SECTION 33 3211 – FIELD ERECTED WASTEWATER PUMPING STATIONS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall furnish all the necessary labor, materials, equipment, tools, and supplies that are necessary to provide a field erected wastewater pumping station, in compliance with these specifications, standard plates and/or called for in these specifications or its addenda.

1.2 SUMMARY

A. Duplex lift station
B. Pump removal system
C. Pumps
D. Piping
E. Fittings
F. Flow Meter
G. Valves
H. Valve Vault
I. Variable Frequency Controllers
J. Control System
    1. Lift Station Control Panel
    2. Level Transducer
    3. Float Switches
    4. Flood Switch
    5. Position Switches
    6. Temperature Transmitter
    7. Programmable Logic Controller
    8. Operator Interface Terminal
K. Packaged Generator
L. Automatic Transfer Switch

1.3 RELATED REQUIREMENTS

A. SECTION 01 3000 – ADMINISTRATIVE REQUIREMENTS
B. SECTION 22 1319.33 – BACKWATER VALVES (BMU)
C. SECTION 31 2319 – DEWATERING (BMU)

D. SECTION 31 2333 – TRENCHING AND UTILITY BACKFILLING (BMU)

E. SECTION 33 1000 – WATER UTILITIES (BMU)

F. SECTION 33 1419 – VALVE AND FIRE HYDRANTS (BMU)

G. SECTION 33 1900 – WATER UTILITY METERING EQUIPMENT (BMU)

H. SECTION 33 3100 – SANITARY SEWER UTILITIES (BMU)

1.4 APPROVED MANUFACTURERS

A. The following manufacturers are approved for bidding:

B. Contractor shall provide pumps and controls from the same approved supplier.

C. Pumps Manufacturer / Supplier:

1. Flygt/ Electric Pump

D. Variable Frequency Controllers
1. Rockwell Automation Allen-Bradley Co.; Industrial Control Group.

E. Controls Integrator

1. AE2S - Fargo, ND; (701) 364-9111

F. Access Frame and Doors, Trash Basket

1. Halliday

G. Packaged Generator
1. Caterpillar; Engine Div.
2. Kohler Co; Generator Division.
3. Onan Corp./Cummins Power Generation; Industrial Business Group.

H. Conventional Transfer Switches:

1. Caterpillar, Inc.; Engine Division.
2. Onan Corp.; Electrical Products Division.
3. ASCO switch co.

1.5 PRIOR APPROVAL

A. Approval prior to bidding is necessary if it is intended to use materials and equipment other than those specifically named in Approved Manufacturers. Instructions for obtaining such approval are specified in the General Requirements. Prior approved manufacturers shall be named by Addendum.

1.6 CONTRACTUAL OBLIGATIONS

A. This section of the specifications specify and show equipment and materials deemed most suitable for the service anticipated. This is not done, however, to eliminate other products of equal quality and efficiency. The Contractor shall prepare his bid for the bid item " Duplex Lift Station, Controls, Electrical, Generator, Building and Appurtenances" on the basis of the particular equipment and material specified herein, without any substitutions.

The awarding of the contract shall constitute a contractual obligation to furnish the specified equipment and materials.

B. Substitutions: After execution of the contract, should the Contractor desire to substitute equipment other than that specified in the Contract, such substitution will be considered for one reason only: The equipment proposed for substitution is superior in construction and efficiency to that specified in the Contract, and higher quality has been demonstrated by service in a similar installation and the Owner approves same.

1. In the event the Contractor obtains Engineer's approval of equipment other than that for which the station was originally laid out, the Contractor shall, at his own expense, make any changes in the structures, electrical equipment or piping necessary to accommodate the equipment, and shall provide as-built Drawings to the Engineer.
2. It will be assumed that the cost to the Contractor of the equipment proposed to be substituted is less than that of the equipment specified in the Contract and if the substitution is approved, the Contract price shall be reduced by an amount equal to the savings.

1.7 TESTING

A. Testing performed upon each pump shall include the following inspections:

1. Impeller, motor rating and electrical connections shall be checked for compliance with this specification.
2. Prior to submergence, each pump shall be run dry to establish correct rotation.
3. Each pump shall be run submerged in water.
4. Motor and cable insulation shall be tested for moisture content or insulation defects and is free of overheating and overloading any parts.

B. A written quality assurance record confirming the above testing/ inspections shall be supplied with each pump at the time of shipment.

C. Each pump model shall be tested in accordance with the latest test code of the Hydraulic Institute (H.I.) at the manufacturers test facility to determine head vs. capacity and kilowatt draw required. Tests results shall be provided prior to shipping the pumps(s).

D. The pump(s) shall be rejected if the above requirements are not satisfied.

1.8 SUBMITTALS

A. Submittal data shall be provided to show compliance with these specifications, or other specifications that will influence the proper operation of the pump(s).

B. Standard submittal data for approval must consist of:

1. Pump and Performance Curves.
2. Pump Outline Drawing.
3. Motor Performance Curve
4. Station Drawing for Accessories, Including pump lift out system
5. Wetwell and Valve Vault structure drawings including lid, base, and liner or coatings

6. Interior Piping, Valves, Couplings, and Fittings
7. Access Frame Drawing
8. Trash Basket and Rails
9. Portable Davit Hoist
10. Typical Installation Guides.
11. Technical Manuals.
12. Parts List.
13. Printed Warranty.
14. Manufacturer's Equipment Storage Recommendations.
15. Manufacturer's Standard Recommended Start-Up Report Form.
16. NPSH required curve showing design point value.
17. Variable Frequency Controller
18. Controls
    a. Enclosure materials and size
    b. Control and power connection points. Provide ladder type control drawings
    c. Control panel fabrication and nameplate legend drawings, internal panel wiring diagrams and schematic drawings
    d. Dimensioned drawing, wiring, and piping drawing for all field mounted equipment. Drawings shall be specifically created for this project.
    e. Complete system schematic drawings illustrating all components being supplied, complete with electrical interconnections.
    f. Details of each device with manufacturer and complete model or part number.
    g. Provide reference list in bill of materials form. Any devices without listing a manufacturer and part/model number will not be acceptable and are determined to be proprietary or lacking manufacturer's service and support.
    h. A sequence of operation for the control system, all subsystems, and their interactions.
19. Variable Frequency Controllers
20. Automatic Transfer Switch

1.9 PUMP WARRANTY

A. The pump manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and material for a period of five (5) years or 10,000 hours under the Municipal Wastewater- Permanent Installation Warranty policy under normal use, operation and service. The warranty shall be in printed form and apply to all similar units.

B. Start-up report and electrical System Schematics (including Bills of Material) will be required from the supplier for any future Warranty Claims. This Warranty shall not apply to any Product or Part of Product which has been subjected to misuse, accident, negligence, used in a manner contrary to the pump manufacturer’s printed instructions or damaged due to a defective power supply, improper electrical protection or faulty installation or repair. The 5 year (or 10,000 hour) Warranty applies to the following Accessories if originally

purchased with the pumps: Discharge Connection, Access Covers, Guide Bar Bracket(s) and Pump Power Cable(s).

1.10 SITE TESTS

A. The pump manufacturer shall provide the services of a factory trained service technician for a minimum of one (1) eight-hour day for installation checkout and to instruct lift station operating personnel in the proper operation and maintenance procedure for the installation. The pumps shall be tested at startup and voltage, current, vibration and other significant parameters recorded. The manufacturer shall provide a formal test procedure and forms for recording data. Six copies of the operation and maintenance manual shall be provided for the pump systems specified herein. CONTRACTOR SHALL NOTIFY THE OWNER AND ENGINEER IN ADVANCE OF THE SITE TEST.

PART 2.0 - PRODUCTS

2.1 WETWELL AND VALVE VAULT

A. CONCRETE WETWELL

1. The wetwell shall be constructed of precast concrete with mastic joints and base in accordance with ASTM C 850 and C478. Piping and connections shall be located and connected at the elevations and positions as directed by the Engineer. Piping penetrations shall be watertight using manhole boots as manufactured by Press Seal Gasket Corp or Engineer approved equal.
2. The precast concrete wetwell cover shall have an access frame with safety grate cast into cover. Precast supplier shall coordinate with the access frame supplier. The interior of the wetwell shall be supplied with a liner as specified. Other fixtures cast into the cover will also include a portable davit hoist socket, and vent pipe.
3. Schedule PVC 80 vent pipe shall be provided. Vent shall be provided with duckbill check valve to minimum drafts through the vault.
4. Wetwell access frame and doors shall also be sized to allow for easy passage and removal of the trash basket.
5. The precast wetwell supplier shall coordinate with the electrician for power and control cable penetrations to the Control Panel.
6. Wetwell Liner
    a. An HDPE liner shall be used on lift station concrete wet well.
    b. Reference Section 33 3100 – SANITARY SEWER UTILITIES, for HDPE Liner specifications

B. PIPING, VALVES AND FITTINGS

1. PVC Schedule 80 Pipe
    a. All pipe and fittings shall be produced by a single manufacturer and shall be installed in accordance with the manufacturer’s recommendations and applicable code requirements.

b. PVC Schedule 80 pipe intended for pressure applications where the temperature will not exceed 140°F. Pipe and fittings shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with a cell class of 12454 per ASTM D 1784 and conform with NSF International Standards 14 and 61. Pipe shall be iron pipe size (IPS) conforming to ASTM D 1785. Socket fitting shall conform to ASTM D 2467; threaded fittings shall conform to ASTM D 2464 or D2467. Flanges shall meet the bolt pattern requirements of ANSI/ASME B 16.5. Flanges shall be molded 2- piece Van Stone type flanges with slip/socket connection.

c. Solvent cements shall conform to ASTM D 2564, primer shall be IPS P-70 or Oatey Industrial Grade.

d. All straight-line pipe lengths of PVC pipe that shall be tapped for instrumentation connections, including but not limited to pH analyzer, pressure transmitters, pressure gauges, and temperature gauges, shall use a saddle to protect the integrality of the PVC pipe. Saddles shall be on stainless steel construction and be Power Seal Model 3411AS or engineer approved equal. General Contractor shall be responsible for drilling and tapping the pipe to mount the instrumentation equipment. General Contractor shall coordinate with the Controls System Integrator for location and size of taps.

e. Bolts, Nuts, and Washers: Stainless steel ASTM A-193 Grade B8M, Class 2, hex head bolts shall be supplied. Stainless steel washers and lock washers shall be supplied on all nuts and bolts.

2. Pipe Fittings and Specials:

a. Flanges shall meet the bolt pattern requirements of ANSI/ASME B 16.5. Flanges shall be molded 2-piece Van Stone type flanges with slip/socket connection.

b. PVC fittings meet all requirements for Schedule 80 pipe. Socket fitting shall conform to ASTM D 2467; threaded fittings shall conform to ASTM D 2464 or D 2467.

c. Ductile Iron Fittings shall be provided for fittings within the valve vault structure.

