Item No. 329
Submersible Pumps

Notes to Specifier:

Delete these notes and not used paragraphs.

Where options are given, make appropriate selection and delete the other option, fill in all blanks. Electrical requirements must be reviewed by an electrical engineer.

Manufacturers should review this Section prior to Bid.

Verify all references to paragraphs within this Section and to any applicable Sections, standards or other specified sources of information.

Make appropriate selection when options are given within brackets.

329.1 Description

A. This item shall govern furnishing labor, materials, equipment and incidentals necessary to install ___ new submersible sewage pumps, valves, check valves, vault, pressure gauge assemblies, ___ jib crane with foundation and electric hoist, air release valve, piping, **[trash basket with ___-pound electric hoist (where applicable) and fitting],** access hatches, ventilators and vents as indicated on the plans, and new control panel(s). Coordinate wet well access doors with the slide rails. Test equipment in accordance with Paragraph **[1.02]** of this Section.

B. The pump supplier shall furnish discharge elbows, pump impellers, guiderails, brackets, anchor bolts and anchor bolt layouts and bases, lifting chains and grip eye systems, power cables, and trash basket hoists and stands as indicated on the plans.

C. Provide safety grate at each of the access doors to the wet well at the lift station. Verify actual size of the access doors. Installation of the safety grate shall be in accordance with the manufacturer's recommendations and the manufacturer shall provide an Equipment Installation Report certifying that it was installed properly. The manufacturer shall furnish brackets, anchor bolts and anchor bolt layouts and appurtenances required for the installation of the safety grate.

329.2 Quality Assurance

Note to Specifier: Add or delete manufacturers as necessary. Project Engineer to check references and check with NBU to determine if the listed manufacturers are currently acceptable.

A. Acceptable Manufacturers:

1. Flygt
2. Gorman Rupp.
3. KSB
4. No substitutions are allowed

B. Manufacturer's Representative for Startup and Testing: The services of the Manufacturer's technical representative shall be provided for pre-startup installation checks, startup assistance, training of Owner's operating personnel, troubleshooting and other services.

C. The pump supplier shall also provide all of the maintenance required for the first year of operation including the following as a minimum:

1. After 60 days operation, run each pump and record voltage and amperage, pull each pump, open the volute and examine the condition of the volute, impeller, and wear rings. Check condition of oil in seal chambers and condition of coating system on motor housing. Perform any necessary repair under terms of the warranty. Prepare a field service report.
2. After 12 months operation, repeat procedure described above for 60 days. Change oil in the seal chambers.

D. Testing:

1. Each pump and motor shall be performance tested at the factory. All pumps shall be tested with motor cables to be supplied with the pumps. Three copies of certified test reports, including actual test records, shall be submitted and approved by the Engineer prior to shipment of the equipment.
2. Each pump shall be tested for performance at the factory to determine the head vs. capacity, and motor input power for the full speed at which the pumps are specified and shown on a certified performance test curve as continuous functions throughout the pump's performance range. Tests of models, prototypes or similar units will not be acceptable. All tests shall be run in accordance with the test code for centrifugal pumps of the Standards of Hydraulic Institute, latest edition. The motor and cable on each pump shall be tested for moisture content or insulation defects. After the test, the pump cable end shall be fitted with a shrink-fit rubber boot to protect it from moisture or water.

329.3 Submittals

The submittal requirements of this specification item must include:

A. Shop Drawings:

1. Shop drawings shall include a complete description of the equipment offered including control and mounting system. Shop drawings shall include catalog cuts and pertinent engineering data required to fully evaluate the equipment. Characteristic curves shall be submitted with the shop drawings showing the capacity, head, efficiency, and brake horsepower throughout the full operating range of the pump. Complete specifications on the control equipment including a list of optional features shall be submitted with the shop drawings. Submittal data shall be in such form and so presented that the Engineer may readily review the data.

