

SECTION 333213 – PREPACKAGED WASTEWATER PUMP STATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Divisions 1 through 48 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. This section includes the furnishing and installation of factory built duplex raw wastewater pump station systems and wet wells as shown on the plan drawings and as described in this section.
- B. All material, equipment, products, incidentals, and testing required and necessary to provide a complete and operational system. Install where noted on the drawings and as specified within these specifications.
- C. Coordinate all work with this equipment and any other associated equipment, installed and specified under other sections of these specifications.
- D. All work performed under this section shall be in accordance with all approved trade practices and Manufacturer's recommendations.
- E. All work performed under this section shall be in accordance with all approved trade practices and Manufacturer's recommendations.

1.3 SUBMITTALS

- A. The Contractor shall submit manufacturer's technical data and application instruction in accordance with the General and Supplementary Conditions and Division 1 Specifications and any additional information listed herein.
- B. Product Data: Submit Manufacturer's technical data and application instructions.
- C. Shop drawings shall be presented to the Engineer for approval. Electronic submittal information is acceptable. All shop drawings shall clearly identify the specific equipment and material being supplied, the quantity being supplied, and all accessories, dimensions, descriptions, mounting and connection details, and any other information necessary to determine compliance with the plans and specifications. Shop drawings shall include plan and section layouts of the equipment, dimensions, clearances required, power requirements, and wiring diagrams.
- D. Sizes shown on Contract Drawings are typical. Individual Manufacturer's dimensions shall be as shown on the Contract Drawings. Any deviation from given dimensions may interfere with site characteristics. Manufacturer shall be responsible for providing

Engineer with drawings showing proposed changes and/or equipment locations. Any additional engineering costs associated with these changes will be the sole responsibility of the Manufacturer with no additional cost to the Owner.

- E. Prior to or with the delivery of equipment, the Manufacturer shall provide copies of an operation and maintenance manual including storage, installation, startup, operating and maintenance instructions, and a complete parts list and recommended spare parts list. The O&M Manuals shall be in compliance with the General Requirements.
- F. O&M Manuals: Provide three (3) bound paper copies and one (1) digital electronic copy of operating and maintenance manuals containing copies of the approved shop drawings, operating and greasing instructions, and parts list.
- G. Operation Data: Provide description of system operation, adjusting and testing required.
- H. Maintenance Data: Provide system maintenance requirements, servicing cycles, lubrication requirements, and local sources for spare parts.

1.4 RESPONSIBILITY AND COORDINATION

- A. Under this Contract, the Contractor shall be responsible for the purchase, storage, and installation of all equipment required providing a complete operating facility. The Drawings and Specifications are intended to illustrate and define the equipment installation; however, the Contractor shall properly install, adjust, and place in operation the complete installation. The Contractor shall assume full responsibility for additional costs which may result from unauthorized deviations from the Specifications.
- B. The mechanical portion of the pump station including pumps, valves, and controls, shall be provided as a package. The concrete wetwell is **not** required to be part of the package and may be supplied separately by the General Contractor.

1.5 WARRANTY

- A. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.
 - 1. In addition to defects in material and workmanship, fiberglass reinforced polyester station enclosures (where applicable) are warranted for sixty (60) months to be resistant to rust, corrosion, corrosive soils, effects of airborne contamination or physical failures occurring in normal service for the period of the pump station warranty.
 - 2. All other equipment, apparatus, and parts furnished shall be warranted for sixty (60) months, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O rings, etc. The pump station manufacturer shall be solely responsible for warranty of the station and all components.

- B. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.
 - 1. Pump Performance Certifications
 - a. Solids Management System designed for management of sanitary wipes, plastic bags, feathers, hair, sludge, and all other types of stringy solids.
 - b. Solids Handling Capability
 - 1) All internal passages, impeller vanes, and recirculation ports shall pass a 3" spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.
- C. It is not intended that the station manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design or delays in delivery are also beyond the manufacturer's scope of liability.
- D. Equipment supplied by others and incorporated into a pump station or enclosure is not covered by this limited warranty. Any warranty applicable to equipment selected or supplied by others will be limited solely to the warranty, if any, provided by the manufacturer of the equipment.
- E. This limited warranty shall be valid only when installation is made and use and maintenance is performed in accordance with manufacturer recommendations. A start-up report completed by an authorized manufacturer's representative must be received by manufacturer within thirty (30) days of the initial date the unit is placed into service. The warranty shall become effective on the date of acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment from the factory, whichever occurs first.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Five (5) years demonstrated experience in providing packaged pump stations.
- B. The pumps and pump station manufacturer must be ISO 9001:2008 certified, with scope of registration including design control and service after sales activities.
- C. All equipment and materials shall be new and of the best quality.
- D. The term "pump manufacturer" or "pump station manufacturer" shall be defined as the entity which designs, machines, assembles, hydraulically tests, and warranties the final product. Any entity that does not meet this definition will not be considered a "pump manufacturer" or "pump station manufacturer" and is not an acceptable supplier. For quality control reasons and future pump and parts availability, all major castings of the pump shall be sourced and machined in North America.

- E. Upon request from the engineer, the pump station manufacturer shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.
- F. Manufacturer must show proof of original product design and testing. Products violating intellectual property regulations shall not be allowed, as they may violate international law and expose the user or engineer to unintended liabilities. "Reverse-engineered" products fabricated to substantially duplicate the design of original product shall not be allowed, as they may contain substantial differences in tolerances and material applications addressed in the original design, which may contribute to product failure.
- G. Contractor Qualifications. Contractor shall have experience installing prepackaged wastewater pump stations on at least ten (10) projects.

