(s) shall be resistant to deterioration by battery electrolyte. Further, construction shall be such that any spillage or boil-over battery electrolyte shall be contained within the tray to prevent a direct path to ground.

6. Battery Charger

A UL listed, current limiting battery charger shall be furnished to automatically recharge batteries. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input. AC input voltage shall be 120 volts, single phase. Charger shall be in a NEMA 1 enclosure and shall be mounted within the generator set enclosure or the automatic transfer switch panel.

7. Generator Set Main Circuit Breaker

Provide a generator mounted main circuit breaker, molded case construction, 3 pole, NEMA 1/IP22. Circuit breaker rating shall be as shown on the Construction Drawings. Circuit breaker shall utilize a thermal magnetic trip unit and DC shunt trip. The circuit breaker shall be UL listed with shunt trip device connected to engine/generator safety shutdowns. Circuit breaker shall be housed in a steel NEMA 1 enclosure. Circuit breaker shall be provided with a N.C. dry contact that opens when the circuit breaker is open.

8. Outdoor Sound Attenuated Enclosure

- a) Generator set shall be provided with a weather resistant, sound attenuated enclosure constructed of HR4P steel. Acoustical foam shall be provided between all supports and inside doors. Sound baffles shall be provided at air intake and air discharge openings. The enclosure shall attenuate generator set sound levels to 75 dBA at a horizontal distance of 23 feet with the generator set running under full load.
- b) Number of doors on enclosure shall be as required so that all normal maintenance operations, such as lube oil change, filter change, belt adjustment and replacement, hose replacements, control panel access, etc., may be accomplished without disassembly of any enclosure components. Access doors shall be fabricated of the same material as the enclosure walls and shall be reinforced for rigidity. Doors shall be equipped with rubber seals. Door handles shall be key lockable, all doors keyed alike, and hinges shall be zinc die cast or stainless steel. Fasteners shall be zinc plated or stainless steel.
- c) Enclosure air handling will be sized and designed by the manufacturer for a maximum 0.5" static pressure drop through enclosure. Air intake and discharge openings shall be screened to prevent the entrance of rodents. The system shall include a cooling and combustion air inlet silencer system, an equipment enclosure section, and a cooling air discharge silencer section.
- d) Radiator access shall be through a hinged, lockable cover on the enclosure. Engine cooling fan and charging alternator shall be fully guarded to prevent injury.
- e) Engine exhaust silencer shall be internally mounted in the enclosure to maintain the weather resistant integrity and aesthetic appearance of the system. Externally mounted silencers will not be permitted.
- f) All hinges and latches shall be rust resistant. Fasteners shall be zinc plated or stainless steel. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color utilizing electrostatically applied powder baked polyester paint.

9. Sub-Base Fuel Storage Tank

Provide a UL listed double walled, sub-base fuel storage tank. The double walled fuel storage tank shall be constructed of corrosion resistant aluminized steel and shall be provided with over-fill protection and tank rupture and low fuel level alarms. The fuel storage tank, as installed, shall meet all local and regional requirements for above ground diesel storage tanks.

The sub-base fuel storage tank shall contain: drain, baffles, vent, fuel gauge, and outside filler tube with locking cap. The tank shall be located within the generator set structural steel support frame and shall be of all welded construction. Fuel tank shall have sufficient capacity to allow continuous operation of the generator set for a minimum of 24 hours at 100 percent rated load. The fuel tank location shall not encroach upon the required electrical stub-up area directly beneath the generator set main circuit breaker box.

A full tank of fuel shall be provided at Contractor's expense before final acceptance of the lift station by the District.

10. Miscellaneous Accessories

Provide extended lube oil and radiator drains equipped with 316 stainless steel threaded ball valves, extension piping (to outside of enclosure) and threaded end caps.

11. Factory Testing

The assembled generator set shall be tested in the factory. The tests shall be performed at the manufacturer's regular place of business and shall be conducted on a "resistive load bank". These tests may be witnessed by the District's representative. Manufacturer shall provide minimum notice of five (5) working days prior to testing. Three (3) certified copies of the test results shall be forwarded to the District within five (5) days following the tests. Test results shall be reviewed and approved by the District prior to shipping generator set to the project site.

As a minimum, factory testing shall consist of the following:

- a) Perform engine manufacturer's recommended pre-starting checks.
- b) Start engine and make engine manufacturer's after-starting checks during a reasonable run-in or warm-up period.

- c) Run engine continuously as follows:
 - (i) Operate the engine for 30 minutes at 1/2 full rated load.
 - (ii) Follow above run immediately for 30 minutes at 3/4 full rated load.
 - (iii) Follow above run immediately for 30 minutes at full rated load.
 - (iv) If safe limits as specified hereunder and recommended by the engine manufacturer are exceeded during the preceding test, the necessary changes and adjustments shall be made and the complete test shall be repeated.
- d) Instrumentation: The following parameters shall be read and recorded at 15-minute intervals throughout the test:
 - (i) Engine oil pressure, jacket water temperature, engine RPM, and ambient air temperature.
 - (ii) Generator voltage, amperage, and frequency.
- e) Control test: Demonstrate operation of all local alarms and status indicators as specified in Part 2.08F.2 herein.

2.09 AUTOMATIC TRANSFER SWITCH

A. General

The automatic transfer switch shall be an integral part of power service and motor control center, and shall be mounted and wired at the factory, including mounting and wiring of door-mounted accessories. The automatic transfer switch (ATS) shall be as manufactured by ASCO, Olympian, Russelectric, or equal. The ATS and accessories shall be UL listed and labeled and tested per UL Standard 1008 and comply with NEMA ICS2-447, NFPA 70, NFPA 99, and NFPA 110.

The ATS shall include all necessary control devices and circuitry for a complete and operable system capable of the following operations:

1. Supply normal (utility) power to the motor control center when normal power is available. Supply standby power from the emergency standby power generator set when normal power fails or is disconnected.

2. Detect sustained loss or deterioration of "normal" power (power failure), signal the emergency standby generator to start and run when "normal" power fails, and when "standby" power from the generator is within proper limits of voltage and frequency, transfer to supply "standby" power to the motor control center.
3. Detect sustained restoration of "normal" power within proper limits of voltage and frequency, and then retransfer to supply "normal" power to the motor control center.
4. Provide dry contacts for connection to control panel to indicate normal power "on", loss of "normal" power, and "standby" power on.