- Mechanical joint ductile iron fittings shall conform to the requirements of AWWA C110 or AWWA C153.
- Flanged fittings shall conform to the requirements of ANSI/AWWA C110/A21-10.
- Flanges shall be ANSI B16.1 125lb. Class B.
- Bolts for all flanged fittings shall be stainless steel. Bolts for mechanical joint fittings shall be stainless steel.
- Interior and Exterior Coating: The interior and exterior of the fittings shall have an electrostatically applied fusion bonded epoxy according to AWWA C550. Coating thickness shall be 8-12 mils DFT. Supplier shall provide manufacturer’s recommended epoxy coating for touch-up of coating defects. Contractor shall repair all coating defects prior to installation per manufacturer’s recommendation.

3. Gate Valves:

a. Reference Section 33 1419 – VALVES AND FIRE HYDRANTS, for gate valve specifications

4. Rubber Flapper Swing Check Valves:

   a. This specification is intended to cover the design, manufacture, and testing of 2-inch. 42- inch. Rubber Flapper Swing Check Valves are suitable for cold working pressure of 250 psig, 150 psig for 30 in. and in water and wastewater service. Rubber flapper swing check valves shall be provided and installed within the valve vault structure. The check valve shall be of full body type, with an access cover and only one moving part, the flexible disc.

   b. Valves shall be provided with flanges in accordance with ANSI B16.1, Class 125.

   c. The valve body shall be full flow equal to nominal pipe diameter at all points through the valve. The valve shall be capable of passing a 3-inch sphere. The seating surface shall be on a 45-degree angle to minimize disc travel. A threaded port with pipe plug shall be provided on the bottom of the valve to allow for field installation of a backflow actuator, air cushion or hydraulic cushion without special tools or removing the valve from the line.

   d. The top access port shall be full size, allowing removal of the disc without removing the valve from the line. A threaded port with pipe plug shall be provided in the access cover to allow for field installation of a mechanical, disc position indicator.

   e. The disc shall be of one-piece construction, precision molded with an integral O-ring type sealing surface, and contain alloy steel and nylon reinforcement in the flexible hinge area. The flex portion of the disc shall be warranted for twenty-five years. Non-Slam closing characteristics shall be provided through a short 35-degree disc stroke.

   f. The valve body and cover shall be constructed of ASTM A536 Grade 65-45-12 ductile iron or ASTM A126 Class B for 30 in. and larger. The disc shall be precision molded Buna-N (NBR), ASTM D2000-BG.

   g. A screw-type backflow actuator shall be provided to allow opening of the valve during no-flow conditions. Buna-N seals shall be used to seal the stainless-steel stem in a bronze bushing. The backflow device shall be of the rising-stem type to indicate position. A stainless-steel T-handle shall be provided for ease of operation.

   h. A mechanical indicator shall be provided to provide disc position indication on valves 4” and larger. The indicator shall have continuous contact with the disc under all operating conditions to assure accurate disc position indication.

   i. The inside and outside of the valve shall have an electrostatically applied fusion bonded epoxy according to AWWA C550. Coating thickness shall be 8-12 mils DFT.

      - Supplier shall provide manufacturer’s recommended epoxy coating for touch-up of coating defects. Contractor shall repair all coating defects prior to installation per manufacturer’s recommendation.

   j. Manufacturer: Swing Check Valves shall be as manufactured by Val-Matic Model 506CBF, Golden Anderson, Crispen, APCO (Dezurik) or approved equal.

5. Dismantling Joints

   a. Reference Section 33 1900 – WATER UTILITY METERING EQUIPMENT, for Dismantling Joint specifications**.**

6. Sewage Combination Air Valves

   a. Sewage combination air valves shall be installed in Valve Vault, or as directed by the Engineer.

   b. Sewage combination air valves shall be specifically designed for use with sewage.

   c. Each valve shall be equipped with a shut-off valve, blow-off valve; backflushing hose and quick disconnect couplings.

   d. The air release valves shall be Golden Andersen Fig. 942, APCO Series 440 as manufactured by Valve and Primer Corporation and ARI D-025, short version 316 stainless steel internal components camlock vent, reinforced nylon backup or Engineer approved equal.

7. Backwater Valve – Sump Drain Line:

   a. Reference Section 22 1319.33 – BACKWATER VALVE, for Backwater Valve specifications.

8. Transition Sleeves, Couplings

   a. Transition sleeves shall be of ductile iron, long body (min. 12 inches), mechanical joint, gasketed, sleeve type, with diameter to properly fit the new forcemain pipe to the existing forcemain or provide transition between different pipe materials.

   b. All transition couplings shall be ductile iron meeting the requirements of “Pipe Fittings and Specials” of these Specifications. The sleeve shall be wrapped on the exterior with polyethylene wrapping in accordance with AWWA C105. Bolts shall be stainless steel.

C. WETWELL AND VALVE VAULT ACCESS FRAME AND DOORS

1. Precast supplier shall coordinate with the Access Frame supplier. The access frame and cover shall be set so the top of the cover is 3/8” above the top of the concrete cover. Slope the concrete up 3/8” to the frame to provide drainage away from the frame and cover. The access frame and doors shall be constructed of aluminum and come complete with hinged and flush locking mechanism, upper guide holder, level sensor cable holder, safety grate and anchor legs for casting integrally in the concrete cover. Doors shall be of skid proof design.

   a. Pump Access Frame and Doors - The access frame and doors shall be adequately sized by the pump supplier to allow for easy passage of the submersible pumps and be designed to support the weight of the pumps plus pedestrian traffic. The access frame and doors shall be as manufactured by Halliday Products or Engineer approved equal.

   b. Trash Basket Access Frame and Doors - Wetwell access frame and doors shall also be sized to allow for easy passage and removal of the trash basket.

   c. Valve Vault Access Frame and Doors - Wetwell access frame and doors shall be provided.

2. Safety Grate: The protective grating panel as manufactured by Halliday Products, of Orlando, or USF Fabrication, Inc., Hialeah, Florida or engineer approved equal shall be aluminum "I" bar grating with Safety Orange powder- coated finish. Grating shall be hinged with tamper proof stainless steel bolts, and shall be supplied with a positive latch to maintain unit in an upright position. Grating shall have a 6-in. (152mm) viewing area on each lateral unhinged side for visual observation and limited maintenance. Grating support ledges on 300 lbs. psf (1464 kg. per sq. meter) loaded access covers shall incorporate nut rail with a minimum of four (4) stainless steel spring nuts. A padlock hasp for owner-supplied padlock shall be provided.

    a. A safety grate shall be supplied for all access frame and doors in the wetwell and valve vault and maintain the minimum clear opening.

D. TRASH BASKET AND RAILS

1. The trash basket system shall be of the bar screen style basket, having 2" clear opening between ¼" thick bars and solid sides. The heavy duty guide rail system shall be of (2) two 2" schedule 316 stainless steel pipe. The guide rails shall be extruded aluminum channels sized to facilitate easy operation of the basket. An aluminum basket stop shall be supplied loose for field mounting to insure proper basket position. Wetwell penetrations shall be watertight. Trash Basket shall be Series B1A scheduled 316 stainless steel as manufactured by Halliday Products or Engineer approved equal.

2. Fasteners

    a. All anchor bolts, fasteners, structural supports, lifting chains, etc., required in the wetwell shall be stainless steel.

E. Discharge Base

1. A rigid discharge base-elbow to support the total weight of the pumping unit shall be provided for each pump. The base is to be bolted directly to the floor with the 90 degree elbow having a 125 lb. ANSI flange faced and drilled on the outlet side, with a machined mated inlet connection. The design shall be such that the pump to discharge connection is made without the need for any nuts, bolts or gaskets. The base elbow shall also anchor and align the guide rail(s).

    a. For each pump the contractor shall supply and install a discharge connection made of cast iron ASTM A-48, Class 35B.

    b. The outlet flange of the discharge connection shall be 6" drilled according ANSI B16.1-89; tab.5.

    c. There shall be no need for personnel to enter the wet-well.

F. Guide Rail

1. Guide rail(s) shall be provided on which the pump rides when being raised or lowered in the sump and mount on the discharge base elbow. The rail(s) shall align the pump with the discharge elbow as it is lowered into place. The guide rail design keeps the pump in proper alignment with the stationary discharge piping. These rails shall be 2" (min.) schedule 316 stainless steel pipe which bolt directly to the base elbow and to the access frame at the top of the wet well by an upper guide rail bracket. The guide rail system shall be single or dual rail system as required by the pump manufacturer.

a. The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two parallel guide bars extending from the top of the station to the wet well mounted discharge connection. The material of the guide bars shall Stainless steel AISI 304 or 316.

2. The length of the guide bars shall 15 feet and they shall be fasten at the top of the station with a guide bar holder made of Stainless steel AISI 304 or 316.

G. Sealing Flange with Rail Guide

1. A sealing flange/rail guide bracket shall be mounted on each pump discharge. It shall have a machined mating flange which matches the base elbow discharge connection. Sealing of this discharge connection shall be accomplished by a simple linear downward motion of the pump culminating with the entire weight of the pumping unit supported entirely by the base elbow.

2. The sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be accepted. The entire weight of the pump/motor unit shall be borne by the pump discharge elbow. No portion of the pump/motor unit shall bear on the sump floor directly or on a sump floor mounted stand.

H. Guide Bracket

1. An upper rail guide bracket shall be furnished to support and align the rails at the top of the sump. For guide rail lengths greater than 20 feet an intermediate rail guide bracket shall also be included. The upper guide bracket shall align and support the two guide rails at the top of the wet well. It shall bolt directly to the hatch frame and incorporate an expandable rubber grommet for secure rail installation. The upper guide bracket shall be of stainless steel construction.

I. Float Mounting Bracket

1. Mounting brackets for the floats shall be provided with strain reliefs that support and hold the level control cords in the wetwell. Float mounting brackets shall be of stainless steel construction. The wetwell wall penetrations shall be sealed with silicone sealer.

a. For each pump the contractor shall supply and install a cable holder made with 4 hooks of Stainless steel AISI 304 or 316.

J. Lifting Chain

1. Each pumping unit shall be provided with a lifting chain or cable and be of sufficient length to extend from the pump to the top of the wet well. The access frame shall provide a hook to attach the chain when not in use. The lifting chain shall be sized according to the pump weight and be of stainless steel construction. The working load of the lifting system shall be 50% greater than the pump unit weight. All components and accessories necessary for raising and lowering the pumps, including anchors, shall be constructed of stainless steel.

2.2 WASTEWATER MAGNETIC FLOW METER

A. Meter shall be provided with Hard Rubber liner, meter mounter amplifier and Alloy C electrodes. Meter shall be suitable for a CLASS 1, DIV 2 environment.

