

SECTION 805
SUBMERSIBLE WASTEWATER PUMP STATION

805-1 SCOPE OF WORK: This specification provides a general description of pump station requirements. Details may vary depending on equipment offered. Provide materials, equipment, and appurtenances as specified. Construction shall include, but not be limited to providing, pumps and motors and their accessories, wet well, valve vault, electrical building (if needed), electrical service, controls and control accessories, piping, fencing, driveways, foundation pads, site work, generator installation; and associated activities such as factory testing, delivery, installation, and field testing. Pump station shall be complete and operate as specified.

All units installed shall be of the highest standard available for this type of service including field testing of the entire installation and instructing the regular operating personnel in the care, operation, and maintenance of equipment.

Pump Station Types:

- a. Type I Pump Stations are either duplex or triplex stations with total motor load for duty pumps less than or equal to 200 hp. A Type I Pump Station's controls and service entrance panel shall be a freestanding NEMA 250, Type 4X enclosure housing the underground electric service, utility meter, main breaker, automatic transfer switch (ATS), power distribution panel, pump motor starters or VFDs, pump controls, wet well level monitoring controls, programmable pump controller (PPC), and telemetry equipment. The Type I Pump station panel shall be a packaged system from a single panel integrator listed and labeled by Underwriters Laboratory (UL) 508. For additional requirement on a Type I Pump Station and specific project features, refer to the Contract Drawings, the Standard Plans, and as specified herein.
- b. Type II Pump Stations are triplex stations with total motor load for duty pumps greater than 200 hp. A Type II Pump Station's controls, electrical distribution, and motor controls shall be installed in an electrical building. The electric service may be either overhead or underground based on Utility requirements. The Utility meter shall be mounted on the exterior of the building with associated metering transformers installed in the electrical switchgear. The electrical distribution shall be configured with main breakers, automatic transfer switch, diesel engine generator and pump station switchgear. The switchgear shall also include the required motor starters or breakers for VFD breakers. Where VFDs are used they shall be mounted in individual enclosures. The pump station controls shall be provided in a separate enclosure within the electric building including required pump control logic, wet well level controls, PPC, and telemetry equipment. For additional requirements on a Type II Pump Station and specific project features, refer to the Contract Drawings, the Standard Plans, and as specified herein.
- c. Type III Pump Stations have 4 or more pumps and are not covered by this specification.

Excavation, backfill, and foundations for installation of structures including manholes and pump stations packages are all part of the tasks of the installation of the pump station. In the course of construction, Contractor shall protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining washout, and other hazards created by earthwork operations.

805-2 DESCRIPTION OF SYSTEMS: Each station shall be complete and include concrete wet well and valve box, explosion proof standard submersible non-clog wastewater pump units, standby pumps, pump lifting assemblies, and all piping and valves. Pumps/motors shall be designed to facilitate cycling of operation and backup protection in case of pump or motor failure. As specified in Paragraphs 805-21 through 805-48, pump systems shall also include circuit breakers, motor starters or VFDs, ATS, float switch suspension bracket, automatic pumping level controls, telemetry

equipment, generator installation and electrical work with all accessories for complete installation. All the equipment specified herein is intended to be standard equipment for pumping all material in normal domestic wastewater.

Contractor shall operate in a safe and responsible manner by maintaining a safe working environment, properly delineating work areas, utilizing appropriate safety equipment and shall comply with all rules and regulations of local, state and federal authorities. Contractor shall barricade open excavations occurring and post with warning lights as part of this Work.

805-3 GENERAL REQUIREMENTS:

- a. Contractor shall assume responsibility for the satisfactory installation and operation of the entire pumping system including pumps, motors, generator, controls and other auxiliary equipment and materials as specified.
- b. The pumps covered by these Specifications are intended to be standard pumping equipment of proven ability as manufactured by a manufacturer having a minimum of five (5) years experience in the production of such pumps. The pumps shall be installed in accordance with the Contract Documents and manufacturers' installation instructions. The pumps furnished shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed. Pumps shall be manufactured in accordance with the Hydraulic Institute Standards.
- c. Equipment furnished under this Specification shall be new and unused, shall be standard product of manufacturers having a successful record of manufacturing and servicing the equipment and systems specified herein for a minimum of five (5) years. Pump manufacturer shall have, within a 100-mile radius of the Baton Rouge City limits, an authorized warranty center fully staffed with factory trained mechanics, and equipped with a stock of necessary spare parts for each model of pump specified.
- d. The pumps shall be selected from a manufacturer listed on the EBR DPW Qualified Products List (QPL), or approved equal, and appropriate for the job required. The pumps shall meet the specified operating data as shown in the Contract Documents by $\pm 5\%$. A manufacturer's listing on the QPL does not waive the requirement to meet the design conditions.
- e. In order to ensure electrical and control system responsibility, pump control panels shall be furnished by pump manufacturer and shall be completely wired, including interlocking between motor control, accessory devices, and level sensor systems. Programmable controllers shall be manufactured by TESCO Controls, Inc., or approved equal and shall have Ethernet capability. Panel manufacturer/assembler shall provide UL inspection of service entrance and control panels and each panel shall have a UL label meeting UL 508 for Industrial Control Panel standards. Individual parts listing will not be accepted. Each panel shall have a registered UL label attached. Panel manufacturer/assembler shall be TESCO Controls, Inc., or approved equal.

805-4 SUBMITTALS: Submittals shall include 6 copies of at least the following:

- a. Certified shop and erection drawings showing details of construction, dimensions, anchor bolt locations.
- b. Materials of construction list for machinery and structural components.
- c. Descriptive literature, bulletins, and/or catalogs of the equipment.
- d. Contractor shall provide 48 hours' notice to Owner in advance of pump station component delivery.

- e. Data on the characteristics and performance of each size pump. Data shall include guaranteed performance curves, based on actual shop tests of duplicate units, which show they meet specified requirements for head, capacity, efficiency, and horsepower. Factory certified curves should be submitted on 8-1/2-inch by 11-inch paper. Curves shall be plotted from zero flow at shut off head to pump capacity at minimum specified total dynamic head.
- f. Total weight of equipment including weight of the single largest item.
- g. A bill of materials for all equipment.
- h. A list of the spare parts, at a minimum as specified in Article Tools and Spare Parts, with manufacturer's current price for each item; include gaskets, packing, etc. List bearings by bearing manufacturer's number only.
- i. Certified agreement to conditions of the warranty.
- j. Motor data.
- k. Shop and erection drawings shall be submitted showing details of construction, dimensions, anchor bolt locations, dead front panel layouts, sub-dead front panel layouts, etc. Submittal shall also include a layout of panel penetrations for connections of the various conduits detailed in the panel size schedules in the Contract Documents. Each penetration shall be designated in submittal with a letter and description corresponding with letter and description noted on panel size schedules in the Contract Documents for the circuit to be utilizing the particular penetration. Panel supplier shall certify the Drawings.
- l. Wiring diagrams, elementary diagrams and ladder diagrams shall be submitted and certified by panel supplier.
- m. Color photographs of panels presently in service showing complete overall and close up construction details of panels similar to those specified herein shall be provided with shop drawings submittals. Also, a list of locations where similar panels are in service along with contact personnel shall be provided in Shop Drawings for inspection of such panel at Engineer's option prior to review of Shop Drawings.
- n. Descriptive literature, bulletins, and/or catalog data of field and panel-mounted instruments, devices and equipment.
- o. 6 hard and 1 digital copy of Operation and Maintenance Manuals as specified herein.
- p. Written report confirming the results of the startup and testing activities specified herein.
- q. Certificates of Proper Installation for equipment as specified under Article Installation.
- r. In the event that it is impossible to conform to certain details of the Specifications because of different manufacturing techniques, describe completely nonconforming aspects.
- s. If a dewatering system is required, Contractor may be required to demonstrate the adequacy of the proposed system and wellpoint filter sand by means of a test installation. Refer to Specification Section 801 Excavation, Backfilling and Compaction for Sanitary Sewers for dewatering requirements. Discharge shall be clear, with no visible soil particles in a one quart sample.
- t. SCADA Data Exchange Table.

805-5 CONSTRUCTION:

805-5.1 Excavation, Backfill, and Compaction: Excavation, backfill, and compaction required for this Work shall be in accordance with Section 801 and as shown in Contract Documents.

805-6 OPERATING INSTRUCTIONS: After successful completion of Project provide Engineer six (6) hard and one digital copy of an as-built operating and maintenance manual for each size pump, fan, air conditioner, instrument, and item of electrical apparatus. Manuals shall be prepared specifically referenced for each installation and shall include all required cut sheets, equipment lists, descriptions, programming code, parts lists, repair instructions, preventive maintenance requirements, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

805-7 MATERIALS AND EQUIPMENT:

- a. The equipment covered by these Specifications is intended to be standard pumping equipment of proven ability as manufactured by reputable company having long experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed as shown in the Contract Documents.
- b. All parts shall be so designed and proportioned as to have liberal strength and stiffness and to be especially adapted for the work to be done. Ample room and facilities shall be provided for inspection, repairs, and adjustment.
- c. Stainless steel nameplates shall be attached to each pump stating the unit is accepted for use in NEC Class 1, Division 1, Group D, hazardous locations, and giving name of manufacturer, rated capacity, head, speed, serial number, model number, horsepower, voltage, amperes and other pertinent data.
- d. The nameplate ratings for the motors shall not be exceeded, nor shall the design service factor be reduced when its pump is operating at any point on its characteristic curve at maximum speed.
- e. Parts and hardware installed inside wet well shall be constructed of Type 316 stainless steel.
- f. Powered equipment not specifically mentioned in this section shall be appropriate for the operation it is used for.
- g. Appropriate tools will be utilized for their intended tasks. Tools will be properly maintained and in good working order.

805-8 SUBMERSIBLE PUMPS:

- a. The Contractor shall furnish and install explosion proof submersible non-clog wastewater pump units with a submersible electric motor connected for operation on the phase and voltage as shown in the Contract Documents, 60 hertz, and a submersible cable with sufficient length to reach control panel with no splices and suitable for submersible pump applications for flow and total dynamic head conditions shown in Contract Documents. Pump shall be supplied with a mating cast iron discharge connection and rail system to allow pump removal and setting without entering the wet well.
- b. Pumps shall be capable of handling raw, unscreened wastewater with a minimum of three (3) inch solid. The design shall be such that pumping units will be automatically connected to the discharge piping when lowered into place on the discharge connection. The pumps shall be easily removable for inspection or service, requiring no bolts, nuts or other fastenings to be removed for this purpose, and no need for personnel to enter pump well.

- c. Pump casing shall have a machined connecting flange to connect with the cast iron discharge connection specified under article Rail System, and be designed to connect to the pump connecting flange without the need of bolts or nuts.
- d. Sealing of the pumping unit to the discharge connection shall be accomplished by a simple linear downward motion of the pump with the entire weight of the pumping unit guided to and pressing tightly against the discharge connection; no portion of pump shall bear directly on the floor of the sump and no rotary motion of the pump shall be required for sealing.
- e. Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. The lifting handle shall be of Type 316 stainless steel. All exposed nuts or bolts shall be of stainless steel construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating on the exterior of the pump suitable for wastewater immersion in accordance with Section 822.
- f. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with nitrile or Viton® rubber O-rings. For pump-motor connections, fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without requirement of a specific torque limit.
- g. Rectangular cross-sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease, or other devices shall be used.
- h. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in an oil reservoir that hydro-dynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the oil chamber, shall contain one stationary and one positively driven rotating tungsten-carbide or silicon-carbide ring. The upper, secondary seal unit, located between the oil chamber and the motor housing, shall contain one stationary and one positively driven rotating tungsten-carbide or silicon-carbide ring. Each seal interface shall be held in contact by its own spring system. All seal rings shall be individual solid sintered rings. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable. For special applications, other seal face materials shall be available.
- i. The following seal types shall not be considered acceptable or equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. Cartridge type systems will not be acceptable. No system requiring a pressure differential to offset pressure and to affect sealing shall be used.
- j. Each pump shall be provided with an oil chamber for the shaft sealing system. The oil chamber shall be designed to prevent overfilling and to provide oil expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. Seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load. The oil shall meet manufacturer's recommendation. A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing.

- k. Pump shaft shall be an extension of the motor shaft. Couplings shall not be acceptable. Shaft material shall be ASTM Type 420 stainless steel or better.
- l. A wear ring system shall be used to provide efficient sealing between the volute and suction inlet of the impeller. Each pump shall be equipped with a Type 420 or better stainless steel or ASTM A-532 (Alloy III A) 25% chrome cast iron ring insert that is drive fitted to the volute inlet.

805-9 IMPELLER: The impeller shall be of ASTM A-532 (Alloy III A) 25% chrome cast iron with a minimum Rockwell Hardness of 60HRC or ASTM A-351 stainless steel with a minimum Brinell Hardness of 250. The impeller shall be dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The screw-shaped leading edges of the grey iron impeller shall be hardened to Rc 45 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impellers shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

805-10 RAIL SYSTEM: A sliding guide bracket consisting of two (2) 2-inch minimum diameter non-sparking Schedule 40, Type 316 stainless steel rails shall be anchored to the wet well (top, bottom, and in between) as an integral part of pumping unit. The rail system shall consist of upper and lower guide rail supports, pump discharge base elbow, internal discharge piping with hydraulic sealing flanges, and carrier assembly with Type 316 stainless steel chain with stainless steel "D" rings at ten (10)-foot intervals. Rail systems that provide for pump units to be suspended from discharge pipe will not be acceptable.

Intermediate stainless steel rail supports shall be provided as shown in the Contract Documents, or at not more than 10-foot centers.

Sealing of pumping unit to the discharge connection shall be accomplished by a machined metal-to-metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable. There shall be no need for personnel to enter the wet well to connect the pump to the discharge connection.