PART 2 - PRODUCTS

2.1 PRE-PACKAGED PUMP STATIONS

A. Station Enclosure

1. Contractor shall furnish and install factory built above ground valve vaults. The station enclosure shall contain and enclose all valves and associated controls and shall be constructed to enhance serviceability by incorporating the following design characteristics:
 - a. Both sides of the enclosure shall open.
 - b. Panels shall be sized and placed to permit routine maintenance operations through the openings of the enclosure. For these purposes, routine maintenance shall include frequently performed adjustments and inspections of the electrical components, controls and valves.
 - c. The access panels shall be protected by a keyed lock.
 - d. At least one enclosure side shall contain a screened vent or fan to maximize air flow for enclosure ventilations.
 - e. Station enclosure, less base, must be removable or able to be disassembled following the removal of reusable hardware.
2. Ventilation capacity shall be sufficient to change station air a minimum of once every two minutes. Ventilation shall be thermostatically controlled. Motor and control circuit shall be protected by a thermal magnetic air circuit breaker to provide overcurrent and overload protection. Exhaust outlet shall be designed to prevent the entrance of rain, snow, rocks, and foreign material.

B. Station Base

1. Station base shall be constructed of manufacturer's standard materials. The enclosure base shall be positioned at the wet well top. The wetwell top shall incorporate a duplex access lid, sized for the installation and removal of the specified pumps, and shall be of sufficient size to permit access to the wet well. Color used shall deemphasize the presence of dirt, grease, etc., and shall be provided with a nonskid surface.

2. The station base shall incorporate the wet well access hatch, wet well vent and the cable transition plate.
3. The station base shall be furnished with elastomeric compression sealing devices for all piping penetrations to provide for a vapor tight transition between the wet well and lift station enclosure.
4. Station Heater
 - a. Electric radiant heat shall be mounted in the enclosure for freeze protection. The heater shall be thermostatically controlled and shall energize automatically based on field adjustable set points. The electric heater control circuit shall incorporate a thermal-magnetic circuit breaker providing overcurrent and overload protection. Ungrounded heaters shall not be acceptable.
5. Insulation Package
 - a. The pump station shall be fully insulated to an R value of 14.
6. Discharge Gauge Kit
 - a. The pump station shall be equipped with a glycerin-filled pressure gauge to monitor discharge pressures. Gauge shall be a minimum of 4 inches in diameter and shall be graduated in feet water column. Rated accuracy shall be 1 percent of full-scale reading. Pressure gauge shall be graduated 0 to 140 feet water column minimum. Gauge kit shall be mounted and complete with all hoses and fittings and shall include a shutoff valve installed in each connection to discharge piping and a three-way valve to monitor either pump.

2.2 SUBMERSIBLE GRINDER PUMPS (South, South Main, Middle and North Lift Stations)

A. Pump Description

1. Pumps shall be submersible grinder type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Pump shall be capable of reducing all components in normal domestic sewage including “foreign objects” such as sanitary napkins, wood, plastic, glass, wipes, rubber and disposable diapers to finely divided particles which will pass freely through the passages of the pump and discharge piping. The temperature limitation of the liquid being pumped is 160 °F (71°C) intermittent and shall be capable of running dry for extended periods of time.
2. Materials and Construction Features
 - a. Pump casing shall be ASTM A48 cast iron Class 30 components.
 - b. The pumps shall have a seal leak detection sensor that signals an alarm in the control panel.
 - c. Submersible pumps shall be rated to operate in a Class 1, Division 1, Groups C and D hazardous location.

B. Grinder

1. The grinder shall be placed immediately below the pumping elements and shall be direct driven by a single, one-piece motor shaft. The grinder impeller assembly shall be securely fastened to the pump motor shaft by means of a threaded connection attaching the grinder impeller to the motor shaft. Attachment by means of pins or keys will not be acceptable. The grinder shall be a one-piece stainless steel, forged cutter wheel of the rotating type with inductively hardened cutter teeth (Rockwell 56-60) for abrasion resistance. A stationary quench hardened and ground shredding ring shall be provided. The shredding ring will have a staggered tooth pattern with only one edge engaged at a time, maximizing the cutting torque.
2. This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed to minimize clogging and jamming under all normal operating conditions including starting. Sufficient vortex action shall be created to scour the tank free of deposits or sludge banks which would impair the operation of the pump.

C. Performance and Pump Schedule

1. In order to ensure proper operation in all conditions, pump(s) must operate without overheating in continuous operation, maximum head condition required by the system. Pump(s) must also be capable of operating at zero or negative heads without damage to the pump(s).
2. Pump Schedule: Refer to the plan drawings for a complete pump schedule.
3. The pump(s) shall be capable of operating at negative total dynamic head without overloading the motor(s). Under no conditions shall in-line piping or valve be allowed to create a false apparent head.

D. Construction

1. The volute, seal plates and motor housing shall be constructed of high-quality ASTM A-48 class 30 cast iron. The pump(s) shall be painted with air dry enamel of 2 mil minimum thickness. All exposed hardware shall be 300 series stainless steel. Discharge connection shall be a standard 1.25-inch NPT in the vertical position using a threaded bolt on discharge flange.
2. The pump impeller shall be of the recessed, vortex design.
3. The pump shall be a three-bearing design consisting of an upper ball bearing, an intermediate ball bearing restrained for the purpose of carrying the thrust loads, and an oil lubricated lower bronze sleeve bearing to carry radial loads and prevent shaft deflection imposed by the pump impeller and grinder operation. The oil lubricated sleeve bearing shall be located between two mechanical seals. Lip type seals are not acceptable. Designs reducing the number of bearings or substituting sleeve bearings for ball bearings will not be considered equal. Bearings shall have a 50,000-hour B-10 life.

E. Mechanical Seal

1. The pump shall utilize a tandem mechanical shaft seal arrangement and shall operate in an oil atmosphere. Each seal shall be double floating, self-aligning rotary shaft seals to prevent leakage between the motor and pump. The materials of construction shall be silicon carbide. The seal shall be commercially available and not a proprietary design of the manufacturer.

F. Moisture Detection

1. The seal chamber shall include a moisture-sensing probe with leads for connecting to a relay in the control panel. The relay will warn of an impending seal failure without the need of visual inspection of the pump.