B. Ratings and Components

The ATS controls and accessories shall be rated for continuous (24-hour) duty as installed. The switch shall be an open transition, 3-pole, double-throw, having the "normal" and "standby" positions mechanically interlocked, with microprocessor controller to provide automatic operation and shall be suitable for application to a 3-phase, 3-wire, 60 Hz, 480-volt system. The minimum continuous current rating at 480 volts shall be as indicated on the Construction Drawings. The ATS shall be rated to withstand a short circuit current of 50,000 amperes (symmetrical) without parting of the switch contacts. The ATS shall be capable of manual operation under load.

The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism.

The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency. All main contacts shall be silver composition.

All switch and relay contacts, coils, springs, and control elements shall be serviceable or removable from the front of the switch enclosure without disconnection of drive linkages, power conductors, or control conductors.

C. Automatic Controls

Controls shall be solid-state and designed for a high level of immunity to power line surges and transients, demonstrated by test to IEEE Standard C62.41 and C62.45.

Solid-state undervoltage sensors shall simultaneously monitor both sources. Pick-up and drop-out settings shall be adjustable. Voltage sensors shall have field calibration of actual supply voltage to nominal system voltage.

Automatic controls shall signal the emergency standby generator set to start upon signal from the normal source sensor.

Solid-state time delay start, adjustable from 0.1 to 10 seconds (factory set at 3 seconds) shall avoid nuisance start-ups. Battery voltage starting contacts shall be silver, dry type contacts factory wired to a field wiring terminal block.

The switch shall transfer when the emergency power source reaches the set point. Provide a solid-state time delay on transfer, adjustable from 0.1 to 10 seconds.

The switch shall retransfer the load to the normal power source after a time delay retransfer, adjustable from 1 minute to 30 minutes (factory set a 5 minutes). Retransfer time delay shall be immediately bypassed if the emergency power source fails.

Controls shall signal the engine-generator set to stop after a cool down time delay, adjustable from 1 minute to 30 minutes, beginning on return to the normal power source.

Power for transfer operation shall be from the source to which the load is being transferred.

Provide solid state exerciser clock to set the day, time, and duration of emergency standby power generator set exercise/test period. Provide a with/without load selector switch for the exercise period.

D. Front Panel Devices (Inside MCC NEMA 3R Wrap)

Provide control switches mounted on panel inside door front for:

Test: Simulates normal power loss to control for testing of generator set. Controls shall provide for a test with or without load transfer.

Retransfer: Momentary position to override retransfer time delay and cause immediate return to normal source, if available.

Provide LED-type switch position and source available indicator lamps on the front of the transfer switch cabinet.

E. Auxiliary Contacts

One normally closed dry contact, which shall open when normal power fails for "power failure" signal to RTU shall be provided. One normally open dry contact, which shall close when the ATS is connected to the emergency source for "emergency power" signal to RTU shall be provided.

2.10 PRECAST REINFORCED CONCRETE WET WELL

Wet well shaft shall be constructed of Class IV reinforced concrete pipe (RCP) per ASTM C76 with two circular reinforcement cages (quadrant or elliptical cages will not be allowed) and flush bell-and-spigot joints. Bell-and-spigot joints shall be provided with rubber gaskets and shall be suitable for a hydrostatic head of 50' per ASTM C361. Prior to backfill of the wet well structure, Contractor shall perform a field hydrostatic test by filling the wet well shaft with potable water up to the top of the shaft in accordance with Specification Section 03300, Part 3.17. No visible leakage will be allowed.

Pipe sections (except top and bottom sections) shall be minimum 8' long. Top and bottom section lengths shall be adjusted to achieve the required wet well and bypass manhole height and to provide 12" minimum clearance between RCP joints and pipe penetrations.

To assist Contractor during installation, RCP may be furnished with 316 stainless steel lifting lugs cast into the concrete during fabrication. Pipe manufacturer shall be responsible for lifting lug design and placement. Lifting aids installed after the pipe has been fabricated, by drilling or coring the pipe, will not be acceptable.

RCP shall be as manufactured by Thompson Pipe Group-Rialto, Ameron, or equal.

2.11 STAINLESS STEEL PASSIVATION

All stainless steel sub-assemblies shall be passivated after welding for corrosion resistance and to provide a superior surface finish. All stainless steel products shall be fabricated in the shop and passivated at the point of manufacture. Field fabrication or field passivation will not be permitted except for the outer flanges of the discharge piping through the wet well wall per Construction Drawings. Field passivation of the field welded discharge pipe flanges shall be accomplished using pickling paste.

All welds, heated areas of stainless steel parts, and heat affected zones of welds shall be cleaned, descaled and passivated per ASTM A 380. Passivation by use of pastes or sprays will not be permitted. Unless specified otherwise, passivation by means of electrochemical treatment, including electropickling or electropolishing, will not be permitted.

Passivation shall include the following (as a minimum):

- A. The surfaces of all stainless steel products shall be thoroughly degreased and cleaned. Surfaces shall be free of foreign material contamination (ie. markers, chalk, paint, soil, grease, or oil). Cleaning solvents shall be non-chlorinated. Water-break testing per ASTM A 380 shall be performed after cleaning to ensure all foreign material is removed prior to passivation. No break shall be permitted in the film as it drains from the vertical surface.

- B. Upon successful completion of the cleaning process, all stainless steel products shall be glass-bead blasted with clean glass that contains no ferrous materials. All surfaces shall be uniformly blasted and shall be free of rust, free iron, weld scale, heat tint oxides, arc strikes, tool marks, gouges, and scratches that occurred in the procurement or fabrication stage. The finish of all stainless steel surfaces shall be of a high quality and as a minimum, equal to the milled or hot rolled condition specified by the material specification.
- C. Upon successful completion of the descaling process, all stainless steel products shall be acid passivated for corrosion resistance and to provide a superior surface finish in accordance with ASTM A 967. The passivated parts shall exhibit a chemically clean surface and shall not show any pitting, etching, or frost. No heat tint or discoloration is allowed.
- D. All stainless steel products shall be tested to ensure corrosion resistance prior to shipment to site. As a minimum, the testing shall include a water immersion test and a salt water test. Testing procedures shall follow ASTM A 967 and shall be safe for potable water applications. Prior to shipment, a letter of certification from the fabricator shall be provided to the District indicating the passivation procedures performed, test procedures performed including test results, and statements of certification that all work was performed in accordance with ASTM A 380, A 967, and as specified herein.