805-11 MOTORS AND CABLE:

- a. Pump motor shall be submersible type. Pump motors shall be of the phase and voltage as shown in the Contract Documents. A single pump motor power cable shall be furnished for each pump. Control conductors shall be included in the cable for the winding temperature and seal failure sensors wherever possible.
- b. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31 if supplied with variable frequency drive. The use of pins, bolts, screws or other fastening devices used to locate or hold the stator and that penetrate the stator housing are not acceptable. The motor shall be designed for continuous duty while handling pumped media of up to 104°F (40°C). The motor shall be capable of no less than 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of aluminum.
- c. The motor service factor (combined effect of voltage, frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of +/- 10%. The motor shall be designed for continuous operation in up to a 40°C ambient and shall have a NEMA Class B maximum operating temperature rise of 80°C. A motor performance chart

shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.

- d. Pump and motor shall tolerate short periods of partially dry operation or typically complete submergence in the liquid being pumped. Pump and the motor shall be capable of operation with the motor not submerged without damage.
- e. Each pump motor stator shall incorporate three thermal switches, one per stator phase winding and be connected in series, to monitor the temperature of the motor. Should the thermal switches open, the motor shall stop and activate an alarm. The seal leakage chamber shall be equipped with a float type switch or similar moisture sensing system that will signal if the chamber should reach 50% capacity. The thermal switches and seal leakage sensor/switch shall be connected to a Mini CAS or equal control and status monitoring unit, which shall be mounted in the pump control panel. The use of wire nuts or crimp-type connectors is not acceptable.
- f. An elastomer compression seal shall hermetically seal junction chamber containing the terminal board from the motor. Epoxies, silicones, or other secondary sealing systems shall be considered acceptable. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. Wire nuts or crimping type connection devices are not acceptable.
- g. Motor power and sensor cable shall be of the P-1 22 MSHA type insulated cable with a double jacketed protection system, neoprene outside, synthetic rubber inside, exceeding industry standards for oil, gas, and sewerage resistance. The power cable shall be sized according to NEC and ICEA standards. Cable shall be rated 600 volts, 60°C, UL and/or CSA approved, and be of sufficient length to reach junction box without the need of a splice. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet. Power cable shall include control cables from temperature/ moisture sensors whenever possible.
- h. The cable entry seal design shall preclude specific torque requirements to ensure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top.
- i. Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.
- j. The integral pump/motor shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a single ball type bearing to handle radial loads. The lower bearing shall be a two row angular contact ball bearing to handle the thrust and radial forces. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump curve.

805-12 VALVES:

805-12.1 Plug Valves: Plug valves shall be full port (100% port area), manufactured to meet or exceed the requirements of AWWA C517 of latest revision, and in accordance with Section 1019.

805-12.2 Check Valves: Rubber Flapper Swing check valves, sized as shown in the Contract Documents shall be installed in the discharge piping. The valve shall permit flow in one direction only and close tightly without slamming when the discharge pressure exceeds the inlet pressure. Valve shall be flanged full body rubber flapper type with a domed access cover and one moving part as specified in Section 1019.

805-13 WET WELLS AND VALVE PITS: Contractor shall provide precast concrete wet well and valve pit as shown in Contract Documents.

805-14 PRECAST CONCRETE WET WELL AND VALVE PIT:

- a. Contractor shall furnish all materials, labor, and equipment and construct wet wells, valve pits, and accessory items, consisting of precast sections as specified herein.
- b. The forms, dimensions, concrete, and construction methods shall be approved by Engineer in advance of construction.
- c. Precast manufacturer will be responsible for certification of design and construction of precast concrete sections by a registered professional engineer in the State of Louisiana. This certification will accompany Shop Drawings for review by Engineer.
- d. Contractor shall ensure coordination of precast structure fabrication with equipment supplied to achieve the proper structural top slab openings, spacings, and related dimensions for the selected equipment frames and covers. Top slabs and subsurface structures shall be capable of supporting the overburden plus live load equivalent to AASHTO HS-20 loading.
- e. All interior surfaces of the concrete wet well, with the exception of the floors, shall be coated in accordance with Section 822. Protective coating along the walls of the wet well structure shall stop 6 inches above the floor. Protective coating shall be field applied in accordance with Section 822 and manufacturer's recommendations after installation. Shop applied coatings will not be accepted. If a valve pit is required, all interior surfaces, including the floor, shall be coated in accordance with Section 822. Upon completion of the wet well, valve pit and pipe installation the protective coating shall be free of bugholes, pinholes, and continuous across the section joints.
- f. Concrete wet wells and valve pits shall include a Crystalline Waterproofing Additive as outlined below:
 1. Concrete waterproofing system shall be of the crystalline type that chemically controls and permanently fixes a non-soluble crystalline structure throughout the capillary voids of the concrete. The system shall cause the concrete to become sealed against the penetration of liquids from any direction, and shall protect the concrete from deterioration due to harsh environmental conditions.
 2. Crystalline waterproofing for precast structures shall include an approved coloring that will tint the finished concrete as proof of additive. Coloring must be provided by the additive manufacturer. Protective admixture tint shall be uniform in color and appearance throughout wall thickness of concrete structure. If cross-sectional views of concrete structure, such as pipe cutouts or across joints, are not available for visual inspection or do not provide satisfactory evidence of color uniformity, at the request of the Engineer, the Contractor shall have the structure cored to provide evidence. Coring and repair shall be at no cost to the Owner. Any unapproved coatings or paints applied to the manhole structure may be cause for rejection of the manhole by the Engineer.
 3. Crystalline waterproofing for poured in place structures is required in all below grade concrete walls, but is not required for floors. Crystalline waterproofing for

precast concrete structures is required in all concrete.

4. Installer of crystalline waterproofing additive shall be approved by the manufacturer or manufacturer's representative in writing.
5. Waterproofing additive shall be added to concrete mix at time of batching, and dosage rates and installation shall be in accordance with manufacturer's recommendations.
6. Crystalline waterproofing additive shall be as manufactured by Xypex Chemical Corporation or approved equal and shall meet the following requirements:
 - i. Testing Requirements: Crystalline waterproofing system shall be tested in accordance with the following standards and conditions, and the testing results shall meet or exceed the performance requirements as specified herein. Independent tests verifying these results shall be submitted prior to approval.
 - ii. Independent Laboratory: Testing shall be performed by an independent laboratory meeting the requirements of the recognized specifying body of the country in which the testing is performed. Testing laboratory shall obtain all concrete samples and waterproofing product samples.
 - iii. Crystalline Formation: Crystallizing capability of waterproofing system shall be evidenced by independent SEM (Scanning Electron Microscope) photographs showing crystalline formations within the concrete matrix at a magnification no greater than 2000 times.
 - iv. Permeability: Independent testing shall be performed according to U.S. Army Corps of Engineers CRD-C48 - Mod "Permeability of Concrete". Under CRD-C48 treated concrete samples that are no greater than 2 inches thick shall be pressure tested to 150 psi (350 foot head of water). The treated samples shall exhibit no measurable leakage against control samples which shall exhibit full saturation and measurable leakage. In all case cases treated and untreated samples shall have the same mix design.
 - v. DIN 1048/ EN 12390 "Water Impermeability of Concrete"/Requirement: Treated and untreated samples that are 120mm thick shall be subjected to hydrostatic pressure for 3 days (Minimum of 3 samples of each). Control samples shall have a minimum of 100mm of penetration (average of samples). Treated samples shall show a minimum of 90% reduction in depth of water penetration when compared to the control sample (average of samples). In all cases treated and untreated samples shall have the same mix design.
 - vi. Compressive Strength: Independent testing shall be performed according to ASTM C39 "Compressive Strength of Cylindrical Concrete Specimens". Concrete samples containing the crystalline waterproofing additive shall be tested against untreated control sample. At 28 days, the treated samples shall exhibit an increase in compressive strength over the control sample.
 - vii. Crack Bridging Capability: Requirement: Minimum of 0.4mm. Crack heal effect shall be supported by reports from recognized independent agency documenting crack healing effects of crystalline modified versus a control concrete in the same application.
- g. Contractor may choose to provide cast-in-place concrete constructed wet well and/or valve pit; however a watertightness test of the concrete structures will be required prior

to application of protective coating. Crystalline waterproofing additive is required in concrete mix (see subsection 805-14 f 3). Contractor shall submit a design package including but not limited to design calculations and Shop Drawings prepared and sealed by a registered professional engineer currently licensed in the State of Louisiana. Associated costs of design, submittals, and resubmittals are the responsibility of the Contractor.

805.14-1 Precast Concrete Sections:

- a. Precast concrete structures for submersible pump stations shall consist of a precast or cast-in-place base slab, precast wet well sections, top cover slab, precast or cast-in-place valve pit and valve pit cover slabs. Concrete shall have a minimum compressive strength of 5,000 psi at the end of twenty-eight (28) days.
- b. The cylindrical wet well structures may be manufactured as one complete precast section or may be separated into more easily handled sections; however, no section shall be less than four (4) feet in length.
- c. Joints between precast concrete sections shall be set by plastic shims and fitted with non-metallic non-shrink grout, single application of preformed mastic sealant material conforming to ASTM C990, or rubber gaskets conforming to ASTM C443. Joints shall be sealed in strict accordance with manufacturer's instructions and shall provide a watertight structure. Additionally, each section joint shall be sealed with an external rubber seal wrap conforming to ASTM C 877, Type III, chemically bonded adhesive butyl bands. Seal shall be designed to prevent leakage of water through joint of each section.
- d. Top slab sections shall be fitted with aluminum hatches per Contract Documents as specified in article Hatches and Cable Holders. Contractor shall confirm hatch size with pump manufacturer prior to casting top slab.
- e. The various precast sections shall have inside dimensions and minimum thickness of concrete as shown in the Contract Documents. Precast and cast-in-place concrete members shall conform to Building Code requirements for reinforced concrete ACI 318. Precast concrete cylinders shall be designed and manufactured in accordance with the provisions of ASTM C478 as modified herein.
- f. Provide vent pipe; minimum six (6)-inch ductile iron pipe for concrete wells and configured as shown in the Contract Documents. Vent pipe is to be supplied with a 16-mesh stainless steel expanded metal insect screen.
- g. Fillets shall be provided in wet wells. They shall be constructed using concrete fill. Fillets shall be constructed to ensure structural bond between wet well walls and floors, and shall be indicated on Shop Drawings.
- h. Type II cement shall be used except as otherwise approved.
- i. Date of manufacture and name or trademark of manufacturer shall be clearly marked on each precast section.
- j. Sections shall be cured by an approved method and shall not be shipped until at least seven (7) days after having been fabricated and in no case prior to concrete attaining a minimum strength of 4000 psi.
- k. Each precast section manufactured shall be clearly marked to indicate the intended pump station installation location. Contractor shall be responsible for installation of the correct precast sections in their designated pump station locations.

- I. Valve pit, if required, shall be sealed watertight. Drain in valve pit shall have PVC ball valve to prevent backflow into valve area.

805-15 HATCHES AND CABLE HOLDERS:

- a. Aluminum wet well and valve pit access hatches with stainless steel hardware and frames shall be supplied with the pumps and valve boxes. Hatches shall include suitable recessed lifting handles and locking hasp. Hatch operation shall be assisted with a compression spring. For concrete wet wells, metal in contact with concrete shall be coated with coal tar. When cover is in full open position, a hold open device shall be provided to prevent accidental closing. The minimum size of the frames and covers shall be as required by pump manufacturer for clearance of equipment (24-inch x 24-inch minimum) and as shown in the Contract Documents for access to the valves. Hatches shall have drainable frames. Hatches shall be Bilco type JAL-H20 or JD AL-H20 or approved equal. Hatches shall have an H-20 wheel load rating unless wet well design or protective bollards prevent traffic access to the hatches. Hatches up to 30" x 48" may be a single leaf style. Larger hatches shall be a 2 leaf style.
- b. Stainless steel cable holders including three eighths (3/8)-inch minimum cable hooks shall be fabricated from Type 316 stainless steel plate. Sharp corners and edges shall be ground smooth to prevent abrasion and cutting of electrical cable insulation. Cable holder shall be of sufficient length and strength to provide support for each separate cable. Pump power/control cable, float switch cables and pump lifting chain shall be supported by the cable holder. All cables and the pump lift chain shall be easily accessed from a pump hatch opening. Cable holders shall be attached with 3/8-inch minimum 316 stainless steel wedge anchors.
- c. Hatch assembly shall be provided by pump supplier, accommodate all pumps, and include upper guide bearing brackets, safety chain hook, hinged and hasped covers, wiring channel or junction box and level sensor cable holders, as required.

805-16 ELECTRICAL POWER CORD:

- a. The pumps shall be supplied with power and sensor conductors encapsulated in a single cable wherever possible. Whenever separate cables are provided for power and sensors, Contractor shall furnish and install separate conduit runs to enclose each conductor. Cable(s) shall be fixed to pump using a watertight compression assembly. Stainless steel watertight connectors, equal to Crouse-Hinds Type CGB, with neoprene glands shall be furnished and installed in junction box enclosure to terminate each conduit and seal each cable end into the panel as shown in the Contract Documents.
- b. Electrical power cord shall be water resistant 600 volts, 60°C, UL and/or CSA approved and applied dependent on amp draw for size. Cord shall be of sufficient length to reach junction box with no splices and appropriate slack.
- c. Power cord leads shall be connected to motor leads by power distribution blocks.
- d. Cord cap assembly where bolted to connection box assembly shall be sealed with a Buna N Rubber O-ring on a beveled edge to assure proper sealing.

805-17 PRODUCT HANDLING:

- a. Parts shall be properly protected so no damage or deterioration will occur during a prolonged delay from time of shipment until installation is completed and the units and equipment are ready for operation.
- b. Equipment and parts shall be properly protected against damage during storage at site.

- c. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from Engineer.
- d. Finished surfaces of exposed pump openings shall be protected by wooden blanks, strongly built and securely bolted thereto.
- e. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- f. After hydrostatic or other tests have been completed, entrapped water shall be drained prior to shipment and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.
- g. Each box or package shall be properly marked to show its net weight in addition to its contents.

805-18 WARRANTY:

805-18.1 Pumps: Pump manufacturer shall warrant pumping equipment for each time period or duration of actual operational running time whichever occurs first, participating in the cost of repair or replacement, in accordance with the following schedule.