B. The meter shall include bidirectional metering capabilities with programmable totalizers. The meter shall allow for an accuracy of +/-0.25 percent with a flow range of 300:1.

C. The power consumption shall be 24 VDC, 8 watts. The meter shall provide a variety of analog outputs, digital outputs, pulse outputs, frequency output and miscellaneous outputs. Units of measure shall include ounces, pounds, liters, US gallon, cubic meters, cubic feet and acre feet.

D. The meter shall be supplied and installed with stainless-steel ground rings.

E. The amplifier shall be integrally mounted to the detector or shall available remote mounted. The amplifier shall be housed in a cast aluminum, powered coated, NEMA 4X enclosure. The amplifier shall receive the detectors analog signal, amplify the signal and convert the signal into digital information. The signal shall be converted to both analog and digital signals that shall display rate of flow and totalization. The processor shall control zero-flow stability, analog and frequency outputs, serial communications and a variety of other parameters. It shall include a four-line, 20-character LCD display to at shall indicate rate of flow, forward and reverse totalizers and diagnostic messages.

1. Programmable parameters of the amplifier shall include (but are not limited to) calibration factors, totalizer resets, unit of measure, analog and pulse output scaling, flow alarm functions, language selection, low flow cutoff, noise dampening factor and excitation frequency selection. The amplifiers main function is to detect and condition flow information from the electromagnetic detector.

   a. Amplifier shall be capable of generating and encoded output, compatible with the Elster EA Water 43.0 Module (Contact Elster Meter Co. for Specifications) or;

   b. Third party AMI/AMR signal generator that converts pulse-based flow to encoder output. Equipment similar to “The Encodalizer”, model PTE (Pulse to encoder) shall be provided with the meter.

F. Acceptable Manufacturers for water meters shall be Badger M Series Magnetic Flow meter with M3000 amplifier, No Approved Equals.

2.3 SUBMERSIBLE SEWAGE PUMPS

A. GENERAL

1. Each station shall be equipped with two (2) submersible, close-coupled wastewater pumps.

2. Each pump shall be equipped with a xx HP submersible electric motor, capable of operating on a 480 volt, 3 phases, 60 hertz voltage supply.

3. The pump shall be Explosion approved according FM CLASS 1. DIV 1 "C" & "D"

4. The hydraulic of the pump shall be equipped with a semi open multi vane impeller designed to transport wastewater and municipal sludge up to 8% DS.

5. The pump shall be capable to operate without any limitation between 50% and 125% of the Best efficiency point (B.E.P) of the performance curve.

	Flow in USgpm	TDH in feet	Hydraulic efficiency %	NPSHre in feet
Required Duty Point	xxx	xx	xx	xx

B. PUMP

1. The impeller blades shall be self-cleaning upon each rotation as they pass across a sharp relief groove in the Insert ring and shall keep the impeller blades clear of debris. The clearance between the insert ring and the impeller leading edges shall be adjustable.
2. The impeller shall be wear resistant and made of high chromium cast iron with at least 24% chrome against sand and grit which is expected to enter the pump station with the sewage or the storm water. Impellers that have surface hardening (by thermal, coating, etc.) will not be allowed.
3. The pump shall be capable of operating in a continuous condition in a liquid with a temperature up to 104°F even when the motor is not submerged.
4. The impeller shall be mounted on the motor shaft. Couplings shall not be accepted.
5. Sealing of the 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.
6. It shall be possible to lift and lower the pumps on parallel guide bars and connect them to wet well mounted discharge connection. There shall be no need for personal to enter the wet well when removing or reinstalling the pumps.
7. The pump housing shall be prepared for the assembling of a sump mixing valve. The discharge flange of the pump housing shall be 4" w/ 6" base elbow".
8. The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated and have a nominal L10 lifetime of 50.000 hours. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.
9. Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber shall be a leakage-free seal. The upper seal shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide seal ring. The rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. 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 are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance. Any leakage passing the sealing shall not pass the bearings. Before it reaches the bearings the liquid shall create an alarm via the floating leakage sensor.

10. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. Seal lubricant shall be non-hazardous.
11. Where a seal cavity is present in the seal chamber, the area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.
12. The Materials of construction shall be as follows:
    a. Pump housing: ASTM A-48, Class 35B
    b. Impeller and insert ring: A 532 ALLOY III A (25% Chrome)
    c. Cooling jacket: Stainless steel AISI 316
    d. Stator housing: ASTM A-48, Class 35B
    e. Shaft: ASTM A479 S43100-T.
    f. Shaft seal: Pump side: - Corrosion resistant Tungsten carbide WCCR
    g. Shaft seal Motor side: - Corrosion resistant Tungsten carbide WCCR
13. All castings must be blasted before coating. All wet surfaces are to be coated with two-pack oxyrane ester Duasolid 50. The total layer thickness should be at least 120 microns. Zink dust primer shall not be used.
    a. The motor shall be equipped with (50, 65, or 100)(choose one) feet of cable suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.
    b. Each completed and assembled pump/motor unit shall undergo the following factory tests at the manufacturer's plant prior to shipment. The Manufacturer shall provide on demand a copy of his quality control plan for these tests and an ISO 9001 factory certificate:
        - Minimum 3-point hydraulic performance test
        - No-Leak seal integrity test
        - Electrical integrity test

C. MOTOR

1. The pump motor shall be induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. It shall be permanently submersible according standard IEC 60034 and protection class IP 68.
2. The motor shall be provided with an integral motor cooling system. A stainless steel cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket.
3. The motor shall be capable of no less than 30 evenly spaced starts per hour and be able to operate throughout the entire pump performance curve from shut-off through run-out.
4. The stator windings shall be insulated with moisture resistant Class H insulation rated for 356°F.
5. The junction chamber containing the terminal board shall be hermetically sealed from the motor by an elastomeric compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. The motor and the pump shall be produced by the same manufacturer.
6. The motor shall be protected by 3 thermal switches embedded in the stator set to open at 284°F (140°C) and one leakage sensor floating type located in a leakage chamber below the main bearing. The sensor and the switches shall be connected to the control panel which shall stop the motor and send an alarm when the sensors are activated.
7. The cable entry shall consist of dual cylindrical elastomer sleeves, flanked by washers, all having a close tolerance fit against the cable and the cable entry. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

D. SUMP MIXING VAVLE

1. One pump unit in each pump station shall be equipped with an automatically operating flush valve mounted directly to the pump volute. During the starting the valve shall redirect a portion of the pumped media into the sump to re-suspend solids and grease by the turbulent action of its discharge.
2. The valve shall be equipped with an adjustable, wear-resistant discharge nozzle that can be used to direct flow within the sump. The valve shall operate by differential pressure across the valve and shall not require any electric or pneumatic power source to operate. The valve shall be suitable for use in Class I, Division 1 hazardous locations.
3. The valve shall open at the beginning of each pumping cycle and shall automatically close during the pump operation after a pre-set time. A method of adjusting the valve operating time shall be provided.

2.4 AIR BREAK ELECTRIC JUNCTION BOX

A. Lift Station shall include a exterior mounted junction box to provide a termination point for all electrical connections between the lift station controls, electrical and valve vault.

B. Junction box shall be located immediately adjacent to the lift station building as indicated by the design engineer.

C. Junction box shall be a lockable, 20”x24”x8” 304 stainless steel, Type 3R enclosure. Box shall be installed with enclosure leg kit and skirt. Legs and skirt shall be fabricated from 304 stainless steel.

D. Box shall include terminal strips for a connection, including flow meter, level transmitter, floats, pumps, and any other exterior electrical component.

E. Equipment shall be model 1WTE242002SF, BP2420M, LG2408S and SK1836S as manufactured by West Tool or engineer equivalent.

2.5 VARIABLE FREQUENCY CONTROLLERS

A. GENERAL

1. Description: NEMA ICS 2, IGBT, PWM, VFD; listed and labeled as a complete unit and arranged to provide variable speed of a NEMA MG 1, Design B, 3-phase, induction motor by adjusting output voltage and frequency. Unit shall be fully compatible with associated motors.
2. Design and Rating: Match load type for pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
3. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range..
4. Unit Operating Requirements:
   a. Input ac voltage of 480 VAC, 3 phase , plus or minus 10 percent.
   b. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
   c. Capable of driving full load without derating with:
      - Ambient Temperature: 0 to 40 deg C.
      - Humidity: Less than 90 percent (noncondensing).
      - Altitude: 3300 feet (1000 m).
   d. Minimum Efficiency: 96 percent at 60 Hz, full load.
   e. Minimum Displacement Primary-Side Power Factor: 96 percent.
   f. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
   g. Starting Torque: 100 percent of rated torque or as indicated.
   h. Speed Regulation: Plus or minus 1 percent.
   i. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
5. Internal Adjustability Capabilities:
   a. Minimum Speed: 5 to 25 percent of maximum rpm.
   b. Maximum Speed: 80 to 100 percent of maximum rpm.

c. Acceleration: 2 to a minimum of 22 seconds.

d. Deceleration: 2 to a minimum of 22 seconds.

e. Current Limit: 50 to a minimum of 110 percent of maximum rating.

6. Self-Protection and Reliability Features:

a. Input transient protection by means of surge suppressors.

b. Snubber networks to protect against malfunction due to system voltage transients.

c. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.

d. Motor Overload Relay: Adjustable and capable of NEMA 250, Class 10 performance.

e. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.

f. Instantaneous line-to-line and line-to-ground overcurrent trips.

g. Loss-of-phase protection.

h. Reverse-phase protection.

i. Short-circuit protection.

j. Motor overtemperature fault.

7. Multiple-Motor Capability: Controller suitable for service to multiple motors and having a separate overload relay and protection for each controlled motor. Overload relay shall shut off controller and motors served by it when overload relay is tripped.

8. Automatic Reset and Restart: To attempt three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

9. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.

10. Torque Boost: Automatically vary starting and continuous torque to at least 1.5 times the minimum torque to insure high-starting torque and increased torque at slow speeds.

11. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled fan-ventilated motors at slow speeds.

12. Input Line Conditioning: Provide a 3% line reactor.

13. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:

a. Output frequency (Hz).

b. Motor speed (rpm).

c. Motor status (running, stop, fault).

d. Motor current (amperes).

e. Motor torque (percent).

f. Fault or alarming status (code).

g. PID feedback signal (percent).

h. DC-link voltage (VDC).

i. Set-point frequency (Hz).

j. Motor output voltage (V).