2. The Equipment Manufacturer shall submit with the shop drawings a list of 20 similar installations in Texas which have been in satisfactory operation for at least two years. Shop drawings not including this required information will not be accepted. Also, manufacturer must furnish evidence of having an authorized fully staffed and stocked service facility within 200-mile radius of the jobsite as well as having 24-hour parts availability.

3. Data sheets supplying the following information for the pumping units shall be submitted with the shop drawings.

   a. Pump:

Make and type of pump	
Speed	___ rpm
Horsepower at rated head	___ HP

   b. Pump:

Total weight (pump and motor)	___ lb.
Rated capacity and head on pump curve	

   c. Motor:

Make and type of motor	
Brake horsepower of motor	___ HP
Locked Rotor Current at full nameplate voltage	___ amps
Motor Voltage Phase	___ phase
Motor service factor	
Insulation class and temperature rise at service factor load	

4. Shop drawings shall be supplied to ensure successful installation and operation of the control system and shall consist of all of the following:

   a. Sufficient detail to evaluate compliance with these specifications.

   b. A detailed component list including manufacturer and catalog number.

   c. A custom wiring diagram for this specific application to facilitate and insure accurate field connections to the control panel by electrical installation personnel.

   d. A description of operation for the control system.

   e. An enclosure dimension print.

B. Operation and Maintenance Manuals:

1. Manuals shall be prepared by the equipment Manufacturer and shall incorporate storage and installation instructions and operation and maintenance procedures, appropriate final certified shop drawings, performance curves, and test data. Manuals may be Manufacturer's standard instructions, but shall be supplemented as necessary to cover any special feature not included in standard material. Submit preliminary manuals for review prior to delivery of the equipment.

C. [List as necessary.]

329.4 Design Conditions

A. The pumps shall be designed to handle raw unscreened sewage on a continuous duty basis and shall be capable of passing a 3-inch non-compressible sphere. Pumps shall be guaranteed free from excessive cavitation and/or vibration throughout the system performance range. The pumps shall meet the operating conditions as specified and shall be designed to operate on a continuous duty basis. Design conditions for the pumps at each lift station shall be as specified. Also see attached system head curves for initial and future conditions.

B. The presence of abrasives, rags, large solids and stringy materials shall not be considered as abnormal, unanticipated or abusive with regard to the equipment operation or warranty.

329.5 Delivery and Storage

A. The Vendor shall be responsible for delivery of the pump, motor, and accessories, f.o.b. to the job site or to such storage site as may be designated by the OWNER or Construction CONTRACTOR, in good condition and undamaged.

B. Unloading and storage of the equipment shall be the responsibility of the Construction CONTRACTOR who shall inspect the equipment for apparent damage. Equipment which is found to be damaged shall not be accepted until properly repaired or replaced by the Vendor.

C. The pumps, motors, and accessories shall be stored indoors. When this equipment is stored indoors, it shall never be in direct sunlight and the indoor temperature shall be maintained at a level satisfactory to the OWNER. The CONTRACTOR is responsible for providing the indoor storage facility or enclosure.

329.6 Warranty

A. Guarantee: The equipment supplier shall furnish a warranty for all equipment provided by the equipment supplier for a period of 2 years from date of Owner's final inspection and acceptance but not longer than 30 months from date of equipment delivery. All equipment shall be guaranteed against defects in material and workmanship to the effect that any defective equipment shall be repaired or replaced without cost or obligation to the Owner.

329.7 Submersible Sewage Pump

A. Each pump, motor, and cable assembly shall be furnished in one integral unit, factory assembled by the Pump Manufacturer. Pump shall be listed as explosion proof by Underwriter Laboratories (U.L.) or by C.S.A.

B. The pump design shall be such that the pumping unit will be automatically and firmly connected to the discharge piping when lowered into place on its mating discharge connection. The discharge connection shall be permanently installed in the wet well. The pump shall be easily removable for inspection or service, requiring no bolts, nuts or other fastenings to be disconnected. The guide mechanism shall be a non-sparking design and U.L. or C.S.A. listed. Connection and disconnection of the pumping unit from the discharge piping shall not require personnel to enter the wet well. Sealing of the pumping unit to the

discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. A sliding guide bracket shall be an integral part of the pump unit.