2.3 SUBMERSIBLE (CHOPPER) PUMPS (Winchester Lift Station)

A. Pump Description

1. The pump and motor assembly shall be designed for continuous submerged operation at the bottom of the wet well and to be easily removable from the top surface of the wetwell without any human entrance into the wetwell being required. The unit will be designed to connect with the wetwell discharge piping by sliding down two stainless steel rails mounted inside the wetwell. Pumps and motors furnished shall be complete with all necessary components to provide a functional and long-lasting dependable system.
2. Pumps shall be an explosion proof, solids handling, chopper type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Pump shall be capable of solids handling to reduce solid sizes to pass solids in the waste stream greater than 3” in size. The temperature limitation of the liquid being pumped is 160 °F (71°C) intermittent and shall be capable of running dry for extended periods of time.
3. Materials and Construction Features
 - a. Pump casing shall be ASTM A48 cast iron Class 30 components.
 - b. The pumps shall have a seal leak detection sensor that signals an alarm in the control panel.
 - c. Submersible pumps shall be rated to operate in a Class 1, Division 1, Groups C and D hazardous location.

B. Chopper Mechanism

1. The radial cutter, slicing blade and striker blade shall be made of 440C Stainless Steel. The slicing mechanism shall be designed to reduce solid size small enough to prevent clogging of the pump.
2. This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The chopper shall be constructed to minimize clogging and jamming under all normal operating conditions including starting. Sufficient vortex action shall be created to scour the tank free of deposits or sludge banks which would impair the operation of the pump.

C. Performance and Pump Schedule

1. To ensure proper operation in all conditions, pump(s) must operate without overheating in continuous operation, maximum head condition required by the system. Pump(s) must also be capable of operating at zero or negative heads without damage to the pump(s).
2. Pump Schedule: Refer to the plan drawings for a complete pump schedule.
3. The pump(s) shall be capable of operating at negative total dynamic head without overloading the motor(s). Under no conditions shall in-line piping or valve be allowed to create a false apparent head.

D. Construction

1. The volute, seal plates and motor housing shall be constructed of high-quality ASTM A-48 class 30 cast iron. The pump(s) shall be painted with air dry enamel of 2 mil minimum thickness. All exposed hardware shall be 300 series stainless steel.
2. The pump impeller shall be of the dual vane design to reduce clogging and constructed of ASTM A-48 Ductile Iron to protect from corrosion and breakage. Impeller shall be dynamically balanced to ISO G6.3 tolerances.
3. Shaft: The pump shaft shall be pickled, turned, ground and polished stainless steel 416 steel designed to carry maximum torque.
4. Shaft Keys: shall be constructed of #416 stainless steel.

E. Mechanical Seal

1. The pump shall utilize a tandem carbon / ceramic vs. silicon / carbide seals with oil filled seal chamber. The seal shall be commercially available and not a proprietary design of the manufacturer.

F. Power/Sensor Cord:

1. AWG rated submersible pump cable sized accordingly to the motor supplied and the National Electric Code, not allowing a voltage drop of more than 5% from the panel to the motor. The power cord shall include power and sensor wires and have a water-tight, quick disconnect, type 4X, water and gas tight design, plug-and-play cord end to simplify installation and maintenance operations.

G. Moisture Detection

1. The seal chamber shall include a moisture-sensing probe with leads for connecting to a relay in the control panel. The relay will warn of an impending seal failure without the need of visual inspection of the pump.

2.4 ELECTRIC MOTORS

A. Single Phase Motors

1. Single phase motors shall be of the capacitor start, capacitor run, NEMA L design. The motor shall be designed to be non-overloading throughout the entire pump curve. The motor shall be constructed with the open windings operating in a sealed housing, which contains clean dielectric oil for heat dissipation from the windings and for lubrication of the bearings, making it capable of operating in a totally, partially, or non-submerged condition for extended periods of time without damage due to heat being generated. Oil used must be able to be disposed of as non-hazardous waste. Air-filled motors shall not be acceptable.
2. Protection against excessive temperature shall be provided by heat sensor.
3. The pumps shall be equipped with a watertight strain relief cord grip with a grommet that protects the outer cord jacket. An epoxy filled cord jacket will provide anti-wicking moisture protection.

B. Three Phase Motors

1. Three phase motors shall be of the dual-voltage 240/480, NEMA B design.
2. The motor shall be three-phase, dry squirrel-cage induction type in design conforming to IEC / VDE / EN standards. The motor shall be adequately sized and rated for continuous operation to maximum a fluid temperature of 104 °F (40 °C).
3. The motor housing shall be both air filled and watertight. Motor protection shall be at minimum IP 68.
4. Allowable maximum submergence shall be not more than 25 m.
5. The motor shall be rated for supply voltage of 460 V and frequency of 60 Hz and accept voltage fluctuations as per range B of DIN EN 60 034-1 (Supply voltage +/- 10 % supply frequency -5% /+3 %).
6. Motors rated higher than 7.5 kW shall be designed for a maximum of 30 starts per hour. Starting of the motor shall be full-voltage type.
7. The motor stator shall be wound to have an overall motor rating of 180°C, Class H. The rotor bars and short circuit rings shall be made of cast aluminum. The motor and pump set complete shall be designed and manufactured by the same company.

2.5 AUTOMATIC DISCHARGE CONNECTION

- A. Each pump shall be furnished with a submersible discharge connection system to permit removal and installation of the pump without the necessity of an operator entering the wet well. The design must insure an automatic and firm connection of the pump to the discharge piping when lowered into place.
- B. A gray iron or fabricated steel base plate with integral guide rail pilots shall be provided along with all hardware and anchor bolts required for permanent installation to the wet well floor. The base plate shall be designed with an integral 90⁰ elbow or adapt to a commercially available elbow for connection to the vertical discharge piping utilizing standard ANSI 125 lbs. flanges. The base plate shall be coated with an epoxy coating for corrosion resistance. The manufacturer shall provide all necessary drawings to insure proper installation and alignment of baseplate within the sump.
- C. Each pump shall be provided with a replaceable ductile iron slide rail guide shoe attached to pump discharge flange. A replaceable neoprene seal shall be provided as an integral part of the guide shoe to form a seal with the base plate connection and eliminate the possibility of leakage and erosive wear during operation. The seal shall contact mating faces in a static position and shall have adequate flexibility to flex under pumping pressure to increase seal efficiency. Metal-to-metal contact at the discharge connection shall not be acceptable.
- D. The contractor shall provide two lengths of 2", schedule 40 stainless steel guide rail pipe for each pump.
- E. Upper guide rail pilots, and a lifting cable shall be furnished for each pump. Bottom pilots shall be an integral part of the baseplate for ease of installation and proper alignment.
- F. The guide shoe shall direct the pump down two vertical guide rails and onto the discharge connection in a simple lineal movement. The buildup of sludge and grease on guide rails

shall not present problems during the lifting operation. The guide shoe shall be designed with integral hooks at the top to transmit full weight of the pump to the base plate flange. No portion of the pump shall be supported directly on the bottom of the wet well, guide rails, or lifting cable.