14. Control Signal Interface: Provide VFD with the following:

a. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.

b. Pneumatic Input Signal Interface: 3 to 15 psig (20 to 104 kPa).

c. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:

- 0 to 10-V dc.
- 0-20 or 4-20 mA.
- Potentiometer using up/down digital inputs.
- Fixed frequencies using digital inputs.
- RS485.
- Keypad display for local hand operation.

d. Output Signal Interface:

- A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:
  - ◊ Output frequency (Hz).
  - ◊ Output current (load).
  - ◊ DC-link voltage (VDC).
  - ◊ Motor torque (percent).
  - ◊ Motor speed (rpm).
  - ◊ Set-point frequency (Hz).

e. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

- Motor running.
- Set-point speed reached.
- Fault and warning indication (overtemperature or overcurrent).
- PID high or low speed limits reached.

15. Communications: Provide an Ethernet/IP, interface allowing VFD to be used with an external system within a multidrop LAN configuration.
16. Integral Disconnecting Means: NEMA AB 1, instantaneous-trip circuit breaker with lockable handle.
17. Provide VFD with EMI/RFI Filter.
18. VFD shall be rated for a pump application.
19. Integral Input Disconnecting Means and OCPD: UL 489, thermal-magnetic circuit breaker with pad-lockable, door-mounted handle mechanism.

B. ENCLOSURES

1. Factory enclosure, rated for ambient conditions of controller location.
2. NEMA 12

C. ACCESSORIES

1. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
2. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type. Provide a jog control input on the drive that allows the motor to be jogged through the VFD.
3. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory- applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
4. Control Relays: Auxiliary and adjustable time-delay relays.
5. Standard Displays:
    a. Output frequency (Hz).
    b. Set-point frequency (Hz).
    c. Motor current (amperes).
    d. DC-link voltage (VDC).
    e. Motor torque (percent).
    f. Motor speed (rpm).
    g. Motor output voltage (V).
6. Historical Logging Information and Displays:
    a. Real-time clock with current time and date.
    b. Running log of total power versus time.
    c. Total run time.
    d. Fault log, maintaining last four faults with time and date stamp for each.
7. Current-Sensing, Phase-Failure Relays for Bypass Controller: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on

phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

8. Cover Mounted H-O-A and Green running LED Pilot Light.
9. LINE REACTOR
    a. Provide 5% Line Reactor
10. EMI/RFI Filtering:
    a. Provide EMI/RFI filtering to eliminate Common Mode and Differential Mode Noise.
    b. Install EMI/RFI filter on input side of VFD.
    c. Filter shall be equal to MTE #RF3 series.

D. FACTORY FINISHES

1. Manufacturer's standard prime-coat finish ready for field painting.
2. Finish: Manufacturer's standard paint applied to factory-assembled and -tested VFDs before shipping.

E. BYPASS SYSTEMS

1. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.
2. Bypass Mode: Manual operation only; requires local operator selection at VFC. Transfer between power converter and bypass contactor, and retransfer shall only be allowed with the motor at zero speed.
    a. Bypass Contactor: Load-break, IEC-rated contactor.

2.6 CONTROLS

A. GENERAL

1. Control, alternation, logic function, alarm, and all other functions shall be performed with proven field experience and relay logic as described herein. The control equipment shall be manufactured by a UL approved fabricator in accordance with UL 698A (Enclosed Industrial Control Panel Relating to Hazardous Locations with Intrinsically Safe Circuit Extensions) and labeled to that effect.
2. Furnish a lift station control panel designed to automatically operate the pumps as described herein. The lift station control panel will operate in a specified sequence, in response to variations in the liquid level.
3. Control Panel shall be UL 508A listed.

B. WIRING

1. All wiring shall have not less than 600 volt insulation and all power wiring and bus shall be in complete conformity with the National Electric Code (NEC) and State, Local, and NEMA electrical standards.

2. Control wiring shall be color coded and wire numbered. All connections shall be made at approved type terminal blocks with engraved marker strips.
    a. Color coding is:
        - L1 - Black
        - L2 - Red
        - L3 - Blue
        - Neutral – White
        - 120V Switchleg – Yellow
        - Low Voltage DC - Blue
3. All control wiring shall be contained within plastic/PVC wiring duct with covers. Where dimensional constraints prevent the use of wiring duct, wires shall be trained to panel components in groupings. The wire groupings shall be bundled and tied not less than every three (3) inches with nylon self-locking cable ties.
4. Every other cable tie shall be fastened to the enclosure door or inner device panel with a cable tie mounting plate with pressure tape. Where wiring crosses hinged areas, such as when trained from the inner device panel to the enclosure door.

C. INCOMING SERVICE

1. The lift station control panel shall be service entrance rated. The power supply shall be 480 volt, three (3) phase, four (4) wire sixty 60 hertz.

D. ENCLOSURES

1. The described equipment shall be housed in Hoffman NEMA 3R Stainless Steel enclosures for single door enclosures or Type 3R, gasketed, Stainless Steel enclosures for double door enclosures. The enclosure shall be constructed of not less than fourteen (14) gauge stainless steel. The enclosure shall be listed by Underwriters Laboratories, Inc. (UL.)
    a. Control Panels will be mounted on the wall inside the building as shown on the Plan Sheets.
2. The enclosures shall be designed specifically for mounting in an indoor location. The door shall contain data pockets. The outer door shall have a manual stop to remain open at ninety (90) degrees without being held open.
3. All the components normally accessed by operating personnel shall be accessible. All major components and subassemblies shall be identified with laminated, engraved, nameplates. A plastic coated wiring diagram shall be supplied on inner door of the panel. Stainless steel, door-in-door, construction. All conduits, fittings or connections shall enter the enclosure through the bottom only for any outdoor enclosure.
4. All conduits, fittings or connections shall enter the enclosure through the bottom only for any enclosure.

E. CIRCUIT BREAKERS

1. Branch Circuit Breakers shall be provided as follows:

2. Power circuit breakers shall be provided and mounted on the inner door of the control panel to provide a disconnect means and short circuit protection for any 120 VAC (or less) devices not powered from the motor starter circuit.

F. GROUND LUG

1. An equipment ground lug shall be provided for grounding the enclosure. The ground lug shall be suitable for the service provided to the enclosure sized per table 250-95 of the NEC. In all cases, the enclosure must be adequately grounded per Article 250 of NEC.

G. PHASE MONITOR

1. Phase loss, low voltage, phase reversal, and phase unbalance relay with adjustable trip delay of one (1) to ten (10) seconds, automatic reset, contacts for phase failure indicating light and pump trip, and UL listed or recognized; Symcom Motor Saver Model 460 or equal. Each input of the phase motor shall be fused.

H. SURGE PROTECTION

1. Surge capacitors rated 600 VAC RMS; three (3) poles, 1.0 mfd per pole; Delta CA 603R or equal.

2. A lightning arrestor shall be suppled in the control system and connected to each line of the load side of the main power disconnect. The arrestor shall protect the control system against damage as the result of transient voltage surges caused by lightning interference, switching loads, and power line interferences. It shall begin shunting to ground at 400 volts maximum. Arrestor shall be UL 1449 listed with surge capacity based on IEEE C62.41.2 – 2002 Category C high, rated 600 VAC RMS, 200kA SCCR, individually fused & thermally protected MOVs and UL listed.

3. 120 VAC control circuit surge protection shall be MTL MA 15 or equal.

I. SELECTOR SWITCHES

1. Provide a 30mm diameter Hand-Off-Auto, three (3) position, rotary, oil tight, heavy duty selector switch for each pump; Square D, Allen Bradley or equal.

J. PUSH BUTTON DEVICE

1. Provide 30mm diameter flush mount, oil tight, heavy duty push buttons for needed applications; Square D, Allen Bradley or equal.

K. INDICATION LIGHTS

1. Pilot lights shall be 30 mm, oil tight design, Push to Test, LED type pilot light; Square D, IDEC, Allen Bradley or Equal.

   a. Running lights for each pump (pump running signals shall be derived from auxiliary contacts on the motor starter) - GREEN lenses shall be provided.

   b. Fault lights for each pump – RED lenses shall be provided.

   c. Thermal Fail lights for each pump – RED lenses shall be provided

   d. Seal Fail lights for each pump – AMBER lenses shall be provided

L. CONDENSATION HEATER

1. Provide a properly sized 120 VAC fan-driven condensation heater and thermo switch. Heater shall have an adjustable thermostat control. Hoffman or equal (Minimum 200watt)

M. INTRINSICALLY SAFE BARRIERS

1. The control panel shall be equipped with an intrinsically safe level control circuit. Panel mounted, UL 913 listed, intrinsically safe isolations relays shall be provided to reduce float switch signal levels and level transducer signal levels which extend into the wet well to be suitable for use in Class I, Division I, Groups A, B, C, D, hazardous atmospheres. The isolation relays as well as all other components in the control panel shall be factory installed in accordance with UL 698A.
2. Provide intrinsically safe barriers for all float switches, flow meter and level transducer.

N. CONTROL TERMINAL BLOCK

1. Control terminals shall be provided for connecting float switch leads. Terminal blocks shall be rated for 600 volt use and accept a wire range of #22-8. Block shall be constructed of nylon and have insulating walls on all sides of the lug. Terminal blocks must be UL recognized.

O. CONTROL POWER TRANSFORMER

1. The Control Panel shall be equipped with a 2KVA transformer with fused primary and secondary.

P. UNINTERRUPTABLE POWER SUPPLY (UPS)

1. The control panel shall be provided with an on-line, double conversion 1000 VA battery backup system. Uninterruptable power supply system shall be an Eaton 9SX1000. A general-purpose relay shall be used to monitor the incoming power (YS-201) and logic shall be programmed into the PLC to indicate when an incoming power failure occurs AND when a failure by the UPS occurs.

Q. PUMP SUPERVISORY RELAY (PSR-xxx, xxx) - SEAL FAILURE/OVER-TEMP PROTECTORS (PROVIDED BY PUMP SUPPLIER)

1. A MiniCAS solid state device or equal, as provided by the pump supplier, that provides a signal to the pump mounted moisture and thermal sensors shall measure the moisture and thermal characteristics of the motor and provide an indication of an out of tolerance condition. Upon an over-temperature condition, the unit mounted LED and panel mounted pilot light will illuminate and the motor shall shut down. When the temperature reaches an acceptable level, the pump shall automatically re-start. Upon seal failure condition, the pump will continue to run and the unit mounted LED and panel mounted pilot light will illuminate. The Control Panel Supplier shall be responsible for installing the pump protectors and coordinating with pump supplier for exact sizes and requirements. Control signals from the pump supervisory relays shall be hardwired to the Control Panel (RTU) for monitoring of the supervisory relays.

R. CONTROL RELAYS

1. Relays shall be rated for general purpose duty. They shall have four single pole double-throw contacts. Contacts shall carry a UL inductive and resistive rating of 5 amps at

208 volts. They shall have a mechanical life expectance of 50,000,000 operations and an electrical life expectancy of 200,000 operations with a 3 amp 120 VAC Load. A LED shall be provided to indicate relay coil status.