C. The pump assembly shall also be capable of running dry or partially submerged for extended periods without any damage to the pump, motor, seals, or accessories.

D. Major parts, such as the stator casing, oil casing, sliding bracket, volute, impeller, and base coupling shall be constructed of cast iron or bronze. Surfaces coming into contact with the pumped liquid shall be protected by a factory-applied epoxy coating or shall be stainless steel. External bolts, nuts, and fastening hardware shall be a minimum 300 series stainless steel.

329.8 Pump Construction

A. Pump Volute: The pump volute shall be constructed of cast iron. A wear ring shall be provided in the volute which is constructed of 304 stainless steel with a minimum Brinell hardness of 300. **[For pumps smaller than 40 HP, stainless steel wear plate shall be acceptable in place of wear rings.]**

B. Impeller: The impeller shall be constructed of cast iron, ductile iron or bronze and shall be of the enclosed, non-clogging, dynamically balanced, one-, two- or three-vane design capable of passing 3-inch diameter spherical solids. The impeller shall have a slip fit onto the motor shaft and drive key and shall be fastened using the manufacturer's standard technique. The impeller wear ring shall be 304 stainless steel, with a minimum Brinell hardness of 200. **[For pumps smaller than 40 HP, a two-vane semi-open impeller is acceptable.]**

C. Shaft: The pump shaft shall be series 421 stainless steel. Carbon steel shafts or shafts with sleeves of any type are not acceptable. The shaft shall be one piece construction without joints or stubs attached. All shafts shall be dynamically balanced and shall be amply sized to minimize shaft deflection. Shaft overhang shall not exceed 2.5 times the shaft diameter.

D. Mechanical Seals: Each pump shall be equipped with a double mechanical seal of the cartridge type or a balanced tandem-type design, running in an oil reservoir. The upper and lower faces of the rotating portion of the seal shall be made of tungsten carbide or a high-quality silicon carbide. The two faces shall be held in contact by multiple springs or bellows to ensure uniform face following of the rotating faces against the stationary faces. The entire seal shall be mounted within the oil chamber. The lower stationary seal face shall be made of tungsten carbide or a high-quality silicon carbide. The seals shall require neither routine maintenance, nor adjustment, and shall not be damaged when the pump is run dry. When required, seal oil inspection shall be achieved without disassembly of the pump. The seal shall not require the pumped liquid as a lubricant. All metal parts shall be 316 stainless steel.

E. O-Rings and Fasteners: All mating surfaces of the pump and motor shall be machined and fitted with Viton or Buna-N O-rings where watertight sealing is required. Sealing shall be accomplished by the proper fitting of the parts and not be compression or special torque requirements. All external screws and fasteners shall be made of 316 stainless steel.

F. Bearings: The impeller and motor shaft for each pump shall be suspended on two permanently lubricated ball bearings that are designed by the manufacturer for minimum 50,000-hour AFBMA B10 bearing life under the design conditions.

329.9 Motor and Cable

Note to Specifier: For motors larger than 3/4 HP, use three phase. Verify that 480 V is available.

Note to Specifier: Specifier to determine NEC Class, Division and Group location for each specific project.