Warranty Period	Time After Shipment of Pumping Equipment (months)	Time of Actual Pump Operation (Hours)	Manufacturer's Share of Cost of Repair or Replacement (percent)
1	0-24	0-3000	100
2	25-45	3000.1-6500.0	50
3	46-66	6500.1-10,000.0	25

Warranty shall cover defects in workmanship and material and cover all costs for both labor and parts required to inspect and repair pumping equipment delivered to pump manufacturer's authorized repair and maintenance service center. Contractor shall be responsible for removing and reinstalling pumping equipment in wet well and pump manufacturer shall be responsible for removal and reinstallation of pump power and control cables and transportation or shipping costs for delivery of pumping equipment to service center and return to site during first warranty period. If warranty service is required after first warranty period, Owner shall be responsible for transportation or shipping costs for delivery of pumping equipment to service center and return to site within a 100-mile radius as specified in this section. Pump manufacturer shall be responsible for transportation or shipping costs for delivery of pumping equipment to a service center, outside of the specified 100 mile radius, and return to Owner, in the event that conditions occur that no authorized service center is located within required area at time warranty service is required after first warranty period.

Contractor's obligation under this warranty shall be to repair or replace the defective pumping equipment at the prorated share of cost stated above, exclusive of shipping costs for which pump manufacturer is responsible as stated above.

In addition to the manufacturer's warranty as stated above, the pump manufacturer shall provide a one (1) year clog free guarantee. If the pump clogs with typical solids and/or debris normally found in domestic wastewater during this period (within 12 months of final acceptance by the Owner), the manufacturer or the manufacturer's representative will reimburse the Owner for reasonable cost to remove the pump, clear the obstruction and reinstall the affected pump, or the manufacturer's representative will provide a service technician to perform this work at no cost to the Owner.

805.18.2 Control Panel: From the time the pump station is accepted for maintenance by the Owner, pump control panel components shall carry a full one (1)-year replacement warranty. Programmable pump controller shall carry a ten (10)-year replacement warranty.

805.18.3 Wet Well, Building, VFDs, Transformers, Electrical Distribution Equipment, Air Conditioning, Lighting, Site Improvements, Guide Rail Systems, and Other Accessory Items:

The obligation of the Contractor and pump supplier shall be to repair and/or replace defective access hatches and frames, guide rail systems, wet well and building components, VFDs (if not part of the control panel), transformers, electrical distribution equipment, air conditioning equipment, lighting, site improvements and other accessory items, or any of their defective components which are supplied under this Specification at no additional cost to Owner concurrent with warranty period number one for the pumping equipment. Extended warranty requirements for time periods, after the expiration of warranty period number one as stated above, shall not be applicable to access frames, guide rail system, and other accessory items.

805-18.4 Agreement to Warranty Conditions: Pump manufacturer shall, as a part of the required Shop Drawing and product submittal data, deliver a certified statement of agreement to the above listed conditions of warranty for equipment and materials to be supplied and installed under this Specification. If this agreement is not submitted, equipment shall not be approved.

A typewritten or printed copy of product warranty, including the above provisions and applicable dates of commencement and expiration of each warranty period shall be supplied with other required product data.

805-19 SURFACE PREPARATION AND SHOP PAINTING FOR PUMPS

- a. Before exposure to weather and prior to shop painting, surfaces shall be thoroughly cleaned, dry and free from mill-scale, rust, grease, dirt, and other foreign matter.
- b. Pumps and motors shall be shop coated.
- c. Nameplates shall be properly protected during painting.
- d. Gears, bearing surfaces, and other similar surfaces obviously not to be painted shall be given a heavy shop coat of grease or other suitable rust-resistant coating. This coating shall be maintained as necessary to prevent corrosion during periods of storage and erection and shall be satisfactory to Engineer up to time of final acceptance test.

805-20 PUMP CONTROL AND SERVICE ENTRANCE PANELS:

- a. To establish unit responsibility for the complete operating system, the service entrance and control panel shall be supplied by pump manufacturer/supplier and shall be as specified in Paragraphs 805-22 through 805-48 of these Specifications.
- b. Furnish all labor, materials, equipment and incidentals required and install pump station service entrance and control panels, complete and ready for use. Pump control panels shall be furnished complete with liquid level controls as specified herein and as shown in the Contract Documents.
- c. Pump control logic and sensors are to be made or assembled and warranted by the manufacturer of the service entrance and control panels in addition to all other warranties specified herein.
- d. In order to assume electrical and control system responsibility, the above specified pump control panels shall be furnished completely wired, including interlocking between motor control, accessory devices, and level systems. Pump control panels furnished for all pump stations on this project shall be of the same manufacturer.

805-21 CONTROL PANEL (TYPE I PUMP STATION ONLY):

- a. Furnish and install equipment as shown in the Contract Documents in a low profile, UL 508 listed, weatherproof NEMA 4X, Type 316 stainless steel panel with rain-tight cap, sealed bottom, and eight-inch leg stands. Pump control panel shall be as manufactured

by TESCO Controls Inc., or approved equal. Enclosure shall be furnished with hinged dead front interior and exterior doors. Outer enclosure shall be constructed of 12-gauge, Type 316 stainless steel with non-glare finish. Doors shall be equipped with Type 316 stainless steel polished handles with three point roller bearing latches and hasps for owner padlocks. Doors shall be hinged on the same side and shall open to greater than 90 degrees. Outer doors shall also be furnished with metal doorstops for use in wind conditions. Dead front latches shall be 1/4 turn adjustable with one eighth inch thick latching dog and knurled knob. Interior mounting hardware shall be Type 316 stainless steel. Enclosure exterior shall be unpainted. Interior color including front and back of hinged dead front doors, separation barriers and mounting backpanels shall be white. Painting process shall include five stages of metal preparation using dip tanks as follows: 1) Alkaline cleaner, 2) Clear water rinse, 3) Iron phosphate application, 4) Clear water rinse, and 5) Inhibitive rinse to seal phosphated surfaces. Finish shall be polyester dry powder, electrostatically applied and baked on at 380 degrees F.

- b. Enclosure shall be compartmentalized such that programmable pump controller, power, and telemetry sections are isolated from each other. In compartments containing programmable pump controller, barriers behind inner dead front doors shall separate power sections and space for telemetry. Space shall be available in pump control panel for the mounting of existing or new telemetry components (Ethernet switch, radio/modem, battery and charger). Openings shall be sealed to prevent entrance of insects and rodents.
- c. Pump control panel shall house the main circuit breaker, and an ATS. A separate utility switch with an appropriately sized breaker in a box shall be attached to the main control panel. Main circuit breaker, branch circuit breakers, and wiring shall be located behind interior dead front door. Interlocks, control device and circuit breaker operation shall be possible without opening dead front door. Elapsed time meters, indicating devices and H.O.A. switches, shall be mounted on the inside dead front door. Breaker cutouts for breaker toggle protrusion shall be supplied, to eliminate exposure to hazardous potentials. A physical lockout device shall be supplied on each motor circuit breaker. Lightning/surge protection and PFR power fail relay shall be furnished to protect panel equipment from lightning, loss of power, or Utility power surges. Provide additional surge suppression on 120V ac service to programmable controller and external analog loops. Provide GFCI receptacle, intrusion switch and florescent light with door-activated switch in each panel section. Provide site area light switch with associated circuit breaker protection. Bussing and wire shall be copper. Wire shall be stranded with locking spade pressure connectors and labeled with clip-on permanent plastic wire markers. Circuit breakers and dead front mounted devices (lights and switches) shall be equipped with engraved phenolic nameplates.
- d. When control panel is installed outside, provide climate control devices to keep temperature and humidity within limits of installed devices and equipment. Provide individual heaters in each control enclosure section sized to maintain a minimum temperature and maximum humidity based on the most extreme ambient environment. Each heater shall be controlled by individual humidistat with independent controls for humidity and temperature. For Type I Pump Stations, provide air conditioners on each enclosure section that contains a VFD and where the maximum temperature limit of a housed component may be exceeded. Air conditioners shall be sized to maintain temperature 20 degrees below the high temperature limit of enclosed components within that control panel section during the most extreme anticipated ambient environment. The anticipated outside ambient environment temperature range shall be between 15 and 103 degrees F with 100 percent humidity and direct sun exposure.

805-22 CONTROL PANEL (TYPE II PUMP STATION ONLY):

- a. Furnish and install equipment as shown in the Contract Documents in a low profile, UL 508 listed, weatherproof NEMA 1, steel panel with sealed bottom and eight-inch leg stands. Pump control panel shall be as manufactured by TESCO Controls Inc., or

approved equal. Enclosure shall be furnished with hinged dead front interior and exterior doors. Outer enclosure shall be constructed of 12-gauge steel with painted finish. Doors shall be equipped with Type 316 stainless steel polished handles with 3-point roller bearing latches and hasps for owner padlocks. Doors shall be hinged on the same side and shall open to greater than 90 degrees. Dead front latches shall be 1/4 turn adjustable with one-eighth inch thick latching dog and knurled knob. Interior mounting hardware shall be Type 316 stainless steel. Interior color including front and back of hinged dead front doors, separation barriers and mounting backpanels shall be white. Painting process shall include five stages of metal preparation using dip tanks as follows: 1) Alkaline cleaner, 2) Clear water rinse, 3) Iron phosphate application, 4) Clear water rinse, and 5) Inhibitive rinse to seal phosphated surfaces. Finish shall be polyester dry powder, electrostatically applied and baked on at 380 degrees F.

- b. Enclosure shall be compartmentalized such that programmable pump controller, power and telemetry sections are isolated from each other. In compartments containing programmable pump controller, barriers behind inner dead front doors shall separate power sections and space for telemetry. Space shall be available in pump control panel for mounting of existing or new telemetry components (Ethernet switch, radio/modem, battery and charger). Openings shall be sealed to prevent entrance of insects and rodents.
- c. Elapsed time meters, indicating devices and H.O.A. switches, shall be mounted on the dead front door. Provide lightning/surge protection to protect panel equipment from lightning, loss of power, or utility power surges. Provide additional surge suppression on 120V ac service to programmable controller and external analog loops. Provide GFCI receptacle, intrusion switch and florescent light with door-activated switch in each panel section. Wire shall be stranded with locking spade pressure connectors and labeled with clip-on permanent plastic wire markers. Circuit breakers and dead front mounted devices (lights and switches) shall be equipped with engraved phenolic nameplates.
- d. Electrical building shall be climate controlled to maintain temperature and humidity within limits of the installed devices and equipment. Air conditioning and heating shall be sized to maintain the temperature 20 degrees below the high temperature and above the low temperature limit of enclosed components, respectively, during the most extreme anticipated ambient environment. The anticipated outside ambient environment shall include a temperature range shall be between 15 and 103 degrees F with 100 percent humidity and direct sun exposure.

805-23 UTILITY METERING:

- a. Utility meters shall be installed as per the Contract Documents. Water services complete with metering shall be completed prior to testing or wash down operations. Metering shall meet requirements of and be approved by relevant local utility companies. Until pump station is accepted and turned over to Owner, metering including installation charges, deposits and payment of utilities are responsibility of Contractor. Metering compartment shall be UL labeled as suitable for use as service equipment only. Furnish lever operated meter socket to meet local Utility requirements. Pull section and utility compartments shall be accessible only by local Utility company. Pull section shall include circuit breaker disconnect and neutral landing lug per local utility requirements. Bussing and wire shall be copper.
- b. For Type I Pump Stations, electric service meter compartment shall be constructed as an integral part of pump control panel.

805-24 AUTOMATIC TRANSFER SWITCH:

- a. Provide automatic transfer switch (ATS) mounted inside control panel for a Type I pump station and mounted in association with the MCC or switchgear for a Type II

pump station as shown on the Contract Documents. Transfer switch voltage and current ratings shall be as shown on the Contract Documents and match main incoming circuit breaker for the Utility incoming feeder. Transfer switch shall be open transition type suitable for mounting inside control panel. Utility side shall be connected at the load side of the main breaker. Provide suitable termination means for engine generator cables as shown on the Contract Documents.

- b. ATS shall be as manufactured by ASCO, Russelectric, GE-Zenith Control, or approved equal.
- c. ATS Transfer Switch Features:
 - 1. Type: Electrically operated, mechanically held, double throw.
 - 2. Momentarily energized, single-electrically operated mechanism energized from source to which load is to be transferred.
 - 3. Locking mechanism to maintain constant contact pressure.
 - 4. Mechanical interlock switch to ensure only one of two possible switch positions.
 - 5. Silver alloy contacts protected by arcing contacts.
 - 6. Main and arcing contacts visible when door is open and barrier covers removed.
 - 7. Manual operating handle for transfer in either direction under either loaded or unloaded conditions.
- d. ATS Control Module Features:
 - 1. Completely enclosed and mounted separately from transfer switch unit.
 - 2. Microprocessor for sensing and logic control with inherent digital communications capability.
 - 3. Plug-in, industrial grade interfacing relays with dust covers.
 - 4. Connected to transfer switch by wiring harness having keyed disconnect plug.
 - 5. Plug-in printed circuit boards for sensing and control logic.
 - 6. Adjustable solid state undervoltage sensors for all three phases of normal and for one phase of standby source:
 - i. Pickup 85 to 100 percent nominal.
 - ii. Dropout 75 to 98 percent of pickup setting.
 - 7. Adjustable frequency sensors for standby source:
 - i. Pickup 90 to 100 percent nominal.
 - ii. Dropout 87 to 89 percent of pickup setting.
 - 8. Control module with adjustable time delays:
 - i. 0.5 to 6-second engine start delay.
 - ii. 0 to 5-minute load transfer to emergency delay.