2. Time delay relays shall be rated for general purpose duty. They shall have four single pole double throw contacts. Contacts shall carry a UL inductive rating.8 amps and a resistive rating of 3 amps at 208 volts. They shall have a mechanical life expectance of 50,000,000 operations and an electrical life expectancy of 200,000 operations with a 3 amp 120 VAC load. LEDs shall be provided to indicate "power on" and timing "out." The timing range shall be adjustable from .1 second to 10 minutes.

S. PUMP CONTROL RELAYS

1. Three (3) pump control timer relays (PCR-xxx, xxx, xxx) shall be installed in RTU-xxx for alternate control of the pumps. The pump control timer relay shall be used to "split" the signal coming from each of the float switches installed in the wet well. These float switches shall be used to report status back to RTU-xxx and to hardwire the float switches back to each pump or motor starter. The pump control timer relay shall be an integral part to the logic used to automatically control the operation of the pumps in the event RTU-xxx or any of the associated instrumentation is out of service or not working properly.

T. INTERIOR ALARMS – BUILDING INTRUSION ALARMS

1. Provide an interior, panel mounted alarm beacon assembly (AB-xxx) to RTU-xxx. Alarm beacon shall be 65 mm in diameter, 24 V DC, and be capable of producing a steady/pulsing LED.

   a. Logic in the PLC shall send/emit a pulsing signal to (AB-xxx) on the condition that an "intrusion alarm" condition is detected monitored be (LS-xxx).

   b. Logic in the PLC shall emit a steady signal to (AB-xxx) on the condition that a "general alarm" condition is detected. General alarm conditions are defined by that out of normal mode of operation.

2. Specific Application Requirements:

Installation Identification	ID Code	Size and Installation Notes
Building Entry Alarm - Beacon	AB-xxx	Installation location shall be approved by the Engineer

3. Approved Manufacturers: Interior alarms shall be 855P Series as manufactured by Allen Bradley or Engineer approved equal.

U. MANAGED ETHERNET SWITCH

1. Provide managed Ethernet switch with the capability to configure, manage, and monitor the Virtual LANs, Quality of Service (QOS) for traffic prioritization, resiliency protocols, multicast management, security, and diagnostics. Provide switch with a minimum of one addition port than indicated in the project plans.

2. The Managed Ethernet Switch shall be an Allen Bradley Stratix 5200 managed Industrial Ethernet Switch.

3. The SFP Module shall be an Allen Bradley Stratix Fiber Optic SFP Transceiver, 1000 MB, SMF.

V. PROGRAMMABLE LOGIC CONTROLLERS (PLC)

1. Programmable logic controllers capable of performing relay logic, timing, counting, sequencing, mathematical, PID control, and other functions as required by the functional description in this section. Provide complete unit with rack, power supply, modules, cables and connections.
2. 4K-word minimum, random access CMOS memory (RAM) for program. Provide 8K word EEPROM to retain program during power outages.
3. Auto start-up after power failure. Retain program and setpoints so that the system starts automatically when power is restored.
4. Provide live digital and analog inputs/outputs as specified, plus 20% spares and extra slots.
5. Coordinate with BMU on IP address numbers used with PLC.
6. Requirements:
   a. Digital inputs
      - Minimum 20 base inputs
      - LED indicator
      - Maximum of 16 inputs per card
   b. Relay outputs
      - Minimum 12 base relay outputs
      - LED indicator
      - Individually isolated or common point modules as required.
   c. Analog inputs
      - Minimum 4 base analog inputs
      - Field selectable 4-20 mADC or 1-5 VDC input on each channel.
      - 16 bit analog to digital conversion.
      - 250 ohm input impedance.
   d. Analog outputs
      - Minimum 2 base analog outputs
      - 0-20 mADC range. Nominal span of 4-20 mADC
      - Capable of driving up to a 750-ohm load.
7. The PLC shall be an Allen Bradley CompactLogix 5069 Series.

W. OPERATOR INTERFACE

1. Provide an operator interface for the local viewing and setting of all levels, flows, pressures, set points, and time delays. The OIT shall be mounted on the front of the control panel.
2. Communication with PLC shall be managed Ethernet switch via Ethernet/IP. Coordinate with BMU on IP address numbers used with operator interface.
3. Operator interface shall be an Allen Bradley PanelView Plus 7 Compact with Factory Talk View Studio Machine Edition software.
4. As a minimum the OIT shall be programmed with the following screens:
    a. Operator Interface Overview Screen - Main menu of the system with current wet well level indicated and access to all other screens used for lift station operation.
    b. Main Overview Screen - Graphic display screen of the respective lift station with level indication and pumps shown as they are in the field. Screen also gives pump information including status of each pump and the overall condition of each pump.
    c. Pump Alternator Screen - Screen used to set alternation sequence of the pumps.
    d. Lift Station Set Points Screen - Screen used to change all set points as described in this section. The screen will also have a graphic display image of the wet well with current level. The wet well image will be used to display the level of all set points in relation to each other and the current wet well level.
    e. Generator Status Screen – Graphic display screen of the respective generator that at a minimum shall display the status and overall condition of the generator.
    f. Timer Screen - Screen is used to change all time delays described previously in this section.
    g. Alarm Screen - The screen shall consist of a history and current alarm conditions that exist. The history screen shall store alarms that have been acknowledged over the past 1 year. The current screen shall indicate alarms that have not yet been acknowledged. All alarm conditions that return to normal state shall automatically reset. These alarms shall remain in the alarm history.
    h. Systems Integrator Screen - Screen shows System Integrator contact information.

X. SUBMERSIBLE LEVEL TRANSDUCER

1. Furnish and install a submersible hydrostatic level transducer in the wetwell. Level Transducer shall be specifically designed for most corrosive liquids and suspended solids. Level transducer shall be ± 1.00% accurate and generates a 4-20 mA signal proportional to the wastewater level in the wet well being monitored.
2. The transducer shall be mounted in a manner that allows easy removal for maintenance purposes. The assembly shall be integrated with supporting electronics in a durable water proof housing constructed of 316 stainless steel. Transducer shall have a minimum 2.75” non-clogging surface area to allow operation in suspended solid applications. Electrical cable shall be ETFE jacket material includes Kevlar members to prevent errors due to cable elongation and a unique water block features that self-heals in the event of accidental cuts to the cable. Provide 50 feet of vented cable and vent filter that provides an atmospheric reference for the sensor. Contractor to field verify length of cable.

3. General Contractor shall be responsible for installing the level transducer in the wet well in a manner to minimize operational problems with the level transducer due to clogging, buildup of solids and interference of fats, oils and greases.

4. Specific Application Requirements:

Installation Identification	ID Code	Range	Size and Installation Notes
Lift Station Level	LIT-xxx	0-5 psi	

5. Approved Manufacturers: The level transducer shall be manufactured by KPSI Model 750 Transducer or Engineer approved equal.

Y. FLOAT SWITCHES

1. General Contractor shall furnish and install float level switches in each of the locations required. Large diameter float switch shall be of rugged construction suitable for most corrosive liquids and suspended solids. A mechanical switch located in the plastic casing, freely suspended at the desired height from its own cable. When the liquid level reaches the regulator, the casing will tilt and the mechanical switch will close or break the circuit.

2. The float switch shall be constructed with a regulator casing that is made of a polypropylene and cable is sheathed with ATON rubber. The plastic components shall be welded and screwed together. Adhesives shall never be used to secure plastic components. Provide cable hanger in location that shall allow easy removal of float switches for maintenance purposes.

3. Floats shall be wired to Pump Control Relays (PCR-xxx and PCR-xxx) that shall be wired to RTU-xxx and the motor starters. In the event that the Level Transducer malfunctions, the floats shall annunciate an alarm condition and maintain wastewater level control. In the event that the PLC loses power, the floats shall maintain wastewater level control through the control of the pumps.

4. Float switches shall be provided with approximately 100 feet of ATON rubber cable. Contractor to field verify length of cable. Cable shall be sealed using an epoxy adhesive.

5. Specific Application Requirements:

Installation Identification	ID Code	Size and Installation Notes
LEAD AND LAG Pump OFF	FLS-xxx	Suitable for 0.95 – 1.10 g/cm^3 density
LEAD Pump ON (KARI 1-2)	FLS-xxx	Suitable for 0.95 – 1.10 g/cm^3 density
LAG Pump ON (KARI 1-3)	FLS-xxx	Suitable for 0.95 – 1.10 g/cm^3 density
High Level Alarm (KARI 4-5)	FLS-xxx	Suitable for 0.95 – 1.10 g/cm^3 density

6. Float level switches shall be Cable Suspended Float Level Sensors as model KA-4H5E as manufactured by KARI.

Z. FLOOD SWITCH

1. Small diameter float switch shall be of rugged construction suitable for most corrosive liquids. The Contractor shall furnish and install the wire the flood switches as required. The stem and float shall be constructed of 316 stainless steel and operate in a range of 0°F to 300°F. The float level switch shall operate on an intrinsically safe level. The switches shall be individually suspended approximately 1 to 2-inch off of the floor.

2. Specific Application Requirements:

Installation Identification	ID Code	Size and Installation Notes
Wet Floor alarm- Valve Vault	FS-xxx	Installation location shall be approved by the Engineer

3. Approved Manufacturers: Wet floor level switches shall be LS-270 Series as manufactured by Gem.

AA. POSITION SWITCH – BUILDING ENTRY ALARM

1. General Contractor shall furnish and install position switches in each of the locations. Provide heavy-duty industrial switches that convert mechanical motion into electrical inputs. Provide switches capable of mounting in any position. Provide watertight switches NEMA 4.

2. Specific Application Requirements:

Installation Identification	ID Code	Size and Installation Notes
Door Entry Switch- Main Door	LS-xxx	Installation location shall be approved by the Engineer
Disconnect Switch – Pump #1	LS-xxx	Installation location shall be approved by the Engineer
Disconnect Switch – Pump #2	LS-xxx	Installation location shall be approved by the Engineer

3. Approved Manufacturers: Entry limit switches shall be Type 802 as manufactured by Allen-Bradley or Sentrol Industries Type 151.

BB. TEMPERATURE TRANSMITTER – BUILDING

1. General Contractor shall furnish and install temperature transmitters that generate a 4-20 mA signal proportional to the air temperature. Transmitter shall be 100 ohm RTD transmitter. Mount temperature transmitter midway on wall.