A. The motor shall be housed in either an air or oil filled chamber, watertight enclosure. The motor shall conform to NEMA design Class B, and incorporate minimum Class F insulation material to withstand a continuous operating temperature of 155 C (311 F). The pump and motor shall be capable of handling liquids with a maximum temperature of 40 C (104 F). The motor shall be capable of sustaining up to 10 evenly spaced starts per hour. The motor shall be capable of operating in dry or partially submerged conditions for extended periods without damage. If the motor is expected to be exposed for longer than 15 minutes, furnish air filled motors with a water jacket if required. The nameplate motor service factor shall be at least 1.15. The motor shaft shall be 400 series stainless steel. The motors shall be **[460] [240] [120]**-volt, **[1] [3]**-phase, 60-cycle. Lead wires shall be suitable for operation in oil. The motor shall be provided with Klixon motor thermal switches embedded in the windings to protect the motor from burnout due to excessive heating. Inrush on starting shall be no more than allowed by NEC Code Letter F for motors 50 HP and larger, and no more than allowed by NEC Code Letter G for motors less than 50 HP. Each motor shall be suitable for use in a NEC Class 1, Division 1, Group D location and be U.L. or C.S.A. listed.

Note to Specifier: Delete the paragraph below if VFD not used.

B. Motor shall be rated inverter duty for operation on a variable frequency drive and shall comply with NEMA MG-1. The Motor Manufacturer shall provide a letter certifying that the motor is compatible with the variable speed drive.

C. The electrical cable entrance to the motor shall be provided with positive strain relief to prevent leakage or pullout of the cable in the event that a force is accidentally placed on the cable during the raising or lowering of the pump. The design of cable entry shall preclude specific torque requirements to insure a watertight and submersible seal. Cable entry shall consist of a single cylindrical elastomer or Buna-N grommet, flanked by stainless steel washers all having a close tolerance fit against the cable's outside diameter and the entry inside diameter and compressed by the body containing the strain relief function separate from the function of sealing the cable. One spare set of cable seal accessories shall be provided. The entry cable system shall be warranted as described in Paragraph **[1.06]**, Warranty.

Note to Specifier: Select one of the next two paragraphs below and delete the other.

A. Incoming lead wires shall be spliced in the motor terminal housing. After splicing, the terminal housing shall be filled with epoxy to seal the outer cable jacket and the individual strands to prevent possibility of water entering the motor housing or the terminal housing. A secondary elastomer compression grommet shall also be supplied. The combination of the epoxy seal and compression grommet shall provide complete sealing and strain relief.

Sufficient cable shall be supplied to extend from the motors to the pump control without splicing. Each pump shall be equipped with adequate cable to be routed from the **[pump controller] [termination junction box]** to the pump without any splices at a minimum. The power cable shall be sized according to NEC and ICEA standards and also meet P122-MSHA approval and this classification shall be embossed on the cable.

B. Wire leads entering the junction box chamber and motor shall be separated by a terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Alternately, the junction box chamber shall be sealed from the motor with a poured epoxy seal with bared conductor to prevent wicking. The assembly shall provide ease of changing the cable when necessary using the same entry seal. Sufficient cable shall be supplied to extend from the motors to the pump control without splicing. Each pump shall be equipped with adequate cable to be routed from the **[pump controller] [termination junction box]** to the pump without any splices at a minimum. The power cable shall be sized according to NEC and ICEA standards and also meet P122-MSHA approval and this classification shall be embossed on the cable. The cable entry junction chamber shall be isolated from the motor by a terminal board.

C. The junction chamber, containing the terminal board, shall be sealed from the motor by elastomer compression seals (O-ring). Connection between the cable conductors and stator leads shall be made with threaded compressed type binding post permanently affixed to a terminal board each with an individual o-ring to prevent liquid passage.

D. Each unit shall be provided with an adequately designed cooling system. Provision for external cooling and flushing shall also be provided, if the cooling system consists of a water jacket. Each unit shall have motor seal failure sensor(s).

E. The motor, cable, and electrical controls shall be sized, furnished, and installed so that the motor shall never exceed the nameplate rating at any point on the pumping curve.

F. Provide stainless steel cable strain relief on each cable at wet well roof slabs.

329.10 Discharge Elbow and Guiderail Base

A. A discharge elbow and guiderail base shall be provided for each pump and shall be permanently installed in the wet well. Stainless steel anchor bolts embedded in concrete in accordance with pump manufacturer’s layout and recommendations shall secure these connections.