- iii. 0 to 30-minute retransfer to normal delay.
 - iv. 0 to 30-minute unload running time delay.
 - v. Switch to bypass any of the above time delays during testing.
9. Form-C start contacts, rated 10 amperes, 32-volt dc, for two-wire engine control, wired to terminal block.
10. Exerciser, adjustable in fifteen (15)-minute increments, seven (7)-day dial clock complete with dead-front door mounted NO LOAD and LOAD selector switch with option to manually initiate exerciser sequence.
11. In-phase monitor to control transfer when both sources are within acceptable phase angle limits.
12. Adjustable zero (0) to five (5) minutes time delay relay for engine starting signal.
13. Provide dry-contact outputs rated at 5 amps, 120V ac for the following conditions:
- i. Normal power fails.
 - ii. Normal power available.
 - iii. Generator power available.
 - iv. ATS in normal position.
 - v. ATS in generator position.
- e. Indicators:
- 1. Type: Manufacturer's standard.
 - 2. Mounting: Dead-front door mounted.
 - 3. Green lens to indicated switch position for normal power source.
 - 4. Red lens to indicate switch position for standby power source.
 - 5. Green lens to indicate normal power source is available within parameters established by pickup and dropout settings.
 - 6. Red lens to indicate standby power source is available within parameters established by pickup and dropout settings.
 - 7. Provide one normally open and one normally closed, 5 amperes, 120V contact for remote indication when transfer switch is in either position.
- f. Factory Tests:
- 1. Test to ensure correct:
 - i. Operation of individual components.
 - ii. Sequence of operation.
 - iii. Transfer time, voltage, frequency, and time delay settings.

2. Dielectric strength test per NEMA ICS 1.

805-25 TERMINAL AND DISTRIBUTION BLOCKS: Distribution blocks shall be furnished and installed as required for "fan-out" of control power and other 120V sources within enclosure. Blocks shall be rated 300V at a minimum of 20 amperes and sized for the conductors served. Distribution blocks shall be Entelec, Allen Bradley, Connectron, or approved equal.

805-26 CIRCUIT BREAKERS: Unless noted otherwise on the Contract Documents, pumps less than 5 horsepower shall have 230V ac, three-phase service with breakers, starters and overloads as per NEC recommended sizes. Pumps five (5) horsepower and over shall have 480V ac service with breakers, starters & overloads as per NEC recommended sizes. All 230/480 volt circuit breakers shall have interrupting capacities at 14,000 amperes. All 120-volt breakers shall be rated 10,000 amperes interrupting capacity. Circuit breakers shall be of the indicating type, providing ON, OFF, and TRIPPED positions of operating handle. Circuit breakers shall be quick-make, quick-break, with a thermal-magnetic action. Circuit breakers shall be bolted on type with molded case and lugs on both sides. Use of tandem or dual circuit breakers in a normal single-pole space to provide the number of poles or spaces specified is not acceptable. Multiple-pole circuit breakers shall be designed so an overload on one pole automatically causes all poles to open. Circuit breakers shall meet requirements of UL and NEMA AB I. Breakers shall be Cutler Hammer EHD, QC, or approved equal. Circuit breakers shall be UL listed heavy-duty molded case circuit breakers. Circuit breakers shall conform to UL 489, UL 486B, and UL 1087. Circuit Breakers shall also comply with the National Electrical Code and Federal Specification W-C-375C.

805-27 MOTOR CONTROL:

b. Fixed Speed:

1. Provide each motor with suitable controller and devices that will perform functions as specified for their respective motors. Controllers shall conform to applicable requirements of NEMA ICS, ANSI C19.1, the NEC, and UL. Anticipated horsepower ratings are shown on the Contract Documents. This information is for guidance only and does not limit equipment size. When motors furnished differ from the expected ratings indicated, make necessary adjustments to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate motors actually installed at no additional cost to Owner.
2. Each motor control system shall be equipped with a HAND/OFF/AUTO control switch, indicating lights, elapsed time meter, motor starter, and three-phase pump current monitoring.
3. Control switches and indicating lights shall be UL listed oil-tight devices rated heavy duty as manufactured by Allen Bradley or approved equal. Motor starters shall be NEMA rated with an electrically held contact and single reset, three-phase, overload relay with a normally closed holding contact and a normally open isolated contact for overload alarm. Each overload shall be ambient compensated and shall trip on 600% of full load current in less than six (6) seconds. Each motor starter Size 3 and larger shall be furnished with a minimum of four auxiliary contacts and provisions for adding two more. Auxiliary contacts shall be convertible, in the field, from normally open to normally closed. Each overload relay shall have a test trip push-button built-in and an adjustable calibrated trip with indicating dial. There shall be an unbreakable steel operator, with insulated plastic foot (for safety) through the dead front door for manual reset. Motor starters shall be Allen Bradley or approved equal.
4. Indicating Lights Color Convention:
 - i. Red = pump running.

- ii. Green = pump off.
 - iii. Yellow/Amber = pump fail.
5. Elapsed running time meter for recording total elapsed running time for each motor shall be six digit, non-reset, recording in hours and tenths. Meters shall be mounted to dead front door with stainless steel machine screws. Sheet metal screws will not be acceptable.
- c. Variable Frequency Drives (VFDs):
- 1. Drive Units:
 - i. Incorporate a switching power supply operating from a dc bus, to produce a PWM output waveform simulating a sine wave and providing power loss ride through of 2 milliseconds at full load, full speed.
 - ii. Current-limiting semiconductor fuses for protection of internal power semiconductors.
 - iii. Employ a diode bridge rectifier providing a constant displacement power factor of 0.95 minimum at all operating speeds and loads.
 - iv. Use transistors for output section, providing minimum 97 percent drive efficiency at full speed, full load.
 - v. Employ dc power discharge circuit so that after removal of input power dc link capacitor voltage level will decay below 50 volts dc within 1 minute after de-energizing following NEMA CP 1 and NFPA 79. Design dc link capacitor for a MTBF of 5 years.
 - vi. Operate with an open circuited output.
 - vii. Input Voltage: As shown on Contract Drawings plus or minus 10 percent.
 - viii. Output Voltage: 0 to the input voltage as shown on Contract Drawings, three-phase, 0 to 66-Hz, minimum.
 - ix. Maximum peak voltage of PWM AFD output pulse of 1000 volts, with pulse rise time of not less than 2 microseconds, and a maximum rate of rise of 500 volts per microsecond. Maximum frequency of PWM AFD output pulse (carrier) frequency of 3,000-Hz. If magnitudes of these characteristics be more stressful to motor insulation than specified values, furnish insulation systems on the motors suitable for the proposed values.
 - x. Motor Audible Noise Level: When operating throughout speed range of PWM AFD, no more than 3 dBA above that designated in NEMA MG 1 for same motor operated at constant speed with a 60-Hz supply voltage.
 - xi. Short-Time Overload Capacity: 125 percent of rated load in rms current for 1 minute following full load, full speed operation.
 - xii. Equipment Short-Circuit Rating: Suitable for connection to system with maximum source three-phase, bolted fault, short-circuit available of 42,000 amps rms symmetrical at 480 volts or 21,000 amps rms symmetrical at 240 volts.
 - xiii. Furnish drives with output current-limiting reactors mounted within equipment enclosure.

xiv. Diagnostics: Comprehensive for drive adjustment and troubleshooting:

- A. Memory Battery Backup: 100 hours minimum during a power loss.
- B. Status messages will not stop drive from running but will prevent it from starting.
- C. Fault Condition Messages and History: First fault protection function to be activated, ability to store six successive fault occurrences in order. Minimum faults numerically:
 - 1) Overcurrent (time and instantaneous).
 - 2) Overvoltage.
 - 3) Undervoltage (dc and ac).
 - 4) Overtemperature (drive, motor windings, motor bearing, pump bearing).
 - 5) Serial communication fault.
 - 6) Short-circuit/ground fault (motor and drive).
 - 7) Motor stalled.
 - 8) Semiconductor fault.
 - 9) Microprocessor fault.
 - 10) Single-phase voltage condition.
 - a) Drive Protection: Fast-acting semiconductor fuses.
 - b) Overcurrent, instantaneous overcurrent trip.
 - c) Dc undervoltage protection, 70 percent dropout.
 - d) Dc overvoltage protection, 130 percent pickup.
 - e) Overtemperature, drive, inverter, converter, and dc link components.
 - f) Overtemperature, motor, and pump.
 - g) Single-phase protection.
 - h) Reset overcurrent protection (manual or automatic reset).
 - i) Active current limit/torque limit protection.
 - j) Semiconductor fault protection.
 - k) Short-circuit/ground fault protection.
 - l) Serial communication fault protection.
 - m) Microprocessor fault.
 - n) Surge protection for transient overvoltage (6,000 volts, 80 joule surge, tested per IEEE C62.41).
 - o) Visual display of specific fault conditions.

xv. Operational Features:

- A. Use manufacturer's standard unless otherwise indicated.
 - B. Sustained power loss.
 - C. Momentary power loss.
 - D. Power interruption.
 - E. Power loss ride through (0.1 second).
 - F. Start on the fly.
 - G. Electronic motor overload protection.
 - H. Stall protection.
 - I. Slip compensation.
 - J. Automatic restart after power return (ability to enable/disable function).
 - K. Critical frequency lockout (three selectable points minimum, by 1.5-Hz steps in 10-Hz bands, to prevent resonance of system).
 - L. Drive maintenance system software for complete programming and diagnostics.
 - M. Ground fault protection, drive, and motor.
 - N. Operate with no motor connected to output terminals.
2. Rectifier: Three-phase, 6-pulse full wave diode bridge rectifier for pump horsepower less than 150 horsepower and 18-pulse full wave diode bridge rectifier for pump

horsepower 150 horsepower and greater to provide constant dc voltage to drive's dc bus.

3. Furnish series choke and capacitors on dc bus to reduce ripple in rectifier output and to reduce harmonic distortion reflected into incoming power feeders.
4. Controller: Microprocessor-controller PWM inverter to convert to dc voltage to variable voltage, adjustable frequency three-phase ac output. Output voltage shall vary proportionally with frequency to maintain a constant ratio of volts to hertz up to 60-Hz. Above 60-Hz, voltage shall remain constant with drive operating in a constant horsepower output mode.
5. Operator Interface:
 - i. Controls: Mount drive local control on dead front door of enclosure and include control switch and membrane type keypad for the following operator functions:
 - A. Start (when in local mode).
 - B. Stop (when in local mode).
 - C. Speed increase (when in local mode).
 - D. Speed decrease (when in local mode).
 - E. Parameter mode selection (recall programmed parameters).
 - F. HAND/OFF/AUTO control selection (in auto, furnish for auto RUN command digital input and speed increase/decrease via remote 4 -20 mA analog signal).
 - G. Fault reset, manual for all faults (except loss of ac voltage which is automatic upon return).
 - H. HAND/preset speed.
 - I. Parameter lock (password or key switch lockout of changes to parameters).
 - J. Start disable (key switch or programmed code).
 - ii. Control circuit disconnect shall de-energize circuits in units that are not de-energized by main power disconnect device.
 - iii. Arrange component and circuit such that failure of any single component cannot cause cascading failure(s) of any other component(s).
 - iv. Alphanumeric Display: During normal operation and routine test, the following parameters shall be available:
 - A. Motor current (percent of drive rated current).
 - B. Output frequency (Hertz).
 - C. Output voltage.
 - D. Running time.
 - E. Hand/Auto indicator.
 - F. Status of digital inputs and outputs.
 - G. Analog input and output values.
 - H. Output motor current per leg.
 - I. All test points.
 - v. Adjustable Parameters: Set drive operating parameters and indicate in a numeric form. Potentiometers may not be used for parameter adjustment. Minimum setup parameters available:
 - A. Frequency range, minimum, maximum.
 - B. Adjustable acceleration/deceleration rate.
 - C. Volts per Hertz (field weakening point).
 - D. Active current limit/torque limit, 0 to 140 percent of drive rating.
 - E. Adjustable voltage boost (IR compensation).

- F. Preset speed (adjustable, preset operating point).
- G. Provision for adjustment of minimum and maximum pump speed to be furnished as function of 4 -20 mA remote speed signal.

6. Signal Interface:

i. Digital Input:

- A. Accept a remote RUN command contact closure input.
- B. High temperature contact closure input from field mounted motor temperature monitoring relay.

ii. Digital Output: Furnish three discrete output dry contact closures rated 5 amps at 120 V ac.

- A. DRIVE RUNNING.
- B. DRIVE FAULT, with common contact closure for all fault conditions.
- C. DRIVE IN REMOTE MODE.

iii. Analog Input: When LOCAL/OFF/REMOTE switch is in REMOTE, control drive speed from a remote 4 -20 mA dc signal. Make provisions for adjustment of minimum and maximum motor speed which shall result from this signal. Factory set this adjustment to comply with operating speed range designated in driven equipment specifications. Frequency resolution shall be 0.1 percent of base speed.

iv. Analog Output: Furnish two 4 -20 mA dc signals, for actual frequency, actual load.

805-28 DIESEL ENGINE GENERATOR SET:

805-28.1 General:

a. When generator is Owner-furnished, Contractor shall:

1. Receive, load, and transport generator from Owner designated site, within City-Parish to pump station site.
2. Offload and store generator at pump station.
3. Set, level and anchor generator on Contractor installed foundation.
4. Terminate interconnecting structures and conductors to pump station systems.
5. Touchup or repair damage to coatings resulting from unloading, storage, installation, testing and startup.
6. Cooperate with Owner's generator supplier with startup and testing:
 - i. Supplier to inspect installation and issue Certificate of Proper Installation prior to testing. Contractor to remedy deficiencies noted by Supplier associated with the work performed by the Contractor.
 - ii. Functional Test: Contractor to assist Supplier in performing functional test to verify engine generator runs within its allowable limits, unit safety devices function, and automatic transfer switch transfers load to generator on loss of utility power and back on restoration of power.

- iii. Performance Test: Contractor to assist Supplier in performing load cell test to verify rated output of generator and test to verify generator can power installed load. Supplier will supply and temporarily wire the load cell.
 - iv. Contractor to provide assistance during testing to correct installation issues relating to Contractor's scope of Work. As a minimum, Contractor's electrician shall be present during the Functional Test and for the Performance Test until generator is operating in a steady state.
- b. When generators are indicated in the Contract Documents to be provided by the Contractor, generator shall meet requirements in Paragraphs 805-29.2 through 805-29.16.