2. Specific Application Requirements:

Installation Identification	ID Code	Range	Size and Installation Notes
Building Temp.	TT-xxx	0-150^{O}F	Installation location shall be approved by the Engineer

3. Approved Manufacturers: Temperature transmitters shall be TCS Basys Controls.

2.7 PACKAGED ENGINE-GENERATOR SET

A. GENRAL

1. Packaged engine-generator set shall be a coordinated assembly of compatible components.
2. Generator output ratings shall be as follows:
   a. Voltage: 480 VAC, 3 phase, 4 wire
   b. Power Output: xx KW (standby)
   c. Frequency: 60 Hz
3. Power Output Ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.
4. Output Connections: Three (3) phase, four wire.
5. Safety Standard: Comply with ASME B15.1.
6. Nameplates: Each major system component shall be equipped with a nameplate to identify manufacturer's name and address, and model and serial number of component.
7. Mounting Frame: Adequate strength and rigidity to maintain alignment of mounted components without depending on concrete foundation. Mounting frame shall be free from sharp edges and corners and shall have lifting attachments arranged for lifting with slings without damaging components.
8. Generator set shall be equipped with equipment that allows for communication with 3rd parties via Ethernet protocol.

B. GENERATOR-SET PERFORMANCE

1. Steady-State Voltage Operational Bandwidth: 4 percent of rated output voltage from no load to full load.
2. Steady-State Voltage Modulation Frequency: Less than 1 Hz.
3. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
4. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 5 percent variation for a 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
7. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, the system shall supply a minimum of 250 percent of rated full-load current for not less than 10- seconds and then clear the fault automatically, without damage to generator system components.

9. Start Time: Comply with NFPA 110, Type 10, system requirements.

C. SERVICE CONDITIONS

1. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
   a. Ambient Temperature: Minus 40 to plus 120 deg F.
   b. Relative Humidity: 0 to 95 percent.
   c. Altitude: Sea level to 1200 feet (367 m).

D. ENGINE

1. Fuel: Diesel or Natural Gas (BMU Staff to decide during design)
2. Rated Engine Speed: 1800 rpm.
3. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).
4. Lubrication System: The following items are mounted on engine or skid:
   a. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
   b. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
   c. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
5. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
6. Governor: Electronic.

E. ENGINE COOLING SYSTEM

1. Description: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
   a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and non-collapsible under vacuum.
   b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

F. FUEL SUPPLY SYSTEM

1. Diesel or Natural Gas (BMU Staff to decide during design)
2. If Natural Gas, coordinate required Natural fuel supply and service with Northwestern Energy.

G. ENGINE EXHAUST SYSTEM

1. Muffler: Super Critical, Hospital grade type, sized as recommended by engine manufacturer; sound level measured at a distance of 10 feet (3 m) from exhaust discharge shall be 85 dBA or less. (Furnished by general supplier, field installed by mechanical contractor).
2. Connection from Engine to Exhaust System: Flexible section of corrugated stainless-steel pipe. (Furnished by general supplier, field installed by mechanical contractor).
3. Connection from Exhaust Pipe to Muffler: Stainless-steel expansion joint with liner. (Furnished by general supplier, field installed by mechanical contractor).
4. Other Exhaust Piping External to Engine: Furnished and installed by mechanical contractor.
5. Thimbles fore Exhaust piping: Comply with NFPA 211. (Furnished by generator supplier, installed by contractor).
6. Supports for muffler and exhaust piping: Furnished and installed by mechanical contractor.
7. Provide all materials and labor as necessary to complete the generator exhaust system installation.

H. COMBUSTION-AIR INTAKE

1. Description: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

I. LOUVERS

1. Provide appropriate sized louvers.
2. Mount Louvers in building walls.
3. Provide all associated hardware and wiring.

J. STARTING SYSTEM

1. Description: 24-V electric, with negative ground and including the following items:
   a. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Environmental Conditions" Paragraph in "Service Conditions" Article.
   b. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
   c. Cranking Cycle: As required by NFPA 110 for this project’s specific application.

d. Battery: Adequate capacity within ambient temperature range specified in "Environmental Conditions" Paragraph in "Service Conditions" Article to provide specified cranking cycle at least three times without recharging.

e. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.

f. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Include accessories required to support and fasten batteries in place.

g. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.

h. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236.

K. CONTROL AND MONITORING

1. Functional Description: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of the generator set. When mode-selector switch is switched to the on position, the generator set starts. The off position of the same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down the generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down the generator set.

2. Functional Description: Switching on-off switch on the generator control panel to the on position starts the generator set. The off position of the same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down the generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down the generator set.

3. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

4. Indicating and protective devices and controls shall include those required by NFPA 110 for this particular application.

5. Indicating and Protective Devices and Controls:

a. AC voltmeter.

b. AC ammeter.

c. AC frequency meter.

d. DC voltmeter (alternator battery charging).

e. Engine-coolant temperature gage.

f. Engine lubricating-oil pressure gage.

g. Running-time meter.

h. Ammeter-voltmeter, phase-selector switch(es).

i. Generator-voltage adjusting rheostat.

j. Start-stop switch.

k. Overspeed shutdown device.

l. Coolant high-temperature shutdown device.

m. Coolant low-level shutdown device.

n. Oil low-pressure shutdown device.

6. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

7. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.

8. Generator set shall be equipped with standard or third party equipment that allows for communication via **ALLEN BRADLEY ETHERNET/IP** Protocol.

L. GENERATOR OVERCURRENT AND FAULT PROTECTION

1. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.

a. Tripping Characteristic: Designed specifically for generator protection.

b. Trip Rating: As indicated in project documents.

c. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.

d. Mounting: Adjacent to or integrated with control and monitoring panel.

M. GENERATOR, EXCITER, AND VOLTAGE REGULATOR

1. Comply with NEMA MG 1 and specified performance requirements.

2. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

3. Electrical Insulation: Class H.

4. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

5. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

6. Excitation shall use no slip or collector rings, or brushes, and shall be arranged to sustain generator output under short-circuit conditions as specified.

7. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.

a. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

8. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

9. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

10. Sub transient Reactance: 12 percent, maximum.

N. FINISHES

1. Manufacturer's standard enamel over corrosion-resistant pretreatment and compatible standard primer.

O. SOURCE QUALITY CONTROL

1. Testing: Factory Load Bank test this specific engine-generator set before shipment.

a. Tests: Comply with NFPA 110, Level 1 energy converters in Paragraphs 3.2.1, 3.2.1.1, and 3.2.1.2.

b. Generator Tests: Comply with IEEE 115.

2. Report factory test results within 10 days of completion of test.

2.8 AUTOMATIC TRANSFER SWITCH – CLOSED TRANSITION

A. GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

1. Transfer switch shall be fully rated to carry and switch a continuous current of 200 Amps at **480/120 VAC, 3 PHASE, 4 WIRE**.

2. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions present based on testing according to UL 1008. Minimum rating shall be 22,000 Amps RMS Symmetrical.

a. Where External Circuit Breaker or Fuses Protect Transfer Switch: Products are listed for use with the actual devices providing the fault-current protection at each location for Project. Rated fault-current, withstand-duration times include the following:

- Units Protected by Molded-Case Circuit Breakers 150 A and Less: 1.5 cycles.
- Units Protected by Molded-Case Circuit Breakers Larger than 150 A: 3 cycles.
- Units Protected by Power and Insulated-Case Circuit Breakers: 10 cycles.
- Units Protected by Current-Limiting Fuses: 0.5 cycles (nominal).

3. Solid-State Controls: Repetitive accuracy of all settings is plus or minus 2 percent or better over an operating temperature range of minus 20 deg C to 70 deg C.

4. Resistance to Damage by Voltage Transients: Components meet or exceed voltage-surge withstand capability requirements when tested according to ANSI C37.90.1. Components meet or exceed voltage-impulse withstand test of NEMA ICS 1.

5. Neutral Terminal: Provide fully rated, solid, unswitched neutral terminal, unless otherwise indicated.
6. Factory Wiring: Train and bundle factory wiring and label consistent with Shop Drawings, either by color code or by numbered or lettered wire and cable tape markers at terminations.
    a. Designated Terminals: Pressure type suitable for types and sizes of field wiring indicated.
    b. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
    c. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
7. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric motor-operated mechanism, mechanically and electrically interlocked in both directions.
8. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
    a. Limitation: Switches using molded-case switch or insulated-case circuit-breaker components and switches using contactors not designed for continuous-duty repetitive switching between active power sources are not acceptable.
    b. Switch Action: Double throw; mechanically held in both directions.
    c. Switch Contacts: Silver composition for load current switching. Conventional automatic transfer-switch units rated 225 A and greater have separate arcing contacts.

B. AUTOMATIC TRANSFER SWITCH

1. Comply with Level 1 equipment according to NFPA 110.
2. Switching Arrangement: Double-throw type, **CLOSED TRANSITION**.
3. Active Synchronization: Closed transition shall require active synchronization between utility and generator power source before transfer from one live source to the other is allowed.
4. Utility Relaying: Provide Utility Relay protection that will act to prevent the generator from paralleling with the serving electric utility for more than 60 cycles. The utility relaying must fully conform to the requirements of the serving electric utility. Coordinate all requirements with the utility specified electrical engineer.
5. Manual Switch Operation: Manually operated under load, and with either or both sources energized. Transfer time is the same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
6. Signal-before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

C. AUTOMATIC TRANSFER-SWITCH FEATURES

1. Voltage sensing for each phase of normal source. Pickup voltage is adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
2. Time delay for override of normal-source voltage sensing delays transfer and engine start signals. Adjustable 0 to 6 seconds and factory set at 1 second.
3. Voltage/Frequency Lockout Relay: Prevents premature transfer to an emergency generator set. Pickup voltage is adjustable from 85 to 100 percent of nominal. Factory set to pickup at 90 percent. Pickup frequency is adjustable from 90 to 100 percent of nominal. Factory set to pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes and factory set at 10 minutes. Provides automatic defeat of the delay on loss of voltage or sustained undervoltage of the emergency source, provided normal supply has been restored.
5. Test Switch: Simulates normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via the transfer-switch, normal- and emergency-source sensing circuits.
    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
8. Unassigned Auxiliary Contacts: 2 normally open single-pole, double-throw contacts for each switch position, rated 10 A at 240 V, ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of the condition of the normal source. A pilot light indicates override status.
10. Engine Starting Contacts: 1 isolated, normally closed and 1 isolated, normally open. Contacts are gold flashed or gold plated and rated 10 A at 32 V, dc minimum.
11. Engine Shutdown Contacts: Time delay adjustable from 0 to 5 minutes; factory set at 5 minutes. Initiates shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Closed Transition switch matching generator and utility frequency before transfer. Transfer between live utility source and live generator source shall be transparent to electrical loads in facility.
13. Unit shall be **FRONT ACCESS ONLY**. Unit shall not require side or rear access to terminate cables or make electrical adjustments.
14. The switch shall have the ability to incorporate a remote START (dry-contact) command from the process control system PLC.
15. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine-generator set and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise

cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory-set periods are for 7 days, 20 minutes, and 5 minutes, respectively. Exerciser features include the following:

a. Exerciser Transfer Selector Switch: Permits selection between exercise with and without load transfer.

b. Push-button programming control with digital display of settings.

c. Integral battery operation of time switch when normal control power is not available.