- G. Lifting cable shall consist of a stainless-steel braided wire cable attached to the pump lifting bail. A crimped ball end shall be provided at the upper end of this cable for attaching to the wet well access frame.
- H. All bolts, machine screws, nuts, washers, and lock washers for complete assembly of access cover, guide rails, and discharge elbow shall be stainless steel.

2.6 WET WELL ACCESS

- A. The wet well access shall be fabricated from welded aluminum sections. A hinged aluminum door shall be provided for each pump. The hinged door shall be fabricated from 1/4" thick aluminum with non-skid diamond tread on upper surface. All hardware on access assembly shall be stainless steel with a flush upper surface without protrusions. For safety, the door shall have a 300 lbs./sq.ft. rating and be fitted with a recessed staple for padlock. Door shall be furnished with a flush aluminum drop handle and automatic hold open arm.
- B. A fall protection safety grate shall be provided. An aluminum grate provided and installed allowing access to pump cables, lifting cables and guide rail brackets without removal. The grate is latchable in the open position, includes 316 SST hardware and is load rated consistent with the access cover.

2.7 VALVES AND PIPING

- A. Piping components to include the following:
 1. Suction elbows (90-degree standard radius) supplied for each pump.
 2. Discharge check valves for each pump, with clean out ports.
 - a. Lever & weight swing check valves with flanged connections, AWWA C508 with ductile iron ASTM A536 body and epoxy coated for wastewater service.
 3. Three-way discharge plug valves with manual lever operator as required.
 4. Common header piping.
 5. Automatic Air Release Valves (AARV), one (1) for each pump with stainless steel fittings.
 - a. Air release / vacuum valve with a cast iron body, stainless steel trim and threaded 2" NPT connections with Buna-N seat, rated for 150 PSI and includes a backflush kit with drain hose to wet well.
 6. Isolation ball valves (1" SST) supplied for each AARV.
 7. Pump drain kits with valves for each pump.
 8. Drain hose supplied (10 ft.) with mating camlock fitting, one for each station.
 9. Gauge kit:
 - a. A gauge kit shall be supplied for each pump. Suction pressure must be monitored by a glycerin-filled compound gauge, and discharge pressure by a glycerin-filled pressure gauge. Gauges to be at least 4 inches in diameter, graduated in feet water column. Rated accuracy shall be 1% of full-scale

- reading. Compound gauge shall be graduated -34 to +34 feet water column minimum. Pressure gauge to be graduated 0 to 140 feet water column minimum.
- b. Gauges to be factory mounted on a resilient panel with frame assembly secured to pumps or piping. Gauge installations shall be complete with all hoses and stainless-steel fittings, including a shutoff valve for each gauge line at the point of connection to suction and discharge pipes.
10. Discharge Bypass Piping
- a. The station header pipe shall incorporate a 2-way plug valve to permit emergency access to the pump station force main after isolation of the pumps. The plug valve shall be non-lubricated, tapered type. Valve body shall be cast iron with flanged end connections drilled to 125-pound standard. Valve shall be furnished with a drip-tight shutoff plug mounted in stainless steel or teflon over phenolic bearings and shall have a resilient facing bonded to the sealing surface.
 - b. The header pipe shall penetrate the station side wall and terminate with a male OPW type quick connect fitting.
11. Suction Bypass Piping
- a. The station shall incorporate piping to permit emergency access to the pump station wet well.
 - b. The pipe shall penetrate the station side wall and terminate with a male OPW type quick connect fitting.
12. Alarm Light
- a. Station manufacturer will supply one 115-volt AC, LED alarm light fixture with vapor-tight red globe, guard, conduit box, and mounting base. The design must prevent rainwater from collecting in the gasketed area of the fixture, between the base and globe. The alarm light will be shipped loose for installation by the contractor.
13. Alarm Flasher
- a. The alarm light circuit shall be equipped with a repeat cycle timer causing the alarm light to flash. Flash rate shall be approximately 1 second. (1/2 second on and off).

2.8 ELECTRICAL CONTROL COMPONENTS

- A. The pump station control panel will be tested as an integral unit by the pump station manufacturer. The control panel shall also be tested with the pump station as a complete working system at the pump station manufacturer's facility.
- B. Panel Enclosure
 - 1. Electrical control equipment shall be mounted within a common NEMA 1 stainless steel, dead front type control enclosures. Doors shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on removable steel back panels secured to enclosure with collar studs.
 - 2. All control devices and instruments shall be secured to the sub-plate with machine screws and lock washers. Mounting holes shall be drilled and tapped; self-tapping

screws shall not be used to mount and component. All control devices shall be clearly labeled to indicate function.

3. A main terminal block and ground bar shall be furnished for field connection of the electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the pump station loads. The main terminal block shall be mounted to allow incoming wire bending space in accordance with Article 373 of the National Electrical Code (NEC).

C. Control Panel UL Label Requirement

1. Pump station controls shall conform to third party safety certification. The panel shall bear a serialized UL label listed for "Enclosed Industrial Control Panels". The enclosure, and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures.

D. Station Enclosure Low Temperature Alarm:

1. Pump station shall be supplied with a thermostat which shall monitor interior station temperature. The control shall incorporate an unpowered dry contact wired to terminal blocks for field connection to a remote alarm device. The contact will close in the event that the temperature within the enclosure falls below approximately 35 degrees F.