805-28.2 Manufacturer Special Requirements:

- a. Generator set shall be listed to UL 2200 or submitted to an independent third party certification process to verify compliance as installed. Field evaluated products are not acceptable.
- b. Manufacturer of generator set shall be certified to ISO 9001 and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

805-28.3 Manufacturers:

- a. Generator Sets:
 - 1. Baldor
 - 2. Caterpillar
 - 3. Cummins.

805-28.4 Service Conditions:

- a. Ambient Temperature at Air Intake: 95 degrees F maximum.
- b. Ambient Temperature at Engine Generator Set: 95 degrees F maximum.
- c. Suitable for service in a legally-required standby power system per NFPA 70, National Electric Code.
- d. In conjunction with automatic transfer switch, able to restore power within 60 seconds after failure of the normal power supply.

805-28.5 Generator General Characteristics

- a. Generator sets shall be used to drive centrifugal pump motors and ancillary loads and shall be Industrial Grade.
- b. Ratings:
 - 1. Operate at maximum 1,800 rpm.
 - 2. Power and voltage ratings shall be sized to start and operate the sized pumps provided for pump station and associated ancillary loads. Sizing shall be based on ancillary loads and one pump starting in the first unit step with one pump started in subsequent steps.

3. Rated based on standby service.
- c. Emissions: Engines shall be certified in compliance with 40 CFR 89.

805-28.6 Engine

- a. General:
 1. Manufacturer's standard design, unless otherwise specified.
 2. Designed with adequate strength for specified duty.
- b. Type:
 1. Diesel cycle, 4-stroke type with unit mounted radiator and fan cooling.
 2. Minimum displacement shall be as recommended by generator manufacturer.
 3. Minimum number of cylinders shall be four.
- c. Starting System:
 1. Type: Automatic, using 12-volt or 24-volt battery-driven starter acting in response to control panel.
 2. Starter shall be capable of three complete cranking cycles without overheating.
 3. Batteries:
 - i. Sized as recommended by engine manufacturer.
 - ii. Lead-acid type.
 - iii. Capable of providing 15 seconds minimum of cranking current at 0 degree C and three complete 15-second cranking cycles at 40 degrees C.
 - iv. Housed in acid-resistant frame isolated from engine generator main frame.
 - v. Located such that maintenance and inspection of engine is not hindered.
 - vi. Complete with battery cables and connectors.
 4. Battery Charger:
 - i. Locate within enclosure.
 - ii. UL 1236 listed and labeled.
 - iii. 10-amp automatic float, taper and equalize charge type, with plus or minus 1 percent voltage regulation over a plus or minus 10 percent input voltage variation.
 - iv. Temperature compensated to operate over an ambient range of minus 30 degrees C to 50 degrees C.
 5. Include:
 - i. Ammeter and voltmeter.

- ii. Fused ac input and dc output.
 - iii. Power ON pilot light.
 - iv. AC failure relay and light.
 - v. Low and high dc voltage alarm relay and light.
- 6. Alarm relay dry contacts rated 4 amps at 120V ac.
- d. Fuel System:
 - 1. Engine driven, mechanical, positive displacement fuel pump.
 - 2. Fuel filter with replaceable spin-on canister element.
 - 3. Fuel Connections to Engine: Flexible hose, suitable for application.
- e. Governing System:
 - 1. Electro-mechanical or electro-hydraulic type.
 - 2. Regulates speed as required to hold generating frequency within tolerable limits and within 5 percent of nominal design speed.
 - 3. Accessories:
 - i. Manual speed control device.
 - ii. Positive overspeed trip switch.
- f. Jacket Water Cooling System:
 - 1. Radiator:
 - i. Consisting of jacket water pump, fan assembly, and fan guard.
 - ii. Cooling System: Rated for full load operation in 122 degrees F (50 degrees C) ambient as measured at alternator air inlet.
 - iii. Sized based on a core temperature that is 20 degrees F higher than rated operation temperature.
 - 2. Engine Thermostat: As recommended by manufacturer to regulate engine water temperature.
 - 3. Engine Cooling Liquid: Fill cooling system with a 20/80-propylene glycol/water mixture prior to shipping.
- g. Lubrication System:
 - 1. Type: Full-pressure.
 - 2. Accessories:
 - i. Pressure switch to initiate shutdown on low oil pressure.
 - ii. Oil filter with replaceable element.

- iii. Bayonet type oil level stick.
- iv. Valved oil drain extension.
- 3. Oil Cooling System: Water-cooled heat exchanger utilizing jacket water if recommended by manufacturer.
- h. Exhaust System:
 - 1. Muffler: Rated for residential silencing.
 - 2. Exhaust Pipe: ASTM A335, Grade P11, standard wall, with fittings selected to match piping materials.
 - 3. Pipe Connections: Welded.
 - 4. Engine Connection: Flanged.
- i. Air Intake System: Equip with dry type air cleaner with filter service (restriction) indicator.

805-28.7 Generator:

- a. General:
 - 1. Meet requirements of NEMA MG 1.
 - 2. Synchronous type with 2/3 pitch, revolving field, drip-proof construction, air cooled by a direct drive centrifugal blower fan.
 - 3. Stator Windings:
 - i. Skewed for smooth voltage waveform.
 - ii. Reconnectable, 12 lead.
 - iii. Overspeed Capability: 125 percent.
 - iv. Waveform Deviation from Sine Wave: 5 percent maximum.
 - v. Telephone Interference Factor: 50 maximum.
 - vi. Total Harmonic Current and Voltage Distortion: 5 percent maximum, measured at generator main circuit breaker.
 - vii. 480-volt, three-phase, 60-cycle or 230-volt, three-phase, 60-cycle as indicated on the Contract Documents or specified herein.
- b. Insulation System:
 - 1. Class H, with a maximum rise of 125 degrees C over 40 degree C ambient in accordance with NEMA MG 1.
 - 2. Epoxy varnish.
- c. Excitation System:
 - 1. Field brushless type or permanent magnet generator (PMG) exciter.

2. PMG and Controls: Capable of providing regulated current, at a rate of 300 percent of nameplate current, to a single-phase or three-phase fault for 10 seconds.
- d. Voltage Regulation:
1. Solid state, three-phase sensing type.
 2. Adjustable output voltage level to plus or minus 5 percent.
 3. Provisions for proper voltage regulation for existing or future adjustable frequency drives as part of generator load.
 4. Conformal coating environmental protection.
- e. Voltage and Frequency Regulation Performance:
1. Steady State Voltage Regulation: Less than plus or minus 1 percent from no load to continuous rating point.
 2. NEMA MG 1 Defined Transient Voltage Dip:
 - i. Less than 20 percent at rapid application of rated load.
 - ii. Recovery to rated voltage and frequency within 2 seconds following initial load application.
 - iii. Steady State Frequency Regulation: Plus or minus 1.5-Hz overload range.
- f. Motor Starting Capability: See Contract Documents.
- g. Short Circuit Capabilities: Sustain 300 percent of rated current for 10 seconds for external three-phase bolted fault without exceeding rated temperatures.
- h. Main Circuit Breaker:
1. Type: Molded case.
 2. Current Rating: As recommended by generator manufacturer.
 3. Interrupt Rating: See Contract Documents.
 4. Short Time Rating: See Contract Documents.
 5. Trips:
 - i. Thermal-magnetic with inverse time characteristics and adjustable magnetic pickup.
 - ii. Solid state, RMS sensing.
 - iii. Adjustable Functions:
 - A. Long-time current pickup.
 - B. Long-time delay.
 - C. Normal range instantaneous.
 - D. Short-time delay with I²t function.
 6. Enclosure:

- i. Rating: NEMA 250, Type 12.
 - ii. Mounted with vibration isolation from engine generator set.
7. Surge Protective Devices: Three-phase capacitors and arresters mounted in terminal compartment.

805-28.8 Baseplate:

- a. Mount engine generator set on rigid common steel base frame.
- b. Base frame shall be stiffened to minimize deflections.

805-28.9 Integral Subbase Fuel Tank:

- a. General:
 1. Full load operation of generator set for 72 hours.
 2. UL 142 listed and labeled.
 3. Installation shall be in compliance to NFPA 37.
 4. Double-walled, steel construction and shall include the following features:
 - i. Emergency tank and basin vents.
 - ii. Mechanical level gauge.
 - iii. Fuel supply and return lines, connected to generator set with flexible fuel lines as recommended by engine manufacturer and in compliance to UL 2200 and NFPA 37 requirements.
 - iv. Leak detection provisions, wired to generator set control for local and remote alarm indication.
 - v. High and low level float switches to indicate fuel level. Wire switches to generator control for local and remote indication of fuel level.
 - vi. Basin drain.
 - vii. Integral lifting provisions.
 5. Desiccant canister on air vents line.

805-28.10 Vibration Isolators:

- a. Provide vibration isolators, spring/pad type.

805-28.11 Automatic Load Transfer Control:

- a. Automatic run controls shall be suitable for remote interface and control by automatic transfer switch. Engine generator set shall start and run upon closure of a remote dry contact specified in, article Automatic Transfer Switch (Type I and II Pump Stations).

805-28.12 Control System:

- a. Control Panel:

1. Rating: NEMA 250, Type 12.
 2. Material: Steel.
 3. Instrument Identification: Face label or engraved, black, laminated plastic nameplate with white 1/4-inch high letters, attached with Type 422 stainless steel screws.
 4. UL 508 listed.
 5. Tested to meet or exceed IEEE 587 requirements for voltage surge resistance.
 6. Controls shall be solid-state, microprocessor based. Control panel shall be designed and built by generator manufacturer and shall provide operating, monitoring, and control functions for generator set.
 7. Control panel mounting height shall not exceed 6 feet 6 inches above where personnel will access panel. Manufacturer shall modify mounting height for a subbase fuel tank.
- b. Instrumentation:
1. Type: Suitable for engine-mounted vibration environment.
 2. Mounting: Nonshock mounted.
 3. Alarm and Signal Contacts: Rated 5 amps at 120V ac, dry.
 4. Fault Indication Lamps: Manufacturer's standard.
 5. Meters: Digital with analog display, plus or minus 2-percent accuracy.
- c. Operator Controls and Indicators:
1. HANDCRANK/STOP/AUTO/ENGINE TEST selector switch.
 2. Generator voltage adjustment.
 3. Voltmeter PHASE SELECTOR switch.
 4. Ammeter PHASE SELECTOR switch.
 5. Voltmeter.
 6. Ammeter.
 7. Kilo-Watts (kW).
 8. Power factor.
 9. FREQUENCY meter.
 10. Engine OIL PRESSURE indicator.
 11. Engine jacket WATER TEMPERATURE indicator.
 12. Engine SPEED indicator (RPM).
 13. Engine OIL TEMPERATURE indicator.

14. RUNNING TIME indicator.
 15. DC battery voltage.
 16. Emergency Stop button.
- d. Alarm Indicators with Manual Pushbutton RESET:
1. Low oil pressure.
 2. High jacket water temperature.
 3. Engine overspeed.
 4. Engine overcrank.
 5. Low/high dc voltage.
- e. External Interfaces:
1. Furnish a single, common DPDT relay output upon occurrence of alarm condition.
 2. Output: Dry contact rated 5 amps at 120V ac.
 3. Accept remote dry start contact closure from automatic transfer switch, rated 10 amps at 32V dc.
- f. Functional Requirements:
1. LCD text display of alarm/event descriptions.
 2. Recracking Lockout: When engine fires, starting control shall automatically disconnect cranking control to prevent recracking for a preset period of time after engine stop.
 3. Overcranking Lockout: Initiate after four cranking cycles of 10 seconds on and 10 seconds off or provide continuous cranking cycle with crank time limiter.
 4. Cooldown timer, adjustable from 5 minutes to 60 minutes.
 5. Alarms:
 - i. Low coolant level.
 - ii. Low fuel level.
 - iii. Low battery voltage
 - iv. High battery voltage.
 - v. Battery charger failure.
 6. Engine shutdown upon following conditions:
 - i. Engine overspeed.
 - ii. Emergency stop button depressed.

- iii. High jacket water temperature alarm setpoint and shutdown setpoint.
 - iv. Low oil pressure alarm setpoint and shutdown setpoint.
7. Power Requirements: 120 volts, three-phase.

805-28.13 Outdoor Weather-Protective Enclosure:

- a. General:
 - 1. Provide generator set with outdoor enclosure, with entire package listed under UL 2200.
 - 2. Designed for a minimum wind speed of 110 mph.
 - 3. Package shall comply with requirements of NEC for wiring materials and component spacing.
 - 4. Enclosure constructed of minimum 12-gauge steel for framework and 14-gauge steel for panels.
 - 5. Hardware and hinges shall be austenitic stainless steel.
 - 6. Design total assembly of generator set, enclosure, and subbase fuel tank to be lifted into place using spreader bars.
 - 7. Housing:
 - i. Provide ample airflow for generator set operation at rated load in ambient temperature of 100 degrees F.
 - ii. Doors:
 - A. Hinged access doors as required to maintain easy access for operating and service functions.
 - B. Lockable and include retainers to hold door open during service.
 - 8. Roof: Cambered to prevent rainwater accumulation.
 - 9. Openings: Screened to limit access of rodents into enclosure.
 - 10. Electrical power and control interconnections shall be made within perimeter of enclosure.
 - 11. Finishes:
 - i. Prime sheet metal or aluminum for corrosion protection and finish painted with manufacturer's standard color using a two-step electrocoating paint process, or equal meeting performance requirements specified below.
 - ii. Prime and paint surfaces of metal parts. Painting process shall result in coating that meets the following requirements:
 - A. Primer: 0.5 mil to 2.0 mils thick.
 - B. Top Coat: 0.8 mil to 1.2 mils thick.
 - C. Gloss:
 - 1) Per ASTM D523, 80 percent plus or minus 5 percent.
 - 2) Gloss retention after 1 year shall exceed 50 percent.

- D. Crosshatch Adhesion: Per ASTM D3359, 4B-5B.
- E. Impact Resistance: Per ASTM D2794, 120-inch to 160-inch pounds.
- F. Salt Spray: Per ASTM B117, plus 1,000 hours.
- G. Humidity: Per ASTM D2247, plus 1,000 hours.
- H. Water Soak: Per ASTM D2247, plus 1,000 hours.