The Contractor shall passivate, or have vendors pickle and passivate, all fabricated stainless steel parts including pipe sections, straight spools, fittings, piping components, pipe supports, nuts, bolts, washers, cover plates, equipment and equipment parts and sub components. Stainless steel electrical panels and enclosures manufactured by regular commodity enclosure manufacturers are exempt from the submittal requirements, but will be subject to inspection upon delivery as described below.

Contractor shall submit the passivation method for each fabricated stainless steel component to the District for approval prior to passivation.

Finish requirement: Remove free iron, heat tint oxides, weld scale, and other impurities, and obtain a passive finished surface.

The District shall have the right to inspect stainless steel parts upon delivery for proper finish. The District reserves the right to reject deliveries of stainless steel parts with visible signs of improper passivation at the Contractor's expense. The standard for rejection of stainless steel parts will be the presence of free iron, rust, heat tint oxides, and/or weld scale that is visible. The Contractor shall protect stainless steel parts during delivery to minimize the occurrence of nicks and burs. Free iron and or rust in nicks and burs caused by improper protection during delivery shall also be a reason for rejection and replacement at the Contractor's expense.

PART 3 - EXECUTION

3.01 GENERAL

- A. Installation of all equipment and appurtenances shall conform to the requirements of the manufacturer's specifications and installation instructions. When code requirements apply to installation of materials and equipment, the more stringent requirements, code, or manufacturer's specifications and installation instructions shall govern the work.
- B. Contractor shall verify all dimensions and conditions at the site and cross check details and dimensions shown on the Structural Drawings with related requirements on the Civil, Mechanical, and Electrical Drawings and Equipment Shop Drawings. Floor and wall openings, sleeves, variations in the structural slab elevations and other civil, mechanical, or electrical requirements must be coordinated before the contractor proceeds with construction.
- C. The precise dimensions and locations of all openings shall be determined from structural, civil, mechanical, electrical, or similar requirements for the actual equipment being furnished. Shop Drawings with adequate accurate dimensions must be submitted and reviewed prior to contractor constructing facilities including concrete, wall, connecting piping or electrical that are affected by said equipment.
- D. The contractor is advised that the work on this project may involve working in a confined air space. Contractor shall be responsible for "Confined Air Space" Article 108, Title 8, California Administrative Code.
- E. Contractor shall be responsible for maintaining project site security. Project site shall remain secured by temporary chain link fence at all times.
- F. Contractor shall clean inside of all new pipelines by flushing after successful passing of pressure testing.

3.02 COORDINATION

The Construction Drawings show in a diagrammatic form the arrangements desired for the principal equipment, piping, and similar appurtenances, and shall be followed as closely as possible. Proper judgment must be exercised in carrying out the work to secure the best possible headroom and space conditions throughout, to secure neat arrangement of piping, valves, fixtures, hangers, and similar appurtenances, and to overcome local difficulties and interferences of structural conditions wherever encountered.

The Contractor shall take all measurements for his work at the installation sites, verify all subcontractor drawings and be responsible for the proper installation, within the available space for the equipment and material specified and shown on the Construction Drawings, and must secure the approval of the District for any variations before making any changes.

3.03 INSPECTION

Inspect each item of equipment for damage, defects, completeness, and correct operation before installing. Inspect previously installed related work and verify that it is ready for installation of the equipment.

3.04 PREPARATION

Prior to installing equipment, ensure that installation areas are clean and that concrete or masonry operations are completed. Maintain the areas in a broom-clean condition during installation operations. Clean, condition, and service equipment in accordance with the reviewed Instruction Manuals and requirements in other Sections of these Specifications before installing.

3.05 WORKMANSHIP

- A. Preparation, handling, and installation shall be in accordance with manufacturer's written instructions and technical data particular to the product specified and/or approved, except as otherwise specified.
- B. Work shall be furnished and placed in coordination and cooperation with other trades.
- C. Electrical work shall conform to the National Electrical Contractor's Association Standard of Installation for general installation practice.

3.06 GRADING AND SITE WORK

Unless specified otherwise on the Construction Drawings, all grading and site work shall be per District Detailed Provisions, Sections 02201 and 02513 and as specified hereinafter.

- A. Site grading shall be performed in accordance with contract documents, soils report, and grading code of Riverside County, including any special requirements of the grading permit. An approved copy of the grading permit and site/grading plan shall be on site while work is in progress.
- B. Excavated soils may be utilized for selected fill material provided these materials are free of vegetative matter and other deleterious substances and shall not contain rocks or irreducible materials with a maximum dimension greater than 8". The final surfaces shall be wheel rolled to a smooth, well compacted surface at both subgrade and at finished grade.

- C. Selected backfill material around proposed wet well shall be placed in layers which, when compacted, shall not exceed 8" in thickness. Each layer shall be spread, moistened, and compacted uniformly to insure all backfill is properly compacted. After each layer of backfill has been placed, mixed, and spread evenly, it shall be thoroughly compacted to a minimum relative compaction of 95 percent.

3.07 EQUIPMENT INSTALLATION

A. Structural Fabrications

Conform to the AISC Code and Specification references in Article "Structural Steel Fabrications."

B. Equipment

Conform to reviewed Instruction Manuals. Employ skilled craftsmen experienced in installation of the types of equipment specified. Use specialized tools and equipment, such as precision machinist levels, dial indicators, gauges, and micrometers, as applicable. Produce acceptable installations free of vibration or other defects.

C. Anchor Bolts

Deliver bolts with templates or setting drawings and verify that bolts are correctly located before structural concrete is placed.