E. Motor Branch Components

1. All motor branch and power circuit components shall be of highest industrial quality. The short circuit current rating of all power circuit devices shall be a tested combination or evaluated per the National Electrical Code Article 409. The lowest rated power circuit component shall be the overall control panel short circuit rating and shall not be less than the fault current available. The minimum control panel rating shall not be less than 10 kA, rms symmetrical. Control assemblies operating at 120 volts nominal or less may be provided with transformers which limit the fault current and may be rated less than the minimum required short circuit rating.
2. Circuit Breakers and Operating Mechanisms
 - a. A properly sized heavy duty circuit breaker shall be furnished for each pump motor. The circuit breakers must be sealed by the manufacturer after calibration to prevent tampering.
 - b. An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

3. Motor Starters
 - a. An open frame, across-the-line, NEMA rated magnetic starter with under-voltage release, and overload protection on all three phases, shall be furnished for each pump motor. Starters of NEMA size 1 and above shall allow addition of at least two auxiliary contacts. Starters rated "O", "OO", or fractional size are not acceptable. Power contacts to be double-break type made of cadmium oxide silver. Coils to be epoxy molded for protection from moisture and corrosive atmospheres. Contacts and coils shall be easily replaceable without removing the starter from its mounted position. Each starter shall have a metal mounting plate for durability.

4. Overload Relays
 - a. Overload relays shall be solid-state block type, having visual trip indication with trip-free operation. Electrically resetting the overload will cause one (1) normally open and one (1) normally closed isolated alarm/control contact to reset, thus re-establishing a control circuit. Trip setting shall be governed by solid-state circuitry and adjustable current setting. Trip classes shall be 10, 15 and 20. Additional features to include phase loss protection, selectable jam/stall protection and selectable ground fault protection.
 - b. A reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the door.

5. Three Phase Monitor
 - a. The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, voltage unbalance, high voltage, and low voltage. An adjustable time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart, following an adjustable time delay, when power conditions return to normal.

6. Transient Voltage Surge Suppressor
 - a. The control panel shall be equipped with a modular surge arrester to minimize damage to the pump motors and control from transient voltage surges. The suppressor shall utilize thermally protected by heavy duty zinc-oxide varistors encapsulated in a non-conductive housing. Mechanical indicators shall be provided on each phase to indicate protection has been lost. The suppressor shall have a short circuit current rating of 200,000 Amps and a Maximum Discharge current rating [I_{max}] of 40,000 Amperes. Nominal discharge current [I_n] is 20,000 Amperes. Surge arrester according to UL 1449 3rd Edition, Type 2 component assembly.

7. Voltage Alert Indication
 - a. The control panel shall include a voltage alert indicator to reduce the risk of electrical arc flash by pre-verifying the electrical isolation from outside of the control panel. Hardwired to the main incoming point of termination, the indicator shall be powered by the same voltage that it indicates utilizing redundant circuitry, thereby flashing whenever voltage is present. An eight detector display shall visually alert the presence of dangerous AC or DC potentials occurring between any combination of the monitored input lines.
8. Pump Start Delay
 - a. The control circuit for pump #2 shall be equipped with a time delay to prevent simultaneous motor starts.
9. Panel Heater
 - a. The control panel shall be equipped with a panel heater to minimize the effects of humidity and condensation. The heater shall include a thermostat.
10. Fault/Status monitoring signals wired to terminal blocks and includes:
 - a. High Water Alarm (Primary Level Control)
 - b. Low Water Alarm (Primary Level Control)
 - c. Pump Fault No. 1
 - d. Pump Fault No. 2
 - e. Pump Run No. 1
 - f. Pump Run No. 2
 - g. Low Station Enclosure Temperature
 - h. Three Phase Voltage Monitor Fault
 - i. Backup Float Switch Control System Activated
 - j. Wet Well Level Sensed by Analog Signal
 - k. Flow Meter Reading (analog) as applicable
 - l. Low Temperature Fault (Remote Hot Box)

F. Control Circuit

1. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.
2. Pump mode selector switches shall permit manual start or stop of each pump individually or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the motor overload relays. Selector switches to be oil-tight design with contacts rated NEMA A300 minimum.
3. Pump alternation shall be integral to the liquid level controller. Provisions for automatic alternation or manual selection shall also be integral to the liquid level controller.
4. Six-digit elapsed time meter shall be displayed on the operator interface to indicate total running time of each pump in "hours" and "tenths of hours". Pump runtime shall be adjustable, and password protected.

5. A high pump temperature protection circuit shall override the level control and shut down the pump motor(s) when required to protect the pump from excessive temperature. A thermostat shall be mounted on each pump casing. If casing temperature rises to a level sufficient to cause damage, the thermostat causes the Integrinex™ Standard to interrupt power to the motor. The Integrinex™ Standard will display an alarm banner indicating the motor stopped due to high pump temperature. The motor shall remain locked out until the pump has cooled and circuit has been manually reset. Automatic reset of this circuit is not acceptable.
6. The lift station shall be equipped with a 5 KVA step-down transformer to supply 115-volt, AC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer to be protected by a thermal magnetic circuit breaker, sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door and a padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.
7. Two spare 20 amp circuit breakers shall be supplied.
8. Pump Start Delay
 - a. The control circuit for pump #2 shall be equipped with a time delay to prevent simultaneous motor starts.
9. Panel Heater
 - a. The control panel shall be equipped with a panel heater to minimize the effects of humidity and condensation. The heater shall include a thermostat.
10. Wiring
 - a. The pump station, as furnished by the manufacturer, shall be completely wired, except for power feed lines to the branch circuit breakers and final connections to remote alarm devices.
 - b. All wiring, workmanship, and schematic wiring diagrams shall comply with applicable standards and specifications of the National Electric Code (NEC).
 - c. All user serviceable wiring shall be type MTW or THW, 600 volts, color coded as follows:
 - 1) Line and Load Circuits, AC or DC power.....Black
 - 2) AC Control Circuit Less Than Line Voltage.....Red
 - 3) DC Control Circuit.....Blue
 - 4) Interlock Control Circuit, from External Source.....Yellow
 - 5) Equipment Grounding Conductor.....Green
 - 6) Current Carrying Ground.....White
 - 7) Hot with Circuit Breaker Open.....Orange
11. Control circuit wiring inside the panel, with exception of internal wiring of individual components, shall be 16-gauge minimum, type MTW or THW, 600 volts. Power wiring to be 14-gauge minimum. Motor branch wiring shall be 10-gauge minimum.
12. Motor branch and other power conductors shall not be loaded above the temperature rating of the connected termination. Wires must be clearly numbered at each end in conformance with applicable standards. All wire connectors in the

control panel shall be ring tongue type with nylon insulated shanks. All wires on the sub-plate shall be bundled and tied. All wires extending from components mounted on door shall terminate at a terminal block mounted on the back panel. All wiring outside the panel shall be routed through conduit.