329.11 Guiderail and Lifting Chain

A. The guiderails and lifting chain positive recovery system shall be sized by the pump supplier. Guiderails and lifting chains shall be constructed of stainless steel. Intermediate and upper guiderail brackets shall be provided by the pump supplier to achieve the arrangement shown on the Plans.

B. The slide rails shall be continuous stainless steel designed to resist corrosion in sewage or sludge applications. Any joints in the rails shall be reinforced from within if pipe is used; continuously full-depth welded, ground smooth, and treated to resist corrosion. If pipe is used, it shall be minimum Schedule 40. The rail system shall be of adequate length to extend from the lower guide holders on the pump discharge connection to 6 inches below the top of the wet well. The system shall be mounted with stainless steel hardware.

C. The rail support system shall be furnished by the Pump Manufacturer, to adequately support the guide (slide) rails. Intermediate guide rail supports shall be used every 12 to 15 feet or as recommended by the pump manufacturer. The system shall be mounted with stainless steel hardware.

D. Each pump shall be fitted with a stainless steel chain or cable of adequate strength and length to permit raising and lowering the pump for inspection or removal. The chain or cable shall be long enough to extend from the pump in its operating position to 4 inches above the top of the wet well. Furnish and install a stainless steel hook at the top of the wet well to hold the chain when the pump is in service.

E. Each pump shall be fitted with 3 feet of stainless steel chain of adequate strength to permit raising and lowering of the pump, and an adequate length of 1/4-inch diameter nylon rope or 18-inch stainless steel rope. The pump supplier shall provide a grip eye, which when lowered into position over the nylon rope, will automatically attach to the chain for lifting and automatically release the chain after lowering the pump back into position. The grip eye, pump chain, and associated hardware shall have a minimum capacity of 1-1/2 times the pump weight.

329.12 Sliding Coupling System

A. A sliding guide bracket shall be an integral part of the pumping unit or securely attached thereto. The guide bracket shall be designed such that no strain is placed on the pump or guide rails. The volute casing shall have a machined discharge flange to automatically and firmly connect with the discharge connection, which when bolted to the floor of the sump and discharge line, will receive the pump discharge connecting flange without the need of adjustment, fasteners, clamps or similar devices. Discharge base elbow and base plate shall be supplied by the Pump Manufacturer.

B. The pump sliding coupling system shall be designed so that the downward force of the machined mating flanges shall shear away rags, hair, or other debris that would prevent a uniform watertight seal. No portion of the pump unit shall bear directly on the floor of the wet well. The pump body and slide coupling mating faces shall be bronze against cast iron.

Note to Specifier: Select one of the paragraphs "Crane" or "Hoists" below and delete the one that is not used. Modify to meet project conditions.

329.13 Crane

A. Furnish and install a jib or davit crane in accordance with these specifications and as shown on the plans. The crane capacity shall be a minimum of ___ lb. and shall be a Thern, Inc., Model ___ or approved equal. The crane should be capable of lifting the largest pump provided with a factor of safety as recommended by the crane manufacturer. It shall include a mounting base and stainless steel wire rope assemblies with rope length sufficient to reach bottom of wet well.

B. The boom shall be capable of rotating 240 degrees under load. Boom shall telescope to three different lengths and the boom shall have an adjustable angle. Adjustment shall be between horizontal and 45° with the load chain.

C. Operation of the crane shall be manual with a spur gear hand winch attached to the boom and equipped with a disc brake for load control. Steel gear cover shall be provided for protection.