D. Base and Bedplate Grouting

Do not place grout until initial fitting and alignment of connected piping is completed. Level and align equipment on the concrete foundations, then entirely fill the space under base or bedplates with grout. Grout shall be non-metallic non-shrink type. Bevel exposed grout at 45 degree angle, except round exposed grout at horizontal surfaces for drainage. Trowel or point exposed grout to a smooth dense finish and damp cure with burlap for three days. When grout is fully hardened, remove jacking screws and tighten nuts on anchor bolts. Check the installation for alignment and level, and perform approved corrective work as required to conform to the tolerances given in the applicable Instruction Manual.

3.08 CONDUIT INSTALLATION

A. General

1. Contractor shall install conduit and electrical equipment in locations that will cause minimal interference with the maintenance and removal of mechanical equipment. Conduits and connections are shown schematically on the Drawings.

Contractor shall run conduit in a neat manner parallel or perpendicular to walls and slabs, and wherever possible, installed together in parallel runs supported with Unistrut type support system. All conduits shall be installed straight and true with reference to the adjacent work.

2. Locations of conduit runs shall be planned in advance of the installation and coordinated with the mechanical work in the same areas, and shall not unnecessarily cross other conduits or pipe, nor prevent removal of nor block access to mechanical or electrical equipment.
3. Unless noted otherwise on the Drawings, buried conduit shall be installed with a minimum of 30" cover. Buried conduit shall be encased in red colored concrete and mechanical consolidation of concrete shall be used per District Detailed Provisions, Section 03300. Conduit trench backfill shall be compacted to a minimum of 90 percent relative compaction.

Buried conduit shall be installed using approved spacers and cradles, properly supported/anchored and at sufficient intervals to prevent movement during encasement operations (maximum spacing of five feet). Where change in direction is required, long radius PVC-coated Rigid Galvanized Steel elbows shall be installed for GF, PF, and MSF conduits. Prior to installation of conductors in underground conduits, a testing mandrel not less than six (6) inches long and with a diameter 1/4 inch less than the conduit diameter shall be drawn through after which a stiff bristle brush of the proper size for the conduits shall be drawn through until the conduits are free of all sand and gravel. Test shall be accomplished prior to placing concrete.

4. Unless noted otherwise on the Drawings, conduit cast in concrete, under concrete slabs or footings, or through concrete walls, slabs, or masonry walls shall be PVC-coated Rigid Galvanized Steel. Unless noted otherwise on the Drawings, conduits shall be installed beneath concrete slabs, footings, or trenches, and shall be provided with a minimum of 6" clearance between conduit and bottom of concrete. Conduit backfill where installed beneath concrete shall be two (2) sack cement/sand slurry. Conduits shall be cast in concrete only where specifically shown on the Drawings.
5. Unless noted otherwise on the Drawings, buried conduit shall be PVC Schedule 40 Rigid Non-Metallic. Transition from PVC to PVC-coated Rigid Galvanized Steel shall be made at the horizontal leg of the buried conduit bend.
6. Unless noted otherwise on the Drawings, exposed or above grade conduit shall be PVC-coated Rigid Galvanized Steel.
7. Spare conduits shall be flush with the top of concrete slab or wall, and be provided with threaded cap and polyethylene pull rope with 100-pound (minimum) tensile strength.

8. All conduits shall be tightly sealed during construction by use of conduit plugs or "pennies" set under bushings. All conduit in which moisture or any foreign matter has collected before pulling conductors shall be cleaned and dried to the satisfaction of the District.
9. Conduits shall be securely fastened to cabinets, boxes, and gutters using locknuts (one inside and one outside enclosure) and an insulating bushing or specified insulated connectors. Grounding bushings or bonding jumpers shall be installed on all conduits terminating at concentric knockouts.
10. Where conduit is stubbed up through concrete slabs or footings into MCC/electrical panels, provide a minimum of 1-1/2" clearance between rebar and conduit and a minimum of 1" clearance between conduits. Adjust rebar spacing as necessary to a maximum of 1/2 the nominal spacing such that maximum rebar spacing does not exceed 1-1/2 times that specified. The total amount of reinforcing steel shall not be reduced.
11. Conduits shall terminate within the respective MCC/panel section, or in adjacent section if additional space is required. Contractor shall adjust location of conduit terminations based on the approved MCC/panel layout.
12. Underground pull boxes shall be sized and located as shown on the Drawings. Additional pull boxes shall be provided as necessary for conductor pulling (total bends between pull boxes shall not exceed 360°).
Pull box sizes shown are minimum sizes. Depending upon the Contractor's duct bank configuration and pull box knockout area, larger size pull boxes may be necessary. Cost of additional or larger pull boxes shall be borne by Contractor. Pull boxes shall be precast concrete with required knockouts and concrete sump (broken out). Pull boxes shall be set on a minimum of 12" thick of 3/4" crushed rock. Unless noted otherwise, pull boxes shall be provided with one-piece, HDG steel, bolt down-type traffic covers with lifting holes. Pull boxes and covers shall be as manufactured by Jensen, or equal.
13. Contractor shall furnish and install conduit and conductors as shown on the Drawings, as shown on the control diagrams, and as listed on the "Schedule of Conduit and Conductors" drawing. Contractor is advised that not all conduit and conductors are listed in the schedule (particularly 120V lighting and receptacles) and that not all conduit and conductors listed in the schedule are specifically shown, labeled, or called out individually on other drawings.

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B. Identification

Each and every conduit shall be provided with a 14-gauge brass labeling tag, 1-1/2 inch diameter, bearing 3/16 inch high die-stamped lettering with conduit designation shown on the Drawings. Each end of a conduit shall be provided with an identification tag. Each tag shall be securely attached to its conduit with a #10 single-jack brass chain or with brass fasteners. Each tag shall be provided with a hole for securing tag with chain or fasteners.

C. Rigid Non-Metallic Conduit

Unless noted otherwise on the Drawings, PVC conduit shall be used underground. PVC conduits shall not be run exposed. Risers to exposed or above grade locations shall be PVC-coated Rigid Galvanized Steel.

D. PVC-Coated Rigid Galvanized Steel Conduit

Threadless couplings will not be acceptable. Where necessary for connecting conduit, UL listed PVC-coated couplings shall be used. All ends and joints shall be reamed smooth after cutting.