16. Generator and ATS manufacturer shall provide any coordination studies between the serving utility and the equipment which they are furnishing. There equipments shall meet utility requirments for a closed transition.

D. ATS ENCLOSURE

1. ATS component enclosure shall comply with the following: General-purpose NEMA 250, Type 12, complying with NEMA ICS 6; UL 508, unless otherwise indicated.

E. FINISHES

1. Enclosures: Enamel over corrosion-resistant pretreatment and primer. Color - standard factory finish.

F. SOURCE QUALITY CONTROL

1. Factory Test Components, Assembled Switches, and Associated Equipment: Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3.0 - EXECUTION

3.1 PUMP STATION

A. Perform installation in accordance with Contract Documents and manufacturers specifications.

B. EXAMINATION

1. A factory trained technician shall examine the work area prior to beginning work and check the following:

a. The environment is safe to begin working in

b. All surfaces are ready to receive work

c. All tools are in the proper location and are in good condition

d. Grounding of the system

C. FIELD QUALITY CONTROL

1. The follow field tests shall be performed by a factory trained technician

a. Point to point wiring verification

b. Utility power verification

c. Site acceptance testing

d. System demonstration

2. Configuration Verification

a. The factory trained technician shall document the settings using a factory provided configuration checklist. Each parameter shall be verified prior to the beginning of testing and then again after testing is completed.

D. FACTORY TRAINED SUPERVISION

1. The contractor shall procure a factory trained technician to check over equipment prior to putting the equipment into operation.

2. Point to point test of all wiring

3. Functional test of all equipment alarms and controls.

E. CERTIFICATION OF TESTING

1. All tests shall be performed in the presence of a duly authorized representative of the Owner. If the presence is waived, certified results shall be provided by the Contractor.

2. Written notice of all tests shall be given two weeks in advance.

F. TEST EQUIPMENT

1. All test equipment shall be provided by the Contractor.

G. TRAINING

1. Training shall be a minimum of four (4) hours and cover the complete Pumping System and related controls.

2. Instruction material shall be provided for four (4) trainees.

3.2 VARIABLE FREQUENCY CONTROLLERS

A. INSTALLATION

1. Anchor each VFD assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with VFD mounting surface.

2. Install VFDs within control cabinet (RTU).

B. IDENTIFICATION

1. Operating Instructions: Frame printed operating instructions for VFDs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFD units.

C. CONTROL WIRING INSTALLATION

1. Install wiring between VFDs and remote devices according to NEC

2. Bundle, train, and support wiring in enclosures.

3. Connect hand-off-automatic switch and other automatic-control devices where available.

4. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
5. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

D. FIELD QUALITY CONTROL

1. Prepare for acceptance tests as follows:
   a. Test insulation resistance for each VFD element, bus, component, connecting supply, feeder, and control circuit.
   b. Test continuity of each circuit.
2. Testing: Perform the following field quality-control testing:
   a. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.
   b. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pretesting and adjusting VFDs.
4. Test Reports: Prepare a written report to record the following:
   a. Test procedures used.
   b. Test results that comply with requirements.
   c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. ADJUSTING

1. Set field-adjustable switches and circuit-breaker trip ranges.

3.3 CONTROL PANEL NARRATIVE

A. All measurements, references, and alarm conditions called to be displayed locally shall be displayed at the Lift Station. All measurement, reference, and alarm conditions called to be displayed remotely shall be displayed on the East Water Plant Control OIT. All operator designated alarm conditions shall be generated through the existing alarm dialer.

1. Temperature Transmitter – Building: A temperature transmitter (TT-201) shall be furnished and installed as needed. This device shall be used to monitor the room temperature. Temperature of the room shall be displayed locally on RTU-200. The display shall be displayed, so that the Operator can view the display while standing in front of the RTU. Operator-adjustable setpoints in RTU-200 shall be provided to annunciate alarms locally and remotely for temperature out of range for either a high temperature [90°F] or a low temperature [40°F].

2. Wet Floor Switch: Wet floor switch (FS-201) shall be furnished and installed approximately 1- inch above the floor. An alarm shall be wired to RTU-200 and shall remotely generate an alarm condition when wastewater is detected.

3. Intrusion Position Switches: Install building switch (LS-201) so as to cause a contact closure signal to be transmitted to the RTU-200 and energize an alarm beacon (AB-201). After an operator selectable timer expires [120 seconds], the RTU-200 shall then send an unauthorized entry alarm condition via telemetry to the main plant dialer alarm. Alarms shall be capable of being deactivated by depressing alarm acknowledgment push button (PB-201). Depression of alarm acknowledgment shall deactivate alarm condition for the alarm beacon. After alarm acknowledgment an operator selectable timer of [60 min] shall reenergize the alarms to normal operating sequence.

4. General Purpose Relay – Power Outage: Each RTU shall be equipped with a timer relay (YS-201) that monitors the incoming line power. Upon power failure and a predetermined amount of time [30 sec], an alarm will be generated in RTU-200 and displayed locally on the Operator Interface and remotely when a power failure is detected.

5. Influent Wet Well Level Transducer: The level in the wet well will be monitored by a level transducer (LIT-201). The level transducer shall generate a signal that is proportional to the wastewater level in the wet well. The signal will be connected to RTU-200 and used to generate pump run/off conditions and alarm conditions. Operator-adjustable setpoints in RTU-200 shall be provided to annunciate alarm conditions for either a high-high level [6.75 feet], high level [6.25 feet] or a low level [1.4 feet] in the structure. A soft signal shall be programmed into RTU-200 and shall remotely generate an alarm condition in the event the transmitter fails (4-20 mA signal out of range). The level in the wet well shall be displayed locally on the Operator Interface on RTU-200. The anticipated level range is between 0 and 25 feet.

6. Pumps: The wet well will be equipped with a total of two (2) Pumps. The control for the pumps shall include “HAND-OFF-AUTO” selector switches on RTU-200. The “HAND” and “OFF” positions of the switch on the Control Panel shall override all other control from the process control panel. When the switch on the Control Panel is in the “AUTO” position, the control of pump operation shall be from RTU-200. When the switch on the Control Panel is in the “HAND” position, the control of pump operation shall be operator controlled. The starting and stopping of the pumps shall be based on the level in the wet well. The control logic shall generally be as follows:

B. NORMAL MODE OF OPERATION

1. The influent wet well level is monitored by level transmitter (LIT-201) and is hardwired to RTU-200. The level in the wet well shall be displayed locally on the Operator Interface on RTU-200. The anticipated level range is between 0 and 10 feet.

2. Each pump shall be operated by a VFD. Actual pump speed and operator adjustable pump speed setpoint shall be monitored and controlled through RTU-200. Operating pump speed shall be adjustable by the pump speed setpoint [60 Hz] with a range of 30Hz to 60 Hz.

3. Each pump will have a “READY” or “OUT OF SERVICE” software tag associated with it on the operator interface to determine the operation of the pumps. If a pump is tagged with the ”OUT OF SERVICE” tag, the logic within RTU-200 shall skip over

the appropriate pump during the normal operation of starting and stopping pumps based on the wet well level and in the pump alternating sequence.

4. Each pump designation will have a level associated with it that controls the start/stop of the associated pump.

5. A start "LEAD" pump call will be triggered when the wet well level (LIT-201) rises above an operator- selected setpoint [4.75 feet]. A start "LAG" pump call will be triggered when the wet well level (LIT-201) rises above an operator-selected setpoint [5.25 feet]. All setpoints shall be operator-selectable from the Operator Interface and on RTU-200.

6. A stop, "LEAD" and "LAG" pump call will be triggered when the wet well level (LIT-201) falls below an operator-selected setpoint [1.9 feet].

7. A pump alternating sequence shall be programmed into RTU-200 for pump operation. The pumps shall be alternated so that upon expiration of an operator-selected timer [1.0 day] the "LAG" pump shall become the "LEAD" pump, etc. The alternating sequence shall be used to help balance the number of run hours between the pumps.

8. If a pump call is generated and the "LEAD" pump fails to operate for any condition, an alarm condition shall be generated, and the "LAG" pump will be called to start.

9. Pump motor starter auxiliary contacts are to be monitored for proof of pump running. Lift station pumps are to be failed out and alternator locked out if running contacts are not achieved after pump is called for in an operator adjustable amount of time.

10. The lift station generator shall be controlled via a separate control panel which shall communicate with the lift station control panel PLC via an Ethernet/IP connection as shown on the Plans. The control panel shall annunciate a "Generator Common Alarm" for any fault in the generator. The lift station control panel shall provide for the following generator operations via the operator interface:

    a. Generator test: Operator shall be able to select "Generator Test" within the control panel in order to initiate a loaded test of the backup generator which shall last for an operator selected duration [30 minutes].

C. PARALLEL MODE OF OPERATION

1. A parallel mode of operation shall be provided for each of the pumps. A Single KARI float switch (Four contact/events) shall be installed in the wet well at elevations outside the start/stop setpoints described for the pumps when operating based on the level transmitter (LIT-201).

2. Float switches (FLS-201 & 202) shall be installed in the wet well and wired directly to a pump control timer relay (PCR-201 & 202) located in RTU-200 which shall be split to run both on the logic of the PLC in the event of (LIT-201) failure and directly to lift pump #1 and pump #2 in the event of a PLC failure.

3. The "LEAD START" pump float switch (FLS-202) shall be wired to the Pump #1 control relay (PCR- 201). This pump control timer relay shall then be wired directly to Pump #1 motor starter to automatically start the pump in the event that the contact in Influent Pump #1 float switch (FLS-202) is closed AND the pump control timer relay expires [10 seconds]. The pump control timer relay shall have a second set of contacts

that will be wired back to RTU-200. The same should be done for "LAG START" using float switch (FLS-201) and pump control relay (PCR-202).

4. A "STOP" Pump Level float switch (FLS-203) shall be installed in the wet well and wired directly to a pump control timer relay (PCR-201 & 202) located within RTU-200. These pump control timer relays (PCR-201 & 202) shall then be wired directly to automatically stop the pump in the event that the contact in "STOP" Pump Level Float (FLS-203) is open. After shutdown, the pump shall not be restarted until the pump control timer relay expires [5 minutes].
5. The pump control timer relays (PCR-201 & 202) shall be wired back to RTU-200. If the relays are energized, an alarm condition shall be generated remotely indicating which float was energized and displayed locally on the operator interface.