D. Crane and base shall be furnished with a painted finish.

329.14 Hoist

A. Motorized hoist(s) shall be provided by the pump manufacturer. Hoist(s) shall be provided with platform sockets. The hoist(s) shall be positioned for the removal of the **[submersible sewage pumps, trash collection basket]**. Hoist(s) shall consist of platform socket, anchor bolts, mast, boom, winch, static loop, and hook with safety latch. Hoists shall be permanently mounted to prevent removal. Hoist shall be capable of ___-lb. safe load with a reach of ___ inches and a lift of ___ feet. Hoist shall be 120 VAC complete with cord plug for 120 V. receptacle. A ___-ton electric hoist for the jib cranes shall be a single speed extended lift as manufactured by P&H Hevi-Lift Model 3A1 or approved equal. The jib crane electrical hoists voltage shall be as indicated in the electrical plans.

Note to Specifier: The "Aluminum Trash Basket" paragraph below is optional.

329.15 Aluminum Trash Basket

A. A rail mounted removable trash basket shall be furnished as manufactured by U.S. Foundry Mfg., Washington Aluminum Company (WACO) or approved equal. The trash basket is to be constructed from 6061-T6 aluminum sheets with 2-inch diameter holes. The basket shall have extruded aluminum rail guides and 1/4-inch flat bar framing for structural strength with lifting bail. The basket shall be furnished with a rail system attached to the wall of the station for lowering and raising the basket for cleaning. The rail system shall be fabricated from **[stainless steel] [6061-T6 aluminum].** The rails shall be 2-by-2-by-1/4-inch angle with 1/4-by-2-inch flatbar cross supports and anchor pads. The cross support/anchor pads shall be on 48-inch centers maximum. Support gussets shall be 1/4-inch plate cut to shape. A 1-by-3/8-inch S.S. bolt with nut shall be furnished on each rail for basket stop. The rail system shall be attached to the station wall by 3/8-inch diameter S.S. wedge anchors.

Note to Specifier: Select one of the paragraphs "Access Door Hatchways" or "Access Cover" below and delete the one that is not used.

329.16 Access Door Hatchways

A. The access door hatchway shall be provided by the Contractor and shall be as specified in Section **[## ## ## "Floor Access Doors."] [## ## ## "Access Doors and Frames."]** The pump manufacturer shall verify that the proposed pumps will fit through the door opening and that the location of the doors will allow easy removal of each pump. The Contractor shall provide the size doors specified if adequate or the size required if a larger size is required to remove the pumps from the wet well. The access cover shall be provided with open assist-slow closure device and hold open device. Provide hasp and staple or other means for locking.

329.17 Access Cover

A. Heavy duty double door access cover shall be constructed of a minimum 3/8-inch aluminum checkered plate. The structural frame for the cover shall be designed to support one of the submersible pumps at any location on the cover. The pump supplier shall provide the construction details and dimensions for the cover to the Contractor so that he will have adequate information to construct the adjacent flooring system. Suitable brackets shall be provided to mount the lifting chain power cable supports and any other accessories that are

not mounted on the lower level. All accessories shall be mounted so that they are not disturbed during removal of the pumps for routine maintenance. The access cover shall be provided with open assist-slow closure device and hold open device. Provide hasp and staple or other means for locking. Coat access cover frame exterior in contact with concrete with bituminous coating.

Note to Specifier: The "Mix Flush Valve System" paragraph below is optional.

329.18 Mix Flush Valve System

A. The flush mix valve shall be designed to mix the contents of the wet well without use of external equipment. The system shall use the discharge of the submersible pumps as the mixing media and the length of mixing shall be adjustable. The mix valve shall be designed to allow removal of the system along with the removal of the submersible pumps.

B. Provide Mix-Flush Valve Systems for the new submersible pumps. All pumps in the lift station wet well shall be equipped with an automatically operating valve that will provide a mixing action within the sump at the start-up of the pumping cycle.

C. This valve system shall be mounted directly on the pump volute and shall direct a portion of the pumpage into the sump to flush and re suspend solids and grease by the turbulent action of its discharge. The turbulent action caused by the flow shall also provide some sump aeration benefits. The valve shall be mounted on the pump volute so that it can be removed from the sump along with the pump during normal and routine maintenance checks and shall be positioned on the volute or pipe to provide for non-clogging operation. The valve shall be equipped with an adjustable, wear resistant discharge nozzle which shall be used to direct flow from the valve to optimize mixing action within the sump.