E. Supports

Exposed conduit shall be supported with channel supports spaced per NEC requirements (8'-0" maximum spacing) and within 18" of couplings, bends, boxes, etc., unless otherwise shown on the Drawings.

F. Termination and Joints

1. Raceways shall be joined using specified couplings or transition couplings where dissimilar raceway systems are joined.
2. Conduit terminations exposed at weatherproof enclosures and cast outlet boxes shall be made watertight using approved connectors and hubs.
3. Conduit bodies (condulets) are not acceptable as enclosures for splices.
4. At all conduit terminations and boxes, conductors shall be protected by a fitting equipped with a plastic bushing having a smoothly rounded insulating surface.

3.09 CONDUCTOR AND CABLE INSTALLATION

A. General

1. Conductors shall not be installed in conduit runs until all work is completed for each individual conduit run. Care shall be taken in pulling conductors such that insulation is not damaged. UL approved pulling compounds shall be used.
2. Unless noted otherwise on the Drawings, all conductors or cables shall be installed in conduit or electrical enclosures.
3. All cables shall be installed and tested in accordance with manufacturer's requirements and warranty.
4. All field wiring to control panel(s), VFD(s), and to sections of the MCC shall terminate at terminal strips in the respective panels and buckets.
5. Contractor is advised that interconnecting wiring within and between lineups (assembled panels with common interconnecting horizontal wireways) of MCCs, distribution panels, MCPs, and control panels is not specifically listed or shown on the Drawings. Contractor is directed to control diagrams and RTU connection diagrams on the Drawings for these connections, which are subject to change according to approved shop drawings. Contractor shall install wiring for said connections within the bottom wireway of MCCs and panels.
6. No splices unless approved by District.

B. Identification

1. All branch-circuits shall be securely tagged, noting the purpose of each.
2. All conductors shall be numbered and labeled with vinyl wrap-around markers. Where more than two conductors run through a single outlet, each conductor shall be marked with the corresponding circuit number at the panelboard.
3. Conductors size #6 AWG and larger shall be color coded using specified phase color markers and identification tags.
4. All terminal strips shall have each individual terminal identified with specified vinyl markers.
5. Inside of all junction box cover plates shall be identified via felt-tip pen or decal label, denoting the panel and circuit numbers and voltage contained in the box.

6. All receptacles and switches shall be decal labeled on the plate, denoting the panel and circuit number.

C. Connections to Circuit Breakers, Switches, and Terminal Strips; Stranded Copper Conductors

1. #12 through 8 AWG: Conductor shall be terminated in locking tongue style, pressure type, compression lugs, unless clamp type connection for stranded conductor is provided with device.
2. #6 AWG and larger: Conductor shall be terminated in one-hole flat-tongue style, compression type lugs, or by connectors supplied by the manufacturer.

D. Grounding

Enclosures of equipment, raceways, and fixtures shall be permanently and effectively grounded. A code-sized, copper, insulated green equipment ground shall be provided for all branch circuit and feeder runs. Equipment ground shall originate at panelboard ground bus and shall be bonded to all switch and receptacle boxes and electrical equipment enclosures. Ground terminals on receptacles shall be connected to the equipment grounding conductor by an insulated copper conductor.

E. Status, Alarm, and Control Signal (IO)

Status, alarm, and control signal (IO) conductors to and from the RTU terminal strips shall be identified at both ends using the District's labeling designation shown on Drawing E-4, "RTU Status/Alarm Signal Wiring Diagram" (i.e. 4-6, 5-2, etc.).

F. Ultrasonic Level Control System

Interconnecting cable between transducer and controller shall be supplied with unit, and shall be suitable for a maximum system length of 300'. Contractor shall verify length of cable required for each specific installation. Cable shall be installed in a single run with no splices. Cable shall be installed in continuously grounded rigid Schedule 40 HDG, PVC-coated conduit. Conduit shall be installed a minimum of 8' from 480V conduits.

3.10 ELECTRICAL SERVICE INSTALLATION

Contractor shall construct power service facilities in accordance with SCE requirements. Contractor shall furnish and install transformer slab, conduits, and grounding facilities. Contractor shall coordinate all work with SCE and verify slab and conduit locations with SCE prior to installation. All service equipment and panels shall be in strict accordance with SCE requirements.

3.11 ELECTRICAL SHORT CIRCUIT COORDINATION AND ARC FLASH

In accordance with District Detailed Provisions, Section 16040, Contractor shall field verify adjustment of all trip setting with the approved Coordination Study and shall provide arc flash and shock hazard warning labels.

3.12 CONCRETE CONSTRUCTION

All concrete construction shall be in accordance with District Specification Sections 03150, 03200, and 03300 and as specified hereinafter.

A. Formwork, Curing, and Backfill

1. Foundations

Cure per specifications. Wet well foundation shall cure a minimum of 7 days and achieve a minimum compressive strength of 2,500 psi prior to setting wet well RCP. Test cylinders shall be cured in field.

2. Suspended Slabs

Cure per specifications. Forms shall remain in place until a minimum of 14 days and 100 percent of design strength are reached. Test cylinders shall be cured in field.

B. Delineate Raised Concrete Slabs

Provide a 6" wide yellow paint stripe along the edge of all concrete surfaces that are higher than the surrounding finished surface to delineate changes in elevation.

3.13 PIPE INSTALLATION

A. Unless shown otherwise on the Drawings, minimum cover on below grade pipe shall be 30 inches.

B. Where groundwater is encountered, all VCP pipe shall be treated for absorption resistance per District's Specifications.

C. All pipe zone bedding and trench backfill shall be per Standard Drawings SB-157, SB-158, and SB-159.

D. Pipe shall be installed in trench condition and as shown on District Standard Drawings. Backfill shall be completed including compaction tests prior to pressure testing. Backfill in pipe zone shall be compacted to minimum 90 percent compaction. Where pipe is located under slabs, all trench backfill shall be minimum 95 percent compaction.

- E. Unless shown otherwise on the Drawings, piping where stubbed through slabs/foundations shall be wrapped with building paper or Protecto Wrap tape.