- iii. Painting of hoses, clamps, wiring harnesses, and other nonmetallic service parts shall not be acceptable.
- iv. Fasteners used shall be corrosion resistant and designed to minimize marring of painted surface when removed for normal installation or service work.

12. Exhaust Silencer:

- i. Install factory-mounted exhaust silencer inside enclosure.
- ii. Exhaust shall exit enclosure through a rain collar and terminate with a rain cap.
- iii. Exhaust connections to generator set shall be through seamless flexible connections.

13. Maintenance Provisions:

- i. Flexible coolant and lubricating oil drain lines that extend to exterior of enclosure, with internal drain valves.
- ii. External radiator-fill provision.
- iii. External fuel-fill provision for subbase fuel tank.

14. Inlet ducts shall include rain hoods.

15. Provide external emergency stop switch that is protected from accidental actuation.

16. Sound Attenuation:

- i. Provide with sound-attenuated housing which allows generator set to operate at full rated load in an ambient temperature of up to 100 degrees F.
- ii. Enclosure shall reduce sound level of generator set while operating at full rated load to a maximum of 85 dBA at any location 7 meters from generator set in a free field environment when tested in accordance with SAE J1074.
- iii. Insulate enclosure with nonhygroscopic materials.

805-28.14 Factory Tests (on each unit):

- a. Conform to NFPA 110.
- b. Steady Load Test: Test engine generator set at steady load run of 60 minutes minimum duration at 100 percent full-rated load.
- c. Transient Load Test: Conduct transient load test to demonstrate ability to meet load pickup and load release requirements specified.
- d. Harmonic Test: Conduct at full load conditions.
- e. Record and Report:

1. Strip chart recording and full harmonic analysis measuring up to 50th harmonic for both voltage and current and three phases simultaneously.
2. Transient response.
3. Load/speed stability.
4. Engine fuel consumption.
5. Power output.
6. Harmonic analysis.

805-28.15 Field Tests:

- a. Conform to NFPA 110.
- b. Coordinate with the generator supplier to perform the following tests on each unit:
 1. Performance Test:
 - i. Perform upon completion of installation.
 - ii. Operate 2 hours minimum.
 - iii. Manufacturer's representative shall make necessary adjustments.
 - iv. Demonstrate ability of engine generator set to carry specified loads.
 - v. Demonstrate engine generator set safety shutdowns.
 2. Test Report: Record and report the following:
 - i. Electric load on generator.
 - ii. Fuel consumption.
 - iii. Exhaust temperature.
 - iv. Ambient air temperature.
 - v. Safety shutdown performance results.
 - vi. Noise levels at 7 meters.
 3. Post-test Requirements:
 - i. Make final adjustments.
 - ii. Replace fuel and oil filters.
 - iii. Check belt drive tensions.
 - iv. Demonstrate proper operation of equipment, including automatic operation with control from automatic transfer switch, to Engineer and Owner.

805-28.16 Manufacturer's Services for Contractor Procured Generators: Manufacturer's Representative: Present at each pump station site for minimum one person-day, travel time excluded for functional and performance testing and completion of Manufacturer's Certificate of Proper

Installation.

805-29 CONTROL POWER TRANSFORMER: Transformer shall be furnished with primary and secondary fusing. Transformer shall be encapsulated with electrical grade epoxy and silica sand to completely seal the core and coils from moisture and contaminants. Transformer shall be designed for quiet operation, 180 degrees C insulation system standard with 115 degrees C temperature rise for longer, more reliable life. Transformer shall be made in USA and meet or exceed all applicable NEMA, ANSI, OSHA, UL, and CSA requirements.

805-30 PANELBOARD: Panel board shall be circuit breaker type custom constructed to utilize minimum enclosure space with breakers as shown. Circuit breakers shall be molded case, screw-on type with lugs on both sides. Panel board shall be furnished with phenolic nameplates. Panel board transformer shall be dry type construction sized as shown in the Contract Documents with primary breaker protection. Panel board transformer shall be a Jefferson 211, G.E., or approved equal.

805-31 CONDUIT SYSTEMS: Conduit shall be PVC-coated Rigid Galvanized Steel (GRS), rigid aluminum, or Schedule 40 or 80 PVC, unless otherwise noted. All underground conduits shall be direct buried PVC-coated GRS; except conduit for the electric utility service lateral shall be direct bury Schedule 40 or 80 PVC as required by local Utility provider requirements and direct bury Schedule 40 PVC shall be used for conduit between the control panel and the generator pad. Above ground conduits shall be PVC-coated GRS or rigid aluminum. Conduit inside electrical buildings shall be rigid aluminum. No other conduit types will be allowed.

805-31.1 PVC-Coated Rigid Galvanized Steel Conduit: PVC-Coated Rigid Galvanized Steel Conduit shall be constructed to meet the requirements of NEMA RN 1, NEMA C80.1 and UL 6. The exterior finish shall be PVC coating, 40-mil nominal thickness with bond to metal having tensile strength greater than PVC and an interior finish consisting of a 2-mil nominal thickness of Urethane coating. Threads shall be hot-dipped galvanized and factory coated with urethane. Conduit shall be bendable without damage to interior or exterior coating. PVC-Coated Rigid Galvanized Steel Conduit fittings shall meet requirements of UL 514B. Fittings shall be rigid galvanized steel type, PVC coated by conduit manufacturer. Conduit bodies shall be cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC coated by conduit manufacturer of 40-mil PVC exterior, 2-mil urethane interior with overlapping pressure-sealing sleeves. Manufacturer shall be Robroy Industries, Plasti-Bond.

805-31.2 PVC Schedule 40 Conduit: PVC Schedule 40 and 80 conduit shall be constructed to meet the requirements of NEMA TC 2 and UL 651 or as otherwise required by utility provider. The product shall be UL listed and labeled for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors. Fitting shall meet the requirements of NEMA TC 3 for slip-on PVC fittings.

805-31.3 Rigid Aluminum Conduit: Rigid Aluminum Conduit shall be constructed of Type 6063, copper-free aluminum alloy, meeting the requirements of NEMA C80.5 and UL 6A. Fittings used with rigid aluminum conduit shall meet the requirements of and be labeled UL 514. Fitting shall be threaded, copper-free aluminum. Set screw fittings not permitted. Provide fittings as follows:

- a. Insulated Bushings shall be cast aluminum, with integral insulated throat, rated for 150 degrees C as manufactured by O-Z/Gedney, Type AB.
- b. Grounding Bushing shall be cast aluminum with integral insulated throat, rated for 150 degrees, with solderless lugs as manufactured by O-Z/Gedney, Type ABLG.
- c. Conduit Hub shall be cast aluminum, with insulated throat, UL listed for use in wet locations as manufactured by O-Z/Gedney, Type CHA or equal.
- d. Conduit Bodies shall be one of the following Manufacturers and Products
 1. For Normal Conditions:
 - i. Appleton; Form 85 threaded unilets.

- ii. Crouse-Hinds; Mark 9 or Form 7-SA threaded condulets.
 - iii. Killark; Series O electrolets.
- 2. For Hazardous Locations:
 - i. Appleton.
 - ii. Crouse-Hinds.
 - iii. Killark.
- 3. Conduit Sealing Fitting shall be one of the following manufacturers and Products:
 - i. Appleton; Type EYF-AL or Type EYM-AL.
 - ii. Crouse-Hinds; Type EYS-SA or Type EZS-SA.
 - iii. Killark; Type EY or Type EYS.
- 4. Drain Seal shall be one of the following Manufacturers and Products:
 - i. Appleton; Type EYDM-A.
 - ii. Crouse-Hinds; Type EYD-SA or Type EZD-SA.
- 5. Drain/Breather Fitting shall be one of the following Manufacturers and Products:
 - i. Appleton; Type ECDB.
 - ii. Crouse-Hinds; ECD.
- 6. Expansion Fitting shall be one of the following Manufacturers and Products:
 - i. Deflection/Expansion Movement: Steel City; Type DF-A.
 - ii. Expansion Movement Only: Steel City; Type AF-A.
- 7. Cable Sealing Fittings:
 - i. To form watertight nonslip cord or cable connection to conduit.
 - ii. Bushing: Neoprene at connector entry.
 - iii. Manufacturer and Product: Appleton; CG-S.

805-32 PUSH-BUTTONS AND SELECTOR SWITCHES: Furnish and install push buttons and selector switches as shown in the Contract Documents. Engraved phenolic nameplates shall specify each switches function. Switches shall be wired as shown in the Contract Documents. Switches shall be full voltage Allen Bradley 800H series or approved equal.

805-33 RECEPTACLES, DUPLEX: Receptacles shall be of specification grade and of NEMA configuration and rated 2 pole, 3 wire grounding, 20 amperes, 125 volts, such as Leviton 6898, Bryant 5252, or approved equal. Bases shall be of ivory phenolic composition. Wire terminals shall be suitable for 10 AWG wire and shall be screw type. Receptacles shall be UL listed. The receptacles shall have corrosion resistant conducting parts of nickel-plated brass and other metal parts of stainless steel. All external and dead front receptacles shall be installed on ground fault interrupter circuits (GFCI).

805-34 RELAYS, CONTROL: Control relays shall be Potter and Brumfield KU, Idec Type RR or approved equal. Two form-C contacts (minimum) shall be provided on each relay. Provide relay energized neon lamp (inside relay case).

805-35 RELAYS, POWER FAIL: The power fail relay shall continuously monitor the three phases for power loss, low voltage, phase loss, phase reversal and have automatic reset. The power fail monitor shall have a dropout voltage adjustment and a failure indicating LED. Provide Timemark B269, or approved equal.

805-36 RELAYS, FLOAT SWITCH INTERFACE: Float interface transceivers shall be provided for functions as shown in the Contract Documents. Transceivers shall connect to optical floats that have no electrical wires or metallic connections between control panel and floats in wet well. Optical transceivers shall be Opti-Float® model TR2 as represented by Tesco Controls, Inc. or approved equal.

805-37 RELAYS, TIME DELAY: Time delay relays shall be solid state relays with a timer adjustable over the range one (1) to sixty (60) seconds unless other ranges are indicated or required. Provide LED relay energized indicator lamp. Time delay relays shall be Idec RTE or approved equal.

805-38 RELAYS, PUMP MOISTURE SENSING:

- a. Pump moisture sensing relays shall be provided for submersible pumps. The unit shall be specifically designed for monitoring conductive circuits. The unit shall utilize low current (120 micro amps maximum) and low voltage (12 volts d-c maximum). Unit sensitivity shall allow pick-up on circuit closures of 100 K ohms or less. Pump moisture sensing relays shall be TESCO 72-144 or approved equal.
- b. If selected pump manufacturer is FLYGT, then moisture/overtemperature-sensing relays shall be FLYGT Mini-CAS. Pump control panel shall be furnished with 24V ac control power transformer for Mini-CAS power supply. Furnish Mini-CAS reset pushbutton for each pump. Where pump are provided by another manufacturer, provide similar device with the same features, function and level of quality.

805-39 CHECK VALVE CONTROLS: Control panel shall include circuitry to accept a signal from an external check valve position limit switch which will shut down the associated pump if the pump is running and the check valve is not open, and provide a telemetry signal indicating the pump has shutdown.

805-40 LEVEL MONITORING SYSTEM (TYPE I PUMP STATIONS): Level monitoring shall be by a Captive Air System consisting of a 120-volt air compressor, compression bell, 3-way solenoid valve, and level transducer as shown in the Contract Documents. Level transducer senses back pressure of the static air column set up in the compression bell that is periodically replenished by the purge air compressor. Compression bell shall be Type 316 stainless steel and designed for resistance to buildup of foreign material. Compression bell shall also be designed to travel on the independent guide rail system. The specially designed programmed multi-cycle cleaning system shall prevent compression bell from plugging while minimizing compressor run time. Level monitoring system shall also provide a means of manually actuating the purging cycle when immediate purging and cleaning is necessary. 120-volt compressors shall start against a 250-psi head and shall be furnished with a written ten (10)-year warranty.

805-41 LEVEL MONITORING SYSTEM (TYPE II PUMP STATIONS): Level monitoring shall be by a Bubbler System of the following components:

- a. General: Provide all instrumentation, equipment, and ancillaries as required for a fully functional bubbler system.
- b. Air Supply Sets:

1. Parts: Integrally Mounted:
 2. Pressure Controls: Automatic START/STOP, factory set at 30 psig to 50 psig.
 - i. Valves: Manual drain, manual shutoff, pressure relief, and check valve.
 - ii. Pressure gauge.
 - iii. Inlet filter muffler.
 - iv. Power: 120V ac.
 - v. Compressor: Oil-less, single cylinder, rated for at least 1 scfm at 50 psig.
 - vi. Material: Stainless Steel.
 - vii. Manufacturers and Products: ITT Pneumotive; GH Series, or approved equal.
 3. Duplex Air Supply Sets:
 - i. Air Receiver: 20 gallons.
 - ii. Compressors: Two.
 - iii. Automatic Failover Control: Factory set at 20 psig.
- c. Dual Compressor Controller:
1. Features:
 - i. Automatic motor alternation.
 - ii. Lag motor start if lead fails.
 - iii. Adjustable motor failure delay.
 - iv. Adjustable power on delay timer.
 - v. Lamp test feature.
 - vi. 24 VDC level and moisture sensing circuits with intrinsic safety.
 - vii. Common alarm dry contact output.
 2. Operator Indicators:
 - i. On status light.
 - ii. Failure status light.
 - iii. Seal failure status light.
 - iv. High level alarm light.
 - v. Low level alarm light.
 - vi. Common alarm light, with dim glow.
 3. Power Requirement: 115 VAC.