13. Control wires connected to door mounted components must be tied and bundled in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall allow the door to swing full open without undue stress or abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices.
14. Conduit
 - a. Factory installed conduit shall conform to following requirements:
 - 1) All conduit and fittings to be UL listed.
 - 2) Liquid tight flexible metal conduit to be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.
 - 3) Conduit to be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
 - 4) Conduit shall be sized according to the National Electric Code.
15. Grounding
 - a. Station manufacturer shall ground all electrical equipment inside the pump station to the control panel back plate. All paint must be removed from the grounding mounting surface before making final connection.
 - b. The contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electric Code (NEC).
16. Equipment Marking
 - a. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:
 - 1) Equipment serial number
 - 2) Control panel short circuit rating
 - 3) Supply voltage, phase and frequency
 - 4) Current rating of the minimum main conductor
 - 5) Electrical wiring diagram number
 - 6) Motor horsepower and full load current
 - 7) Motor overload heater element
 - 8) Motor circuit breaker trip current rating
 - 9) Name and location of equipment manufacturer
 - b. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.
 - c. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

2.9 LIQUID LEVEL CONTROL

- A. The manufacturer of the liquid level control system must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
- B. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.
- C. The level control system shall be capable of operating as either an air bubbler type level control system, submersible transducer type system, or ultrasonic transmitter type system.
- D. The level control system shall utilize alternation to select first one pump, then the second pump, then the third pump (if required), to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle, or in the event of excessive run time.
- E. The level control system shall utilize an electronic pressure switch which shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the electronic pressure switch shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the electronic pressure switch shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the electronic pressure switch shall start the second and/or third pump (if required) when the liquid reaches the "lag pump start level", or "standby pump start level" so that all pumps are operating. These levels shall be adjustable as described below.
 - 1. The electronic pressure switch shall include integral components to perform all pressure sensing, signal conditioning, EMI and RFI suppression, DC power supply and 120 volt outputs. Comparators shall be solid state, and shall be integrated with other components to perform as described below.
 - 2. The electronic pressure switch shall be capable of operating on a supply voltage of 12-24Vdc in an ambient temperature range of -10 degrees C (14 degrees F) through 55 degrees C (131 degrees F). Ingress Protection of IP56 for indoor use with closed cell neoprene blend gasket material. Evaluated by Underwriters Laboratories for Pollution Degree 2 device for U.L. and cU.L. Control range shall be 0 to 33.3 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water. Memory shall be non-volatile. A Battery backed real time clock shall be standard.
 - 3. Eleven optically isolated, user defined digital inputs for pump and alarm status. Rated at 10mA at 24Vdc. Eight digital output relays (mechanical contacts), configurable for pump start/stop or alarms. Three relays rated at 12 Amp @ 28Vdc and 120Vac, five relays rated at 3 Amp @ 30Vdc and 120Vac. The electronic pressure switch shall consist of the following integral components: pressure sensor, display, electronic comparators, digital inputs and digital output relays.
 - a. The internal pressure sensor shall be a strain gauge transducer and shall receive an input pressure from the air bubbler system. The transducer shall convert the

- input to a proportional electrical signal for distribution to the display and electronic comparators. The transducer output shall be filtered to prevent control response to level pulsations or surges. The transducer range shall be 0-14.5 PSI, temperature compensated from -40 degrees C (-40 degrees F) through 85 degrees C (185 degrees F), with a repeat accuracy of (plus/minus) 2.5% full scale about a fixed temperature. Transducer overpressure rating shall be 3 times full scale.
- b. The electronic pressure switch shall incorporate a digital back lighted LCD panel display which, upon operator selection, shall indicate liquid level in the wet well, and pump status indication for up to 3 pumps. The display shall include a 128 x 64 bit resolution LCD to read out directly in feet of water, accurate to within one-tenth foot (0.1 foot), with a full scale indication of not less than 12 feet. The display shall be easily convertible to indicate English or metric units.
 - c. Level adjustments shall be electronic comparator set-points to control the levels at which the lead, lag and standby pumps start and stop. Each of the level settings shall be easily adjustable with the use of membrane type switches, and accessible to the operator without opening any cover panel on the electronic pressure switch. Controls shall be provided to permit the operator to read the selected levels on the display. Such adjustments shall not require hard wiring, the use of electronic test equipment, artificial level simulation or introduction of pressure to the electronic pressure switch.
 - d. Each digital input can be programmed as pump run, pump HOA, pump high temp, pump moisture/thermal, starter failure (FVNR, RVSS, VFD), and phase failure. Inputs are used for status and alarm indication.
 - e. Each output relay in the electronic pressure switch shall be hard contact mechanical style. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise. Each output relay shall have an inductive load rating equivalent to one NEMA size 3 contactor. A pilot relay shall be incorporated for loads greater than a size 3 contactor.
4. The electronic pressure switch shall be equipped with alarm banners with time and date history for displaying alarm input notification. Alarm history will retain a 16 of the most recent alarm events.
 5. The electronic pressure switch shall be equipped with pump start/stop and alarm input delay(s) that have an adjustable delay set points.
 6. An Antiseptic function with a built in timer shall be incorporated in the electronic pressure switch to prevent the well from becoming septic.
 7. The electronic pressure switch shall be capable of jumping to next available pump if current pump is out of service due to pump failure or manual selection. Circuit design in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit shall not be acceptable.
 8. The electronic pressure switch shall be equipped with a simulator system capable of performing system cycle testing functions.
 9. The electronic pressure switch shall be capable of calculating and displaying pump elapse run time. The elapse run time is resettable and adjustable.