3.14 PIPE TESTING

All piping shall be hydrostatically tested per District Standards. Unless specified otherwise, piping shall be tested under a pressure 1-1/2 times the design operating pressure of the pipe. Testing against valves is not permitted. Contractor shall provide temporary bulkheads, skillets, and appurtenances as required for testing. All piping under concrete slabs/foundations shall pass pressure testing prior to placing concrete. No visible leakage is permitted in exposed piping.

3.15 FIELD TESTING AND COMMISSIONING OF EQUIPMENT

Prior to District's acceptance, calibration and testing, pre-start-up, start-up, and 7-day live test shall be performed in accordance with these Specifications.

The Contractor shall furnish all labor, equipment, and material necessary to perform field testing and commissioning of equipment, including all related appurtenances. All costs for performing calibration and testing, pre-start-up, start-up, and 7-day live test shall be included in the Contract Price, and no extra payment will be made to the Contractor due to overtime, weekend, or holiday labor costs required to perform and complete same. Requirements specified in this Article are in addition to the demonstration and test requirements specified under other Sections of these Specifications.

- A. Pre-start-up, start-up, and 7-day live test shall be performed by the Contractor in accordance with the approved procedure plans to demonstrate to District's satisfaction that:
 - 1. All components of the process systems defined herein and the entire lift station system are fully completed and operable.
 - 2. All units, components, systems, and the entire lift station system operate with the efficiency, repeatability, and accuracy indicated and specified.
 - 3. All components, systems, and the entire lift station conform to the Contract Documents and the reviewed shop drawings, samples, construction manuals, materials lists, and other reviewed submittals.

- B. Prerequisite Conditions

Calibration and testing shall not commence for any equipment item or system until all related structures, piping, electrical, instrumentation, control, and like work has been installed and connected in compliance with the pertaining requirements specified elsewhere in the Specifications.

Pre-start-up, start-up, and 7-day live test shall not commence for any equipment item or system until calibration and testing has been completed as specified herein.

C. Demonstration and Testing Materials

Furnish materials, diesel fuel, and electrical power for all tests. Use potable water or reclaimed water to fill the lift station wet well. Furnish temporary facilities as required such as by-pass or re-circulation piping, diversions, storage, and similar facilities. Use procedures that conserve testing materials and avoid wastage, especially with respect to large quantities of fresh water and electrical power.

D. Inspection and Supervision by Manufacturers

Perform pre-start-up and start-up under continuous inspection by District. Technical representatives of the various equipment manufacturers shall be present for the pre-start-up and the start-up, shall examine their equipment at least twice, and shall supervise the start-up and adjustment procedures.

E. Correction of Defects

Immediately correct all defects and malfunctions disclosed by pre-start-up, start-up, and 7-day live test using approved methods and new materials for repairs as required. Upon District's recommendation, interruption time necessary for corrective work may be added to the specified total 7-day live test period.

F. Acceptance

Satisfactory completion and approval of required operational 7-day live test is one of the conditions precedent to District's acceptance of the work and does not constitute final acceptance.

Upon District's approval of required 7-day live test, Contractor shall check all equipment and confirm proper fluid levels.

G. Manufacturer's Supervision and Installation Check

Each equipment manufacturer shall furnish the services of an authorized representative specially trained and experienced in the installation of his equipment during pre-start-up and start-up to: (1) be present when the equipment is first put into operation, (2) inspect, check, adjust as necessary, and approve the installation, (3) repeat the inspection, checking, and adjusting until all trouble or defects are corrected and the equipment installation and operation are acceptable, (4) witness and supervise field testing and commissioning of equipment to the extent specified, and (5) prepare and submit to the District, upon successful completion of pre-start-up testing, the specified Manufacturer's Certificate of Proper Installation (see attached Exhibit A) confirming that all pumping units and emergency standby power generator set have been installed, inspected, checked, adjusted, and tested in accordance with the manufacturer's recommendations and requirements specified herein.

H. Calibration and Testing

Upon installation of all lift station facilities, Contractor shall perform calibration and testing. At a minimum, calibration and testing shall include the following for all facilities:

1. Meggering all motors and their conductors.
2. Meggering all conductors for 3-phase power.
3. Visually inspecting field wiring against approved shop drawings.
4. Checking for abnormalities that may have occurred during shipping or installation of all equipment and components including loose wiring, physical damage, or insecure mounting of components.
5. Complete all testing and labeling per Section 16040 prior to energizing any electrical panels or equipment.
6. Energizing all panels (only after testing per Section 16040).
7. Simulate all controls and equipment start, stop, and shutdown, including checking discrete signals locally at the panel and by jumpering remote devices at the field end to simulate signals (prior to actually operating equipment).
8. Testing all interlock and maintenance switches.
9. Checking analog signals by utilizing loop calibrator as required.

10. Calibrating all control instrumentation and monitoring equipment (flow, level, pressure, etc.).
11. Calibrating panel devices as required including timers and controllers.

I. Pre-Start-Up

1. General

Upon successful completion of calibration and testing, Contractor shall schedule the pre-start-up. A minimum of fourteen (14) days notice shall be provided to District prior to the pre-start-up. The pre-start-up shall be performed on one (1) day and Contractor's representative(s), District's Operations representative(s), Inspector, and Manufacturer's representative(s) shall attend the pre-start-up. The pumps shall be tested through the force main. Contractor shall provide water for filling the wet-well, operate the pumps, and assure that the discharge piping and force main is completely filled prior to pre-start-up. All equipment shall be operated for a period of 30 minutes unless otherwise specified. All controls and alarm conditions shall be simulated. If the equipment does not perform in conformity with Contract Documents requirements, the Contractor will be required to remove, replace, and restore the equipment to full compliance with the Contract Documents at his expense.

As a minimum, during pre-start-up the Contractor shall demonstrate a complete and operational lift station as follows:

- a) Response of equipment to appropriate manual or automatic controls, or combinations of both automatic and manual controls, shall be demonstrated to be correct and accurate. Where applicable, all components shall be tested for both manual and automatic operation. Where a component performs more than one function, every function shall be validated.
 - (i) Pumping equipment shall respond accurately and reliably to liquid level from the wet well. Automatic alternation and back-up pump functions shall also be validated.
 - (ii) Auxiliary equipment items such as alarm signals to remote telemetry, and like items shall respond accurately and reliably to every condition for which they are programmed, in the manner specified.
- b) Functionality of all alarm and status lights.
- c) Demonstrating uninterruptable power supply.