4. Manufacturer and Model: Control Systems Inc, DC101, or approved equal.
- d. Valve, Solenoid: Solenoid Valve, Two-Way:
1. Type: Globe valve directly actuated by solenoid and not requiring minimum pressure differential for operation.
 2. Materials:
 - i. Body: Brass or stainless steel globe valves as recommended by manufacturer for designated service, unless otherwise shown on Drawings.
 - ii. Valve Seat: Buna N.
 3. Size: Normally closed or opened
 4. Coil: 115V ac
 5. Solenoid Enclosure: NEMA 7.
 6. Manufacturer and Product: ASCO; Red Hat Series 8260, or approved equal.
- e. Valve, Needle:
1. Materials: Brass, or stainless steel to suit.
 2. Size: 0.020 inch orifice.
 3. Manufacturers and Products: Hoke; 3700 Series, or approved equal.
- f. Differential Pressure Flowmeter:
1. For air service.
 2. Rotameter:
 - i. Materials: Glass tube, fiberglass body, stainless steel float, nylon ball check valve.
 - ii. Direct-Reading Scale Length: 2 1/2 inches, minimum.
 - iii. Scale Ranges: 0 scfh to 2.5 scfh.
 - iv. Integral inlet needle valves.
 3. Differential Pressure Regulator:
 - i. Body: Type 316 stainless steel or brass to suit.
 - ii. Diaphragm: Viton or Buna N.
 - iii. Springs: Type 316 stainless steel.
 - iv. Max Pressure: 200 psig at 100 degrees F.
 - v. Maximum Differential Pressure: 100 psi.
 4. Manufacturers and Products:

- i. ABB Automation Series 10A6100, or approved equal.
- g. Pressure Regulator, Air:
 - 1. Provide air at reduced pressures, as shown, constant to within plus or minus 10 percent for flows from 0 scfh to 300 scfh with 100 psi supply pressure.
 - 2. Setscrew for outlet pressure adjustment.
 - 3. Integral filter and relief valve.
 - 4. Manufacturers and Products:
 - i. Fisher; Series 67FR, or approved equal.
- h. Pressure Switch, Adjustable Dead Band:
 - 1. General:
 - i. Function: Monitor pressure, activate switch at set point, and deactivate switch at reset point.
 - ii. Type: Piston-actuated.
 - iii. Both set point and deadband (the differential between set point and reset point) adjustable.
 - 2. Performance:
 - i. Setpoint:
 - A. As noted.
 - ii. Reset Point: As noted.
 - iii. Range: The noted set point shall fall between 20 percent and 80 percent of the range.
 - iv. Deadband: Adjustable within nominally 25 percent and 85 percent of range.
 - v. Overpressure Proof Pressure:
 - A. Pressure psi Ranges: At least 400 percent of rated maximum static pressure.
 - B. Pressure Inches of Water Ranges: 20 psig.
 - C. Compound Range: 250 psig.
 - D. Vacuum Range: 250 psig.
 - vi. Operating Temperature Range:
 - A. Dependent on actuator seal materials.
 - B. For Buna-N seal, 0 degrees F to 150 degrees F.
 - 3. Features:
 - i. Actuator Seal: Buna N
 - ii. Adjustable deadband.

- iii. Mounting: Surface
- 4. Process Connection:
 - i. 1/4 inch type 316 Stainless steel NPT female connections
- 5. Signal Interface:
 - i. Contact Type:
 - A. SPDT.
 - B. Rated for 10 amps minimum at 120V ac.
- 6. Manufacturers and Products:
 - i. Ashcroft; L or P Series or approved equal.
- i. Pressure Differential Transmitter, Nonsmart:
 - 1. General:
 - i. Function: Measure differential pressure and transmit signal proportional to differential pressure, flow, or level.
 - ii. Type: Electronic variable capacitance, two-wire transmitter.
 - iii. Parts: Transmitter and three-valve manifold.
 - 2. Performance:
 - i. Maximum Adjustable Range: Such that the noted range shall be between 40 percent and 80 percent of maximum adjustable range.
 - ii. Accuracy: Plus or minus 0.25 percent of calibrated span between 4 and 100 percent of input differential pressure.
 - iii. Temperature: Operating range minus 20 to plus 150 degrees F, minimum.
 - 3. Features:
 - i. Damping: Fluid or electronic type with adjustment.
 - ii. Materials: Wetted parts including process flanges and drain/vent valves, Type 316 stainless steel, or approved equivalent.
 - iii. Wetted O Rings: Viton
 - iv. Fill Fluid: Silicone
 - 4. Signal Interface: 4 to 20 mA dc output for load impedance of 0 to 500 ohms minimum without load adjustment with 24V dc supply.
 - 5. Enclosure: Wall or pipe mounted NEMA 4X, unless otherwise noted.
 - 6. Three-Valve Manifold, constructed of Type 316 stainless steel
 - 7. Manufacturers and Products: Foxboro; Series 823DP, or approved equal.
- j. Pressure Gauge:

1. General: Pressure indication with Bourdon tube.
2. Accuracy: Plus or minus 0.50 percent of full scale.
3. Features:
 - i. Liquid Filled: Glycerin filled.
 - ii. Dial: 4-1/2-inch diameter.
 - iii. Case Material: Stainless steel.
 - iv. Element Material: Phosphor-bronze.
 - v. Throttling Devices: Brass pulsation dampener required.
 - vi. Pointer: Micrometer-adjustable.
 - vii. Movement: Stainless steel, Teflon coated bearings, rotary geared.
 - viii. Window: Glass.
 - ix. Socket Materials: Brass.
 - x. Threaded reinforced polypropylene front ring for zero adjustment.
 - xi. Case Type: Solid front with solid wall between window and element.
4. Process Connection: 1/2-inch threaded (NPT).
5. Manufacturers and Products: Ashcroft; Duragauge Model 1279/1379, or approved equal.

805-42 FLOAT SWITCH BACKUP CONTROL SYSTEM: Float interface transceivers shall be provided for functions as shown in the Contract Documents. Transceivers shall connect to optical floats that have no electrical wires or metallic connections between control panel and floats in the wet well. Optical transceivers shall be Opti-Float® model TR2 as represented by Tesco Controls, Inc. or approved equal. Provide optical float switches and associated transceivers and cables as specified in 805-36, and Type 316 stainless steel mounting bracket, for low level/high level alarm status as a backup for captive air system level control. Float control system shall call for pumps to operate should primary control system fail. Refer to the Contract Documents for details.

805-43 EXTERIOR ALARM LIGHT AND HORN: Provide weatherproof exterior alarm light with red LEXAN lens on top. Exterior alarm light shall burn dimly during normal conditions to indicate "POWER ON" and "LAMP GOOD" and shall flash brightly during failure condition. Provide Type 316 stainless steel protective box open front and top as shown in the Contract Documents for Type I Pump Stations and on the exterior of the electrical building on NEMA 4X box for Type II Pump Stations. Provide NEMA 4X panel mounted, 120-volt horn with adjustable output from 78 to 103 dB, Edwards Signaling and Security Systems, AdaptaHorn 870P or equal. Horn shall energize when alarm light is signaling failure condition. Mount horn on control side of enclosure for Type I Pump Stations and on exterior of electrical building on NEMA 4X box for Type II Pump Stations.

805-44 COMBUSTIBLE GAS ELEMENT AND TRANSMITTER, REMOTE SAMPLING PANEL:

- a. General:
 1. Function: Continuously and remotely monitor ambient air for the lower explosive limit (LEL) of combustible hydrocarbon based gases.

2. Combustible Gas Sensor Type: Infrared, unless otherwise noted.
 3. Parts: Sensor element, transmitter, monitor, sensor element J-box, interconnecting cable between transmitter and sensor element J-box, panel, calibration kit, and ancillaries.
- b. Performance:
1. Combustible Gas Range: 0 to 100 percent LEL.
 2. Repeatability: Plus or minus 1 percent of full scale.
 3. Long-term Drift: Less than 1 percent full scale LEL per month.
 4. Operating Temperature (Panel and Internal Components): Minus 40 degrees F to plus 160 degrees F.
 5. Operating Humidity (Element/Transmitter and Controller): Combustible Gas IR Sensor: 0 to 95 percent relative humidity, noncondensing.
 6. Element(s)/Sensor(s):
 - i. Number of Sensors: One.
 - ii. Gas Monitored: Combustible gas.
 - iii. Combustible Gas Sensor Type: Single path Non-dispersive Infrared, unless otherwise noted.
 - iv. Sensor Mounting: Remote mounting on rated explosion-proof, Class 1, Division 1, Group B, C & D enclosure. Provide interconnecting cable between transmitter and Sensor.
 - v. Sensor Separation: 25-feet from sensor to transmitter.
 - vi. Calibration cup.
 7. Transmitter(s):
 - i. LCD display.
 - ii. Nonintrusive interface for functional testing, calibration, and alarm testing.
 - iii. Alarm Relays: Three SPST, 5 amps @ 230 VAC resistive, with programmable coil either normally energized or normally de-energized. Configure for HIGH and HIGH-HIGH gas level alarms.
 - iv. Power: 12 – 30 VDC, 350 mA maximum, 3-wire connection.
 - v. Enclosure:
 - A. Explosion proof; suitable for Class 1, Division 1, Group B, C, and Group D; unless otherwise noted.
 - B. NEMA 4X, Type 316 stainless steel.
 - C. Minimum of four-wire entry holes.
 - vi. Output: 4-20mA proportional to gas being measured.
 - vii. Typical Mounting Location: Wet Well Terminal Junction Box top section, unless shown otherwise.

8. Accessories and Ancillary Devices:

- i. Audible buzzer for common warning and alarm with acknowledge/silence button to be installed at pump station control panel.
- ii. Top-mounted Beacon: One installed on pump station control panel, unless otherwise noted.
- iii. Flame arrestor.
- iv. Hydrophobic end-of-line filter.
- v. Sample Line: Length as required, 100 feet maximum.
- vi. Calibration Kit:
 - A. Complete with accessories, including regulator, and zero and span cylinders of gas(es) to be monitored.
 - B. Device that allows operator to nonintrusively calibrate and adjust transmitter.
- vii. Incidental parts and supplies for complete functioning installation.

9. Manufacturer and Product:

- i. Analytical Technology Incorporation (ATI), Model D12-IR
- ii. MSA Gas Detection Sample Flow System with Ultima XE Series Sensors and X3 Series Monitor. See P&I Drawings for additional details.

805-45 DISCHARGE PRESSURE TRANSMITTER: Contractor shall provide pressure transmitter on discharge piping where indicated on Contract Documents. Pressure transmitter shall be Rosemount 3051 (0-100 psi) NEMA 4X or approved equal. Transmitter shall be HART compatible with a 4-20mA output.

805-46 PRESSURE GAUGE: Contractor shall provide local pressure gauges indicated on Contract Documents. Gauge shall be a bourdon tube element type with a scale range of 0 to 100 psig, unless listed otherwise in the Contract Documents. Provide gauge with the following features:

- a. 4-1/2-inch diameter dial.
- b. Glycerin fill.
- c. Black thermoplastic case material.
- d. Wetted parts, including element socket process connection, shall be stainless steel.
- e. Process connection shall be one-half (1/2)-inch MNPT, unless noted otherwise.
- f. Manufacturer shall be Ashcroft, Duragauge Model 1200 series, or equal.

805-47 ANNULAR DIAPHRAGM SEAL: Pressure gauges and pressure transmitter shall be mounted on an off-line annular diaphragm seal, 2-inch size, Red Valve 42 or 742 (depending on orientation) or equal. Provide a 2-inch bronze ball valve to isolate the seal from the main line, and a 3/4-inch ball valve with female garden hose thread coupling on the opposite side of seal to allow flushing with city water.

805-48 TOOLS, SPARE PARTS, AND OPERATION & MAINTENANCE MANUALS: The pump and control panel manufacturer shall furnish a complete set of recommended spare parts necessary for the first five (5) years of operation, which shall include at least the following:

- a. One impeller for each type pump supplied per station.
- b. One set of seals and bearings for each size required by pumping equipment supplied at each station.
- c. Two sets of power fuses of each furnished.
- d. Two sets of control power fuses of each furnished.
- e. One set of pilot lights or each furnished.
- f. Two sets of overload heaters for each set furnished.
- g. Two three-pole sets of current limiting fuses for each motor circuit protector or circuit breaker furnished.
- h. One relay for each type mounted in pump control panel.
- i. One complete motor starter.
- j. Loose spare parts shall be properly bound and labeled for easy identifications without opening the packaging and suitably protected for long storage.
 1. Provide one set of special tools required for normal operation and maintenance. Furnish in a suitable steel tool chest complete with lock and duplicate keys.
 2. Spare parts shall be properly protected for long periods of storage and packed in containers that are clearly identified with indelible markings of the contents.

Contractor shall include a line item for Tools, Spare Parts, and O&M Manuals in schedule of values breakdown for the pump station as 5% of the total lump sum pay item. Contractor shall organize and label tools and spare parts, and O&M Manuals per pump station and include an inventory listing of all required items per pump station.

805-49 INSTALLATION: The Contractor shall submit a Certificate of Proper Installation for the pumps, control panel and Contractor-procured generator from the equipment manufacturer's field representative stating that the installation of the equipment is satisfactory, that the equipment is ready for operation, and that the City-Parish operating personnel have been suitably instructed in the operation.

805-49.1 Concrete Wet Well Installation:

- a. Contractor shall be responsible for handling ground water to provide firm, dry subgrade for structure and shall prevent water rising on newly poured in place concrete or grouted joint sections within twenty-four (24) hours after placing, and shall guard against flotation or other damage resulting from ground water or flooding.
- b. Material shall be placed as a base for wet well and valve pit foundation slabs as shown in the Contract Documents.
- c. Precast foundation slabs conforming to requirements of ASTM C478 and the above listed requirements for precast sections, may be used. Slab shall be set in place in bedding material and adjusted in grade for the correct structure elevation.

- d. Foundation slabs may be cast-in-place concrete and placed on bedding material, as shown in the Contract Documents. Tops of cast-in-place slabs shall be shaped to mate with the precast barrel section.
- e. Precast concrete riser sections shall be set so as to be vertical and in true alignment with one-quarter (1/4)-inch maximum tolerance, per each riser section. The outside and inside joint shall be sealed with materials as specified in Article Precast Concrete Wet Well and Valve Pit of this Specification. Contractor shall install precast sections in a manner that will result in a watertight joint.
- f. Holes in the concrete sections required for handling or other purposes shall be plugged with a non-metallic, non-shrinking grout or by grout in combination with concrete plugs.
- g. Where holes must be cut in the precast sections to accommodate pipes, cutting shall be done prior to setting them in place to prevent any subsequent jarring which may loosen the mortar joints. Cutting shall be performed in such a manner so as to damage the remaining concrete as little as possible and in no case will the breaking of holes by jack hammering or impacting the structure with a sledgehammer be allowed.
- h. Frames and hatches shall be cast into the top slab.