10. The electronic pressure switch shall have internal capability of providing automatic simplex, duplex, and triplex alternation, manual selection of pump sequence operation, and alternation in the event of 1-24 hours of excessive run time.
11. The electronic pressure switch shall be equipped with a security access code to prevent accidental set-up changes and provide liquid level set-point lock-out. The supervisor access code is adjustable.
12. The electronic pressure switch shall be equipped with one (1) 0-33 ft. W.C. input, one (1) scalable analog input of either 0-5Vdc, or 4-20mA, and one (1) scalable analog output of either 0-5Vdc, 0-10Vdc or 4-20mA. Output is powered by 10-24Vdc supply. Load resistance for 4-20mA output shall be 100-1000 ohms.
13. The electronic pressure switch shall include a DC power supply to convert 120Vac control power to 12 or 24Vdc power. The power supply shall be 500 mA (6W) minimum and be UL listed Class II power limited power supply.
14. The electronic pressure switch shall be equipped with an electronic comparator and mechanical output relay to alert maintenance personnel to a high liquid level in the wet well. An alarm banner, visible on the front of the controller, shall indicate that a high wet well level exists. The alarm signal shall be maintained until the wet well level has been lowered and the circuit has been manually reset. High water alarm shall be furnished with a dry contact wired to terminal blocks.
15. The electronic pressure switch shall be equipped with an electronic comparator and mechanical output relay to alert maintenance personnel to a low liquid level in the wet well. An alarm banner, visible on the front of the controller, shall indicate that a low wet well level exists. The alarm signal shall be maintained until the cause for the low wet well level has been corrected and the circuit has been manually reset. A low liquid level condition shall disable all pump motors. When the wet well rises above the low-level point, all pump motors shall be automatically enabled. Low water alarm shall be furnished with a dry contact wired to terminal blocks.
16. Integrinex Standard Analog Output circuit will be furnished with transient voltage surge suppression to protect related equipment from induced voltage spike from lighting.

F. An alarm silence pushbutton and relay shall be provided to permit maintenance personnel to de-energize the audible alarm device while corrective actions are under way. After silencing the alarm device, manual reset of the alarm condition shall clear the alarm silence relay automatically. The pushbutton shall be a membrane style button integral to the Integrinex Standard level controller.

G. Level Control Systems

1. Radar Level Sensor

- a. The transducer shall be FMCW radar type, emitting W-Band energy. The frequency change is proportional to distance and is converted into filling height. Variations in the filling height are converted into a linear 4-20mA_{dc} signal. Signal processing shall filter out false reflections and other background noises.

- b. Range
 - 1) Up to 15 meters (49.21 feet)
- c. Performance Requirements
 - 1) Accuracy: ± 2 mm
 - 2) Process pressure: -14.5 to 43.5 psig
 - 3) Process temperature: -40 to +176 deg F
 - 4) Ambient temperature: -40 to +176 deg F
 - 5) Sinusoidal Vibrations resistance Class 4M8 according to IEC 60271-3-4
 - 6) Shock resistance 50 g, 2.3 ms; according to EN 60068-2-27
 - 7) Impact resistance IK07 according to IEC 62262
- d. Characteristics
 - 1) Protection rating IP 66/68 (3 bar) NEMA 6P submersible
 - 2) Measuring cycle time ≤ 250 ms
 - 3) Boot strap time ≤ 10 s
 - 4) Step response time < 3 s
 - 5) Beam angle 8 deg
 - 6) Output signal 4-20mA with HART
 - 7) 32-point linearization curve
 - 8) Integrated open channel flow algorithms
 - 9) Flumes – Parshall, Palmer-Bowlus, Venturi
 - 10) Weirs – Trapezoidal, Rectangular, V-Notch
- e. Communications
 - 1) Encrypted Bluetooth communication with PIN and authentication process
- f. Certifications
 - 1) CE approved
 - 2) FCC 15.256 approved
 - 3) CSA certified to Ordinary Location for use in Canada and USA
 - 4) CSA certified Intrinsically Safe to Class I, Division 1, Groups A, B, C, and D; Class II, Division 1 Groups E, F, and G; Class III for use in Canada and USA
 - 5) CSA certified Non-Incendive to Class I, Division 2, Groups A, B, C, and D; Class II, Division 2 Groups F and G for use in Canada and USA
- g. Memory
 - 1) The radar shall include a counter for tracking the number of parameter changes to the sensor.
 - 2) The radar shall track the minimum and maximum distance measured, measurement reliability, measurement rate and electronics temperature.
- h. Diagnosis
 - 1) The radar sensor shall include self-monitoring and diagnostics according to NE 107 and VDI/VDE 2650.
 - 2) Status messages categories shall be failure, function check, out of specification and maintenance requirement.

3) The radar sensor shall be able to perform a function test and produce a test report verifying that the sensor is functioning properly.

i. Mounting

1) The radar sensor shall have mounting options of a straining clamp or a mounting bracket.

j. Maintenance

1) No maintenance required in normal operation.

k. Manufacturer

1) VEGA Americas

2.10 BACKUP LIQUID LEVEL CONTROL

- A. A backup level control system shall be provided to operate the pumps, in the event of a failure of the primary solid state level control system. This backup level control will allow for a redundant pump off switch to turn the pump motors off in the event of a primary level control failure.
- B. The backup level control system shall start and stop pump motors in response to changes in wet well level. It shall be the mercury float switch type, incorporating intrinsically safe relays. Rising and falling liquid level in the wet well causes switches within the floats to open and close, providing start and stop signals to the remainder of the level control system.
- C. The backup level control system shall start and stop the pumps in accordance to the wet well level. The pump start and stop float switches shall be set above and below the normal pump start and stop level settings utilized for the primary level control. Upon operator selection of automatic operation, a float switch shall start one pump motor when water rises to the “pump start level”. When the water is lowered to the “pump stop level”, the system shall stop the pump. These actions shall constitute one pumping cycle.
- D. The backup level control system shall work in conjunction with an alternator relay to select first one pump, then the second pump, to run as “Lead” pump. Alternation will occur at the end of each pumping cycle.
- E. Two (2) float switches shall be supplied for installation by the contractor. Each float shall contain a mercury switch sealed in a polypropylene housing, with 50 feet of power cord, and polypropylene mounting hardware. A stainless-steel chain with weight shall be furnished to secure the switches in the wet well.
- F. Two intrinsically safe relays shall be supplied in a separate level control enclosure. Relays must be recognized and listed as intrinsically safe by a nationally recognized testing laboratory. Installing contractor shall make connections from relays to motor controls.