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- d) Demonstrating all control and monitoring features of all main control panels, local control panels, and PLCs in conjunction with associated equipment.
- e) Measuring and recording voltage and amperage draw readings for all equipment motors under loaded conditions.
- f) Testing all components of RTUs, including control systems.
- g) Operating all equipment under all conditions and demonstrate all alarms, shutdowns, and operating modes.
- h) Performance testing of each Pumping Unit through the discharge piping
- i) Operation of Emergency Standby Power Generator Set.

Contractor shall refer to various Technical Specifications herein for additional specific equipment testing requirements.

2. Pumping Units

Pre-start-up testing for pumping units shall be performed utilizing potable or reclaimed water. The wet well shall be filled to pump operating level and discharge from the pumps shall be through the force main. Pump discharge valves shall be throttled to simulate the design operating condition. Contractor shall provide all required testing equipment to perform pumping unit start-up at no additional cost to the District.

Contractor shall provide all instrumentation to confirm pumping unit and electric motor performance, including calibrated test gauges for monitoring discharge pressure, and electrical monitoring equipment to measure current, voltage, power, kVA, and power factor.

Contractor shall record pumping unit flow, discharge pressure, motor voltage, and motor amperage, hourly throughout the test period.

The pumping units shall operate as specified without excessive noise, surging, cavitation, vortexing, vibration, or clogging, and without overheating of the bearings. Each pumping unit shall operate a minimum of 30 minutes.

All automatic and manual controls shall function in accordance with the specified requirements.

The Contractor shall perform the following tasks under the supervision of the pump manufacturer:

- a) Completed pumping unit (pump and motor) shall receive a final field trim balance, as may be required, and vibration shall be checked and recorded. The vibration of all pumps shall be equal or less than the amplitude limits recommended in the Hydraulic Institute Standards and it shall be recorded at a minimum of four pumping conditions defined by the Engineer. All measurements shall be witnessed by the District. Vibration shall be measured at motor thrust bearing housing and at any other locations on pumping unit as directed by the District. Vibration shall be measured over the full range of the pump operating speed.
- b) Each pump's performance shall be documented by obtaining concurrent readings showing motor voltage and amperage, pump flow rate, pump suction head, and pump discharge head. Readings shall be documented at a minimum of three pumping conditions, including the specified design point, to ascertain the actual pumping curves. Another test shall be run at shut-off head. Each power lead to the motor shall be checked for proper current balance.
- c) Pumping units (pump and motor) shall perform substantially in conformance with the certified pump curves and the factory performance test results as adjusted for field conditions. Additionally, discharge from pump shall not exceed the design flow rate by more than 20%. If, in the opinion of the District, the equipment furnished does not perform in accordance with these Specifications, Contractor shall promptly make all necessary repairs or corrections so that the equipment fully complies with these Specifications. Contractor shall remove, restore, and replace the equipment if required at his expense. Factory performance tests, pre-start-up, and start-up testing shall be rerun if necessary at Contractor's expense.

3. Emergency Standby Power Generator Set

A pre-start-up test shall be conducted on the generator set for the lift station. Contractor shall be responsible for the proper conduct of the tests and to furnish all equipment, labor, and material required to perform the tests.

As a minimum, pre-start-up testing shall consist of the following:

- a) Perform engine manufacturer's recommended pre-starting checks.
- b) Interrupt normal electrical service from power utility and verify automatic starting of generator set and transfer switch operation from "normal" to "emergency". Adjust ATS time delays for generator set starting and transfer per manufacturer's recommendations and District preferences.

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- c) Operate lift station pumping equipment and control system under standby generator power for 30 minutes (minimum). During this period, checks shall be made of generator set operating parameters (e.g. engine oil pressure, jacket water temperature, RPM, voltage, amperage, and frequency) to verify generator set is operating properly.
- d) Automatic shutdown of generator set shall be verified by simulating an engine alarm condition. Contractor shall also verify that the alarm signal is transmitted to the RTU and the ATS re-transfers to utility power.
- e) If the engine generator set, ATS, control system, and accessories do not operate in a satisfactory manner, the trouble shall be located, promptly repaired by the Contractor, and retested at Contractor's expense.
- f) If equipped with a DPF, DPF alarms shall be tested and verified.
- g) Equipment operating hours shall be recorded on a daily basis during all testing.
- h) If the site is located 500 feet or less from a school, Contractor shall comply with the following applicable limits or in accordance with the latest revision of SCAQMD Rule 1470, whichever is more stringent:
 - (i) If the genset is on school grounds, it shall not be operated whenever there is a school sponsored activity.
 - (ii) If the genset is located 328 feet or less from a school, it shall not be operated between the hours of 7:30 a.m. and 4:30 p.m. on days when school is in session. If a DPF is installed, the genset shall not be operated between the hours of 7:30 a.m. and 3:30 p.m.
 - (iii) If the genset is located more than 328 feet and less than or equal to 500 feet from a school, it shall not be operated between the hours of 7:30 a.m. and 3:30 p.m. on days when school is in session. A genset that emits particulate matter (PM) at a rate of 0.01 g/bhp-hr or less is not subject to this restriction.

J. Start-Up

Upon successful completion of pre-start-up and after receipt of all Manufacturer's Certificate of Proper Installation by the District, Contractor shall schedule the start-up. A minimum of three (3) days notice shall be provided to District prior to the start-up. The Contractor's representative(s), District's Operations representative(s), Engineering

Consultant, Inspector, Design Engineer, and Manufacturer's representative(s) shall attend start-up.

All testing described for pre-start-up shall be repeated during start-up and the pumps shall be tested through the force main(s). Contractor shall provide water for filling the force main, operate the pumps, and assure that the force main(s) are completely filled prior to start-up.