805-49.2 Pump Installation: Installation shall be in strict accordance with the manufacturer's instructions and recommendations. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations. The Contractor, in accordance with the manufacturer's recommendations, shall set anchor bolts.

805-49.3 Incidentals: Supply anchor bolts, temporary lift equipment, power, water, labor, and other incidentals required for proper installation.

805-50 INSPECTION AND TESTING:

805-50.1 Precast Concrete Wet Wells and Valve Vaults:

- a. Quality of materials, manufacturing process, and finished sections shall be subject to inspection and approval by Engineer. Such inspection may be made at place of manufacture or at site after delivery, or at both places, and the sections shall be subject to rejection at any time on account of failure to meet Specification requirements; even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to site shall be marked for identification and shall be removed from site at once. Sections that have been damaged after delivery will be rejected. However, if already installed, they shall be acceptably repaired, if permitted, or removed and replaced in their entirety, at no additional cost to Owner. This shall be done at the discretion of Engineer.
- b. At time of inspection, the sections will be carefully examined for compliance with the ASTM designation specified and these Specifications, and with the approved manufacturer's drawings. Sections shall be inspected for general appearance, dimension, "scratch-strength", blisters, cracks, roughness, soundness, etc. The surface shall be dense and close-textured.
- c. Imperfections may be repaired, subject to approval of Engineer, after demonstration by manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Cement mortar used for repairs shall have minimum compressive strength of 4,000 psi at the end of seven (7) days and 5,000 psi at end of twenty-eight (28) days, when tested in 3-inch by 6-inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to approval of Engineer.

805-50.2 Pumps

- a. Furnish the services of a factory representative who has complete knowledge of proper operation and maintenance to inspect final installation and supervise a test run of the equipment.
- b. After pumps have been installed and working, under direction of manufacturer, conduct in the presence of the Engineer, such tests as are necessary to indicate pump discharge conforms to Specifications. Field tests shall include all pumps supplied under this Section. Supply electric power, water or wastewater, labor, equipment, and incidentals required to complete field test.
- c. Final Acceptance Test shall demonstrate items on the DPW Pump Station Checklist and these Specifications have been met. In addition conduct the following tests:
 1. Quick release lift out feature functions properly and allows pump to be raised and lowered without draining pit.
 2. Units have been properly installed and are in correct alignment.
 3. Units operate without overheating or overloading and without objectionable vibration.
 4. No mechanical defects.
 5. Pumps deliver specified pressure and quantity.
 6. Pumps capable of pumping raw unscreened wastewater.
 7. Pump sensors and controls perform satisfactorily as to sequence control, correct start and stop elevations, and proper high level alarm functions.

A 24-hour operating period of the pumps will be required before acceptance. During this consecutive 24-hour operating period, Contractor shall supply power, water, labor, equipment, and incidentals necessary. If pump performance does not meet the Specifications, Contractor shall take corrective measures, or pumps shall be removed and replaced with pumps that satisfy the conditions specified. Subsequently additional consecutive 24-hour tests will be required after each revision until satisfactory results are achieved.

805-50.3 Panels and Instrumentation:

- a. Engineer shall have the right to inspect, test, or witness tests of materials or equipment to be furnished under these Specifications prior to their shipment from the point of manufacture.
- b. Notify Engineer in writing prior to initial shipment, in ample time so Engineer can make arrangements for inspection.
- c. Services of panel manufacturer factory representative shall be furnished, for a minimum of one (1) day per pump station, who shall have complete knowledge of proper operation and maintenance to inspect final installation and supervise test run of the equipment.
- d. Field tests shall not be conducted until such time that the entire installation is complete and ready for testing.
- e. In the event the equipment does not meet Final Acceptance Test, Contractor shall, at no additional expense to Owner, make such changes and adjustments in the equipment that they deem necessary and conduct further tests until Engineer indicates full satisfaction and written certification is issued.

- f. Bubbler tubing shall be leakage tested at 60 psi for one hour at constant pressure.
- g. Formal Tests/Checkouts:
 - 1. Contractor shall furnish the services of the manufacturer's servicemen, all special tools, calibration equipment, and labor to perform the tests and checkouts. Utility services, including water, shall be in place prior to 24-hour facility testing. Certified copies of the tests shall be furnished in duplicate to the Engineer.
 - 2. Following installation and final adjustment of instruments, meters, and flow control devices, a performance check shall be made on each metering and flow control system. Meters shall be tested at 10 percent or 12-1/2 percent, 20 percent, 50 percent, and 100 percent of scale, as required. The total error based on manufacturer's certification for differential produced, when added to the field determined instrument errors, shall not exceed plus or minus two (+2) percent.
 - 3. If, during running of the tests, one or more points appear to be out by more than the specified amount, manufacturer's field engineer shall make such adjustments or alterations as are necessary to bring equipment to specification performance. Following such adjustment, the test shall be repeated for all specified points to insure compliance.
 - 4. At least two (2) weeks prior to final acceptance, instrument system supplier shall submit a proposed test procedure to Engineer for approval. Proposal shall be designed to completely check out components and sequences point by point during formal test. Each point of the test shall be completely documented and each point shall be signed off in the presence of the Engineer. Contractor shall supply equipment and labor necessary to complete testing and correct all defects to satisfaction of Engineer.
 - 5. Verify, demonstrate and document that the system works as specified in the functional control logic requirements. Verify and document accuracy of all instrument readings, proper operation of all alarm and status points. Verify and document BITS and WORDS involved in SCADA data exchange. Submit Data Exchange Table to Engineer for review. Refer to sample Data Exchange Table at the end of this Section. Contractor to use this example to develop project specific Data Exchange Table for use of testing and documenting Master SCADA interface test results.
- h. Refer to Article Diesel Engine Generator Set for inspection and testing requirements for that equipment.

805-51 MEASUREMENT AND PAYMENT:

- a. Measurement for submersible wastewater pump stations shall be made on a lump sum basis. This Item shall include but not necessarily be limited to furnishing and installing pump station(s) with wet well, pumps, equipment, electrical power and controls, site preparation, excavation, bedding, backfill, fencing, gates, drives, building, generator installation, limestone, geotextile fabric, wiring, piping, spare parts/tools, utilities, testing, vibration monitoring, start up and all incidentals, thereto related to the pump station as shown in the Contract Documents and specified herein. Payment of amount of bid for these items will be made as measured above, which shall be full compensation in accordance with the Contract Documents and all else incidental thereto for which separate payment is not provided under other Items No.(s) in the Bid Form.
- b. Schedule of Values: Payments during the course of the Work for the pump station lump sum item will be made on the basis of percentage completion of the work items listed in

the schedule of values for each lump sum item. The Schedule of Values (SOV) shall be prepared by the Contractor and submitted to the Engineer as specified herein. The SOV shall serve as a breakdown of the lump sum bid for the purpose of arriving at a basis for the monthly estimate. The schedule shall be broken down into schedule of values categories and each category shall be further broken into each applicable specification section. The schedule shall add up to 100% of the lump sum bid.

1. Eligible payment items shall be separated on the SOV into the following categories:
 - i. Sitework
 - ii. Yard Piping
 - iii. Pumping Station
 - iv. Overall Electrical Power Distribution and Controls
 - v. Generator
 - vi. Odor Control (if applicable)
 - vii. Demolition
 - viii. Startup and Commissioning
 - ix. Spare Parts and O&M Manuals (shall be minimum 5% of overall lump sum)
2. Additional categories may be added if required.

805-52 PAY ITEM:

<u>Item No.</u>	<u>Item</u>	<u>Unit</u>
805020_	Duplex Submersible Wastewater Pump Station (PS___)	Lump Sum
805030_	Triplex Submersible Wastewater Pump Station (PS___)	Lump Sum

SAMPLE DATA EXCHANGE TABLE

Pump Station 19

SCADA Data exchange table - verification of 'Read, Write' ability

Notes:

DATE: 12.10-12.12

1. VERIFICATION OF INTERNAL DATA EXCHANGE TABLE ONLY - ACTUAL FIELD I/O (INPUTS/OUTPUTS) NOT VALIDATED during this exercise. These were to be validated during the pump station commissioning. "PASS" = Data Exchange Table functionality ONLY. Actual I/O not re-verified.
2. Modbus data registers SCADA address off by one digit identified on sheet (i.e., AO31 =AO32) Respectfully. Per Alan Horikawa/TESCO: "Data table will be adjusted to correspond with "SCADA development will be different than the sheet we used this week."

Verification by:

Witnessed by:

Tag	Description	Units	Logic		SCADA		Read		Write		Test		Comment
			Address	Address	Bit	Address	Bit	Word	Bit	Word	Result	Result	
19-XS-05-03-01	High-High Pressure		S0	A031	1	1						Pass	Simulated @PLC w/ModScan
19-XS-05-03-02	Pump 1 H-O-A in Auto		S1	A031	2	1						Pass	
19-XS-05-03-02	Pump 2 H-O-A in Auto		S2	A031	3	1						Pass	
19-TSH-05-05-01	Pump 1 Motor Overtemp		S4	A031	5	1						Pass	Simulated @PLC w/ModScan
19-TSH-05-05-02	Pump 2 Motor Overtemp		S5	A031	6	1						Pass	Simulated @PLC w/ModScan
19-ASH-05-06-01	Pump 1 Seal Fail		S7	A031	8	1						Pass	Simulated @PLC w/ModScan
19-ASH-05-06-02	Pump 2 Seal Fail		S8	A031	9	1						Pass	Simulated @PLC w/ModScan
19-ZSC-05-01-01	Pump 1 Check Valve Open		S10	A031	11	1						Pass	
19-ZSC-05-01-02	Pump 2 Check Valve Open		S11	A031	12	1						Pass	Spring missing
19-XS-05-02-09	Station Secure /Intrusion		S13	A031	14	1						Pass	
19-XS-05-10-00	A/C Phase Fail		S14	A031	15	1						Pass	
19-XS-05-21-00	PLC Power Fail (L2000 0/1)		S15	A031	16	1						Pass	
19-XS-05-21-00	Generator Running		S16	A032	1	1							Not verified
19-XS-05-22-00	Generator Fail		S17	A032	2	1							Not verified
19-XS-05-23-00	Fuel Tank Level Low		S18	A032	3	1							Not verified
19-XS-05-22-00	Battery Voltage Low		S19	A032	4	1							Not verified
19-XS-05-12-00	Normal Power Fail		S20	A032	5	1							Not verified
19-XS-05-11-00	Normal Power Available		S21	A032	6	1						Pass	Simulated @PLC w/ModScan
19-XS-05-15-00	Generator Power Fail		S22	A032	7	1							Not verified
19-XS-05-15-00	A-T-S in Normal		S23	A032	8	1							Not verified

Pump Station 19

SCADA Data exchange table - verification of ' Read, Write' ability

Notes:

DATE: 12.10-12.12

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		S24	AO32	9	1				Not verified
19-XS-05-16-00	A-T-S in Emergency		AO32	10	1				Simulated @PLC w/ModScan
19-AH-05-00-00	LEL High Alarm	S25	AO32	10	1				Simulated @PLC w/ModScan
19-AHH-05-00-00	LEL High-High Alarm	S26	AO32	11	1				Simulated @PLC w/ModScan
	SCADA Comm Fail Alarm	S50	AO34	3	1				Pass
19-XS-05-08-01	Pump 1 Failure Alarm	S55	AO34	8	1				Pass
19-XS-05-08-02	Pump 2 Failure Alarm	S56	AO34	9	1				Pass
	Wetwell Xducr Fail Alarm	S81	AO36	2	1				Pass
19-LSLL-05-00-00	Wetwell Low Level Alarm	S82	AO36	3	1				Pass
19-LSHH-05-00-00	Wetwell High Level Alarm	S83	AO36	4	1				Pass
19-AAH-05-00	LEL Gas Monitor Xducr Fail Alarm	S88	AO36	9	1				Pass
19-AAH-05-00	LEL Gas Monitor High Alarm	S89	AO36	10	1				Pass
19-TAH-05-01	Pump 1 Overtemp Alarm	S90	AO36	11	1				Pass
19-TAH-05-02	Pump 2 Overtemp Alarm	S91	AO36	12	1				Pass
19-JAL-05-01	A/C Phase Fail Alarm	S94	AO36	15	1				Pass
19-JAL-05-02	PLC Power Fail Alarm	S95	AO36	16	1				Pass
19-PAHH-05-00	High-High Pressure Alarm	S96	AO37	1	1				Pass
19-XAH-00-00	Station Intrusion Alarm	S97	AO37	2	1				Pass
19-XS-05-02-01	Pump 1 Running Status	S111	AO37	16	1				Pass
19-XS-05-02-02	Pump 2 Running Status	S112	AO38	1	1				Pass
	L2000 Card Health D.I. (I/O #1)	S120	AO38	9	1				Pass
19-XL-00-02	L2000 Card Health D.I. (I/O #2)	S121	AO38	10	1				Pass
	Wetwell Level 0-34.6 ft	L1	AO10					1	Pass
19-IT-05-07-01	Pump 1 Current 0-200 amp	L2	AO14					1	Pass

Pump Station 19

SCADA Data exchange table - verification of 'Read, Write' ability

Notes:

DATE: 12.10.12.12

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19-IT-05-07-02	Pump 2 Current 0-200 amp	L3	AO15	1	Pass
19-AT-05-00-00	Combustible Gas LEL 0-100 %	L11	AO13	1	Pass Simulated @PLC w/ModScan
19-KQ-05-01	Pump 1 run-time hours	T1	AO41	1	Pass
19-KQ-05-02	Pump 2 run-time hours	T2	AO42	1	Pass