D. PUMP PROTECTION AND EMERGENCY SHUTDOWN

1. The control logic in RTU-200 shall include alarms and overrides to shut down the pumps in the event of an operator-selectable setpoint low wet well level (LIT-201) [1.9 feet] AND an operator-selected timer within the consolidated RTU-200 expires [10 seconds].
2. A "STOP" Pump Level float switch (FLS-203) shall be installed in the wet well and wired directly to a pump control timer relay (PCR-201 & 202) located within RTU-200. The pump control timer relay (PCR-201 & 202) shall be used to split the signal coming for the "STOP" Pump Level Float Switch (FLS-203) to all pumps.

E. FABRICATION

1. Sub-panel shall be drilled and tapped to accept machine thread bolts (self-tapping screws are not acceptable.)
2. All control wiring shall be minimum of 18 AWG wire.
3. Power (motor) wiring shall be in accordance with the National Electrical Code (NEC.)
4. Major groups of wires shall be contained in a plastic wiring trough equal to Panduit.
5. All component parts in the control panel shall be permanently marked and identified using engraved name plates as they are indicated on the drawing. Marking shall be on the back plate adjacent to the component. All control conductors shall be identified with wire markers at each end as close as practical to the end of conductor termination.

F. SCADA INTERFACE

1. The systems integrator shall be responsible to display all levels, pressures, flows, setpoints, alarms, pump run, and pump fail that are collected by the remote station and display on BMU's existing Supervisory Control System. In addition, alarm conditions shall be transmitted back to the East Water Plant and the auto dialer shall be modified to send out alarm conditions via SCADA.
2. Conditions to be reported are as follows:
   a. Pump #1 Running
   b. Pump #1 Overtemp Alarm
   c. Pump #1 Seal Fail Alarm

d. Pump #1 Disconnect Switch Alarm
e. Pump #1 Runtime
f. Pump #1 Start Counts
g. Pump #2 Running
h. Pump #2 Overtemp Alarm
i. Pump #2 Seal Fail Alarm
j. Pump #2 Disconnect Switch Alarm
k. Pump #2 Runtime
l. Pump #2 Start Counts
m. Dual Pump Runtime
n. Wet Well Level
o. Transducer Fail
p. Valve Vault Flood Alarm
q. Generator Running
r. Generator Fail
s. Common Generator Alarm
t. Low, High, High-High Level Alarms
u. PLC Fail
v. Power Fail/UPS Fail
w. Building Entry Alarm
x. Building Temperature Alarm

G. INSTALLATION AND OPERATOR TRAINING

1. The services of a factory-trained, qualified service representative of the equipment manufacturer shall be provided to inspect the completed installation to ensure that it is installed in accordance with the manufacturer's recommendations, make all adjustments necessary to place the system in trouble-free operation and instruct the operating personnel in the proper care and operation of the system.
2. A minimum of one (1) four (4) hour day of operator training and start-up assistance will be required. All training and start-up shall be coordinated at the convenience of the Owner.

H. CALIBRATION, ADJUSTMENT, AND TESTING

1. Devices requiring field calibration shall be calibrated in presence of Owner's representative and documented.

3.4 PACKAGED ENGINE GENERATOR

A. INSTALLATION

1. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
2. Install packaged engine generators level on concrete base.
    a. Vibration Isolation: Mount packaged engine generators on rubber pads or restrained spring isolators with a minimum deflection.
    b. Generator supplier is responsible for transporting generator and off loading onto concrete base.
3. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
4. Exhaust-system piping. Contractor shall extend to point of termination outside structure. Size piping according to manufacturer's written instructions.
    a. Support exhaust piping and muffler with pipe hangers spaced a maximum of 20 feet (6m) horizontally and at each floor vertically.
5. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.
6. Piping installation requirements per approved shop drawings. Shop drawings shall indicate general arrangement of piping and specialties. The following are specific connection requirements:
    a. Connect exhaust-system piping to engines.

B. FIELD QUALITY CONTROL

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections[, and to assist in field testing. Report results in writing.
2. Perform the following field tests and inspections and prepare test reports:
    a. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.15.2.1 and 7.22.1 (except for vibration baseline test). Certify compliance with test parameters.
    b. Perform tests recommended by manufacturer.
    c. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110.
    d. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
        - Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
        - Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
        - Verify acceptance of charge for each element of the battery after discharge.
        - Verify that measurements are within manufacturer's specifications.

e. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float- charging conditions.

f. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.

g. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.

3. Coordinate tests with tests for transfer switches and run them concurrently.

4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

6. Remove and replace malfunctioning units and retest and reinspect as specified above.

7. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

8. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

C. STARTUP SERVICE

1. Engage a factory-authorized service representative to perform startup service.

2. Inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

3. Complete installation and startup checks according to manufacturer's written instructions.

D. DEMONSTRATION

1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. This shall consist of a minimum of 4 hours of on-site training.

2. Coordinate this training with that for transfer switches.

E. INSTALLATION

1. Identify components according to Division 26 Section "Basic Electrical Materials and Methods."

F. WIRING TO REMOTE COMPONENTS

1. Match type and number of cables and conductors to control and communications requirements of equipment used. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

G. CONNECTIONS

1. Ground equipment as indicated and required by National Electrical Code.
2. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

H. FIELD QUALITY CONTROL

1. Preliminary Tests: Perform electrical tests as recommended by manufacturer and as follows:
2. Measure phase-to-phase and phase-to-ground insulation resistance levels with insulation resistance tester. Include external annunciator and control circuits. Use test voltages and procedure recommended by manufacturer. Meet manufacturer's specified minimum resistance.
3. Check for electrical continuity of circuits and for short circuits.
4. Field Tests: Give at least 7 days' advance notice of tests and perform tests in presence of Owner's representative.
5. Coordinate tests with tests of generator plant and run them concurrently.
6. Tests: As recommended by manufacturer and as follows:
7. Contact Resistance Test: Measure resistance of power contacts for automatic transfer switches, nonautomatic transfer switches, and bypass/isolation switches. Resolve values in excess of 500 micro-ohms and differences between adjacent poles exceeding 50 percent.
8. Operational Tests: Demonstrate interlocking sequence and operational function for each switch at least 3 times.
9. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
10. Simulate low phase-to-ground voltage for each phase of normal source to automatic transfer switches.
11. Verify time-delay settings and pickup and dropout voltages.
12. Test Failures: Correct deficiencies identified by tests and prepare for retest. Verify that equipment meets specified requirements.
13. Reports: Maintain a written record of observations and tests. Report defective materials and workmanship and retest corrected items. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
14. Provide a report to the local AHJ indicating all tests that are performed and the results of those tests.

I. DEMONSTRATION

1. Training: Engage a factory-authorized service representative to instruct Owner's personnel in the operation, maintenance, and adjustment of transfer switches and related equipment. Provide a minimum of 2 hours of on-site instruction. Schedule training with owner to ensure compliance with his schedule.

3.5 AUTOMATIC TRANSFER SWITCH – CLOSED TRANSITION

A. WIRING TO REMOTE COMPONENTS

1. Match type and number of cables and conductors to control and communications requirements of equipment used. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. CONNECTIONS

1. Ground equipment as indicated and required by National Electrical Code.
2. Tighten electrical connectors and terminals according to manufacturer's published torque-
3. tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

C. FIELD QUALITY CONTROL

1. Preliminary Tests: Perform electrical tests as recommended by manufacturer and as follows:
2. Measure phase-to-phase and phase-to-ground insulation resistance levels with insulation resistance tester. Include external annunciator and control circuits. Use test voltages and procedure recommended by manufacturer. Meet manufacturer's specified minimum resistance.
3. Check for electrical continuity of circuits and for short circuits.
4. Field Tests: Give at least 7 days' advance notice of tests and perform tests in presence of Owner's representative.
5. Coordinate tests with tests of generator plant and run them concurrently.
6. Tests: As recommended by manufacturer and as follows:
7. Contact Resistance Test: Measure resistance of power contacts for automatic transfer switches, nonautomatic transfer switches, and bypass/isolation switches. Resolve values in excess of 500 micro-ohms and differences between adjacent poles exceeding 50 percent.
8. Operational Tests: Demonstrate interlocking sequence and operational function for each switch at least 3 times.
9. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
10. Simulate low phase-to-ground voltage for each phase of normal source to automatic transfer switches.
11. Verify time-delay settings and pickup and dropout voltages.
12. Test Failures: Correct deficiencies identified by tests and prepare for retest. Verify that equipment meets specified requirements.
13. Reports: Maintain a written record of observations and tests. Report defective materials and workmanship and retest corrected items. Record adjustable relay settings and

measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

14. Provide a report to the local AHJ indicating all tests that are performed and the results of those tests.

D. DEMONSTRATION

1. Training: Engage a factory-authorized service representative to instruct Owner's personnel in the operation, maintenance, and adjustment of transfer switches and related equipment. Provide a minimum of 2 hours of on-site instruction. Schedule training with owner to ensure compliance with his schedule.

PART 4.0 - MEASUREMENT AND PAYMENT

4.1 GENERAL

A. All measurements and payments will be based on completed work performed in strict accordance with the Specifications and the respective prices and payment shall constitute full compensation for all work completed, including incidentals. No separate payment will be made for excavation, trenching, dewatering, backfilling and utility identification. Items of work covered under this section of the Specifications and all such costs pertinent to these items shall be included in the applicable unit prices.

4.2 DUPLEX LIFT STATION, CONTROLS, ELECTRICAL, GENERATOR, BUILDING AND APPURTENANCES

A. Furnishing and installation of the duplex lift station, valve vault, pumps, controls, electrical, generator, building and appurtenances shall be measured as a complete unit of work. Payment shall be made at the contract lump sum price for "Duplex Lift Station, Controls, Electrical, Generator, Building and Appurtenances", as stipulated in the Bid, which price and payment shall be full compensation for all labor, materials, tools and equipment required to furnish and install the lift station, wetwell, wetwell liner and special coatings; valve vault, wetwell and valve vault penetrations; controls, generator, building, telemetry system, electrical and appurtenances, including pumps; piping; fittings; check valves; isolation valves; trash basket and rails; wetwell basin; valve vault access frames and covers; safety grate fall-through prevention equipment; vent pipe; excavation and trenching; foundations; backfilling and compaction; select engineered fill; concrete ballast; removal of water; trench and structure dewatering; temporary moving and relocation of existing utilities; disposing of waste material; site grading; stripping, stockpiling and placing topsoil and gravel surfacing; importing fill; making connections to gravity influent lines and effluent force main; gravity sewer and forcemain installation; transition couplings to make connections to gravity influent lines and effluent force main; concrete foundation for building; exhaust fans; pump guide rail system; electrical; wiring; control panel and enclosures; electrical switches, PLCs, disconnects, control panel connections; microprocessor based controller; transformer pad; spare parts; startup; testing; disinfection; clean up; product warranties; and other incidentals required to complete the facility ready for operation in accordance with the Specifications.

END OF SECTION 33 3211