K. 7-day Live Test

After successful completion of start-up, the Contractor shall participate in a live test of the lift station that shall encompass a 7-day period of trouble free operation. During the 7-day live test of the lift station, the lift station will be operated continuously under normal operating conditions. All alarms shall be transmitted to Contractor and District. The Contractor shall have personnel available within one hour to respond to any problems, and shall diligently pursue repair of the problem. If the District determines the problem to be major, then the District may instruct the Contractor to repeat the 7-day live test. The District may continue to repeat the test until 7 days of trouble-free operation are recorded.

Contractor shall provide potable water to fill the wet well at a constant rate as required to start the pumps 3 times per day (throughout the entire 7-day period) from the hose bib located at the wet well. All costs for potable water, power, and diesel fuel will be borne by the Contractor during this test period.

Contractor shall operate standby generator for two 4-hour periods (different days) and each pumping unit shall be selected in the "lead" position for a minimum of 24 hours during 7-day live test of the lift station.

Contractor shall maintain, and submit to District at the end of the 7-day live test, a log of all alarms and problems.

The log shall include date of alarm or problem, description of alarm or problem, date of corrective action, and corrective action to fix alarm or problem.

Submersible Lift Station with Standby Power
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3.16 IN-SERVICE CHECKS

As a part of the work, an in-service check of each system required to be validation tested shall be performed twice during the period of the Contractor's guarantee by qualified technical representatives of the various system manufacturers, including manufacturers of equipment and components within systems. Checks shall be detailed and complete, requiring not less than 2 hours at the site, and shall be performed under the observation and to the satisfaction of the District. All costs for in-service checks shall be included in the Contract Price.

A. Notification

The District shall be notified in writing at least 10 days before the performance of each in-service check. The proposed dates for checking shall be changed if required by the District's operations personnel.

B. Consultation

At the time of each in-service check, the manufacturer's technical representatives shall consult with the District to review the Operation and Maintenance Manual and the pertinent operational and maintenance problems encountered, and shall furnish technical advice and recommendations to the District.

C. Schedule

Initial in-service checks shall be performed approximately 6 months after final acceptance of the lift station. The second in-service check shall be performed within 60 days of the end of the Contractor's guarantee period.

D. Reports

A written report of each in-service check signed by the appropriate manufacturer or his representative shall be delivered to the District within 10 days following the check. The report shall describe the checking procedure in detail, and shall state all advice and recommendations.

3.17 INSTRUCTION

After all equipment has been installed, tested, and adjusted, and placed in satisfactory operating condition, each equipment manufacturer shall provide classroom instruction to District's operating personnel in the use and maintenance of the equipment. Two (2) hours of instruction shall be provided unless otherwise specified. Contractor shall give the District formal written notice of the proposed instruction period at least two weeks prior to commencement of the instruction period. Scheduled training shall be at a time acceptable to the District and the manufacturer. During this instruction period, the manufacturer shall answer any questions from the operating personnel.

The manufacturer's obligation shall be considered ended when he and the District agree that no further instruction is needed.

3.18 CLEANING

Upon successful completion of start-up and testing, Contractor shall thoroughly clean all equipment and piping. Contractor shall remove all traces of dirt, oil, grease, etc. Contractor shall clean all exposed parts of electrical installations including electrical panel and junction box interiors.

END OF SECTION 11200

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Exhibit A

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

OWNER: _____ EQPT SERIAL NO: _____
EQPT TAG NO: _____ EQPT/SYSTEM: _____
PROJECT NO: _____ SPEC. SECTION: _____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- Installed in accordance with Manufacturer's recommendations.
- Inspected, checked, and adjusted.
- Serviced with proper initial lubricants.
- Electrical and mechanical connections meet quality and safety standards.
- All applicable safety equipment has been properly installed.
- System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Comments: _____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate his equipment and (iii) authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____

Manufacturer: _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

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TABLE 1

RELATED DISTRICT STANDARD DRAWINGS

Refer to the latest Standard Drawings located at the following web site
(<http://www.emwd.org/index.aspx?page=166>)

Standard Dwg. No.	Description
B-286B	Trench Backfill (for PVC forcemain)
B-590	5/8" Meter Service Connection, 1" Copper Tubing
B-590A	5/8" Service Connection, 1" Copper Tubing
B-591	1" Meter Service Connection, 1" Copper Tubing
B-591A	1" Service connection, 1" Copper Tubing
B-597	Backflow Prevention Assembly Installation Diagram
B-656	Location Wire Installation
B-663	Standard Restraint (Tee, Dead End, Bend)
B-665	Guard & Marker Posts
D-672	Chain Link Fence Details
SB-08	Locking Type Manhole Cover & Frame
SB-30	Reinforced Precast Shallow Manhole
SB-53	Precast Reinforced Concrete, 48" & 60" I.D. Manhole
SB-56	Precast Non-Reinforced Concrete, 48" I.D. Manhole
SB-61	Manhole Cover & Frame
SB-157	Pipe Zone Bedding for Sewer Pipe
SB-158	Trench Backfill for Sewer Pipe
SB-159	Classification of Pipe Zone Bedding for Sewer Pipe
- - -	Sewer Guideline for Manhole Sizing *

*Refer to the latest Guideline Standards located at the following web site:
(<http://www.emwd.org/modules/showdocument.aspx?documentid=729>)

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MAINTENANCE BOND
FOR PUMPING EQUIPMENT
(By Developer)

KNOW ALL MEN BY THESE PRESENTS, that we, _____, as Surety, hereinafter called Surety, are held and firmly bound unto Eastern Municipal Water District, hereinafter called District, in the penal sum of \$_____, for the payment whereof (Developer) and Surety bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these present.

WHEREAS, Developer has by written agreement, dated _____ entered into a contract with the District for _____ in accordance with the General Conditions, project drawings and specifications which contract is by reference incorporated herein, and make a part hereof, and is referred to as the contract.

NOW, THEREFORE, the condition of the obligation is such that, if Developer shall remedy any defects due to faulty materials or workmanship which shall appear within a period of 2 years from the date the project is accepted as provided for in the contract, then this obligation is to be void, otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that the District shall give Developer and Surety notice of observed defects with reasonable promptness.

Signed and sealed this _____ day of _____, 20____

Developer (SEAL)

Surety (SEAL)

Title

Title

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