2.11 FLOW METER

- A. Provide flow meter(s) and display(s) where shown on the project drawings and as specified elsewhere.
 - 1. Meter shall be Sparling Model FM656-06-511-0 or equal.
- B. Display mounted within the packaged station enclosure and strap on transducers mounted in/on final discharge piping as shown on the project drawings.
- C. Flow meter signal to be connected to main pump control panel. Analog output from the pump control panel to the fault monitoring system is by the Electrical Contractor and as shown on project instrumentation and control drawings.

2.12 PUMP STATION CERTIFICATION AFFIDAVIT

- A. A Pump Station Certification Affidavit must be completed in total. Failure to furnish the completed affidavit with bids for alternate, unnamed equipment shall be cause for rejection.
- B. The affidavit is also provided to ensure that the proper pumping system is supplied to the owner.

2.13 FACTORY TESTS

- A. All components of the pump station shall be given an operational test at the pump station Manufacturer's facility to check for excessive vibration or leaks in the piping or seals, and to correct operation of the automatic control and vacuum priming systems and all auxiliary equipment. Installed pumps shall take suction from a deep wet well, simulating actual service conditions. The control panel shall undergo both a dry logic test and a full operational test with all systems operating.
- B. Each pump shall be capable of achieving the operating reprime lift while operating at the selected speed and the selected impeller diameter. Reprime test report(s) shall be prepared and certified by the factory's registered Professional Engineer.
- C. Factory test instrumentation must include flow measuring with indicator; compound suction gauge; Bourdon tube-type discharge pressure gauge; electrical meters to measure amperes, volts, kilowatts and power factor; speed indicator.

2.14 SPARE PARTS

- A. A complete replacement pump shaft seal assembly shall be furnished with each pump station. The spare seal shall be packed in a suitable container and shall include complete installation instructions. An O-ring kit shall also be supplied.
- B. An instructional video presentation on the pump mechanical seal system in DVD format shall be included. The DVD shall contain a presentation on the following subjects: purpose and location of the mechanical seal, signs of a defective mechanical seal, how to remove the mechanical seal, troubleshooting seal failure causes, seal components,

required tools, how to reinstall the seal, and how to place the pump back into service. The video shall include footage of an actual seal replacement.

2.15 INSTALLATION AND OPERATING INSTRUCTIONS

- A. Installation of the pump station shall be done in accordance with the written instructions provided by the Manufacturer.
- B. Operation and maintenance manuals shall be furnished which will include parts lists of components and complete service procedures and troubleshooting guide.

PART 3 - EXECUTION

3.1 MANUFACTURER'S SERVICES

- A. The Manufacturer shall provide the services of a factory-trained representative for a period of not less than one (1) total working day, which shall be broken down into one or two trips as necessary on-site to perform initial startup of the pump station, make final adjustments, supervise initial startup of each pump, and prepare a written test report thereof for the Owner, and to instruct the owner's operating personnel in the operation and maintenance of the equipment.
- B. If there are difficulties in operation of the equipment due to the pump station Manufacturer's fabrication and programming, additional service shall be provided at no extra cost to the Owner.

3.2 HANDLING AND STORAGE

- A. During loading, unloading and storage care shall be exercised to insure that the equipment is not dropped or otherwise damaged through impacting with solid surface. The process equipment shall be stored on a smooth surface, free of sharp objects, and if laid horizontally, shall be placed in such a way to avoid structural damage to the inlet and outlet channels. Slings will be accomplished using nylon or other fabric material. Under no circumstances shall cable or chain slings be used.

3.3 INSTALLATION

- A. Install, level, align, and lubricate pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.
- B. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.
- C. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

3.4 ELECTRICAL

- A. All motor starters, fusible safety switches, selector switches, pushbuttons, indicating lights, and all other pilot devices to form a complete operating electrical system will be supplied according to drawings.
- B. All electrical equipment, conduit and wiring not indicated on the Drawings, but necessary to provide a complete operating system shall be provided in this item at no additional cost to the Owner.
- C. Electrical Wiring: The external conduit and wiring required for power supply and control to electrical equipment supplied in this Section will be furnished according to drawings under Section 26.
- D. Motor size: Any deviation in motor size must be approved by the Engineer. Any electrical equipment or wiring that must change to accommodate a different size motor will be at no additional cost to the Owner.

3.5 FIELD QUALITY CONTROL

- A. Pumps
 1. The pumps provided shall be factory tested at three points to verify the pump performs at the design points and tested in the field at start-up to assure proper performance.

2. Tests shall consist of checking the unit at its rated speed, head, capacity, efficiency, and brake horsepower, and at such other conditions of head and capacity to properly establish the performance curve.
3. The standards of the Hydraulic Institute shall govern the procedures and calculations for these tests.

B. Operational Test

1. Prior to acceptance by owner, an operational test of all pumps, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.
2. After construction debris and foreign material has been removed from the wet well, contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

3.6 OPERATION AND MAINTENANCE MANUALS

- A. Prior or with the delivery of equipment, the Manufacturer shall provide copies of an operation and maintenance manual including storage, installation, start-up, operating and maintenance instructions, and a complete parts list and recommended spare parts list. The O&M Manuals shall be in compliance with the General Requirements.

3.7 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstration and Instruction: The Manufacturer of each piece of equipment shall furnish the services of a qualified representative for a period of not less than one (1) day to inspect and adjust the equipment furnished by the Manufacturer. This qualified representative shall also conduct such tests as necessary to demonstrate satisfactory operation and to instruct the Owner's personnel in the care and operation of the equipment.

3.8 PUMP SCHEDULE – AS SHOWN ON THE PLAN DRAWINGS

END OF SECTION 333213