D. The valve shall operate entirely on the pressure in the pump. The valve shall not require any external power source or control to operate, neither electric nor pneumatic or any special equipment. The use of the external power source is not acceptable. The valve shall be suitable for use in Class I, Division 1 hazardous locations.

E. The valve shall open at the beginning of each pumping cycle and shall automatically close during pump operation after a pre-selected time of operation. The valve shall operate automatically by differential pressure across the valve and shall be actuated through a self-contained hydraulic system which uses an environmentally safe fluid.

F. A method of adjusting the valve operating time shall be provided. Minimum flushing time shall be approximately 20 seconds before the valve closes with a maximum time of 50 seconds. The valve shall open again once the pump has stopped and be ready to provide the flush-mix action at the start of the next pump cycle. A means of adjustment shall be provided on the outside of the valve to obtain the desired flushing period.

329.19 Safety Grate

A. The safety grate shall be designed to withstand a minimum live load of 300 pounds per square foot using 17,300 psi as the design stress for the aluminum. Deflection shall not exceed 1/150th of the span. Each safety grate shall be designed to combine covering of the opening, fall through protection per OSHA standard 1910.23 and controlled confine space entry per OSHA standard 1910.146.

B. Safety grate shall be as manufactured for Halliday, USB Fab, Flygt Corporation or approved equal.

C. The safety grate shall be made of 6061-T6 aluminum and designed per the “Specifications for Aluminum Structures”, by the Aluminum Association, Inc., 5th Edition, Dec. 1986 for “Bridge Type Structures.” This specification requires the manufacturer to use 38,000 psi as the ultimate strength and 35,000 psi as the minimum yield strength, for grade 6061-T6 aluminum and then a safety factor of 2.2 be applied, leaving a 17,300 psi design stress.

D. Grate openings shall allow for visual inspection, limited maintenance and float adjustments while the safety grate fall through protection is left in place.

E. Grating design shall provide an opening for the pump power cable once the pump is pulled. This design allows the safety grate(s) to be closed after the pump is pulled, while leaving a space for the power cable.

F. Design must assure that the fall through protection is in place before the doors can be closed.

G. Each grate shall be provided with a permanent hinging system, which will lock the grate in the 90 degree position once opened.

H. Each grate shall have an opening arm, which will allow opening of the grate, while providing the grate as a barrier between the operator and the pit. The opening arm shall also be equipped with a controlled confined space entry lock (lock provided by Owner). This locking device will prevent unauthorized entry to the confined space. The grating system will allow anyone to make visual inspection and float adjustments without entering the confined space.

I. Each aluminum safety grate shall be coated with a safety orange color, promoting visual awareness of the hazard. Powder coat system shall be applied by the electrostatic spray process. The coating is a thermosetting, powder coat finish with a minimum thickness of 2 to 4 mils and shall be baked at 350 to 375 F, or as recommended by the manufacturer, until cured.

J. Welding shall be in accordance with ANSI/AWS D1.2-90 Structural Welding Code for Aluminum.

K. All mounting hardware, bolts, nuts, etc. shall be 316 stainless steel.

Note to Specifier: The “Pump Controller” Article below is to be reviewed by Electrical Engineer for each project. Specification is configured with triplex control system. Modify to meet project conditions. Only use if a packaged pump control is provided by the pump supplier.

329.20 Pump Controller

A. Furnish package pump control panel that shall be supplied by the submersible pump manufacturer.

B. Pump control panel shall include three-phase magnetic full-voltage non-reversing starters for each pump motor, control, overcurrent protection, main disconnect, and all devices required for a complete and operable **[triplex or duplex]** pump control system. Provide float switches for level control as well as for low level cutoff, reset and for high level alarm.

C. Pump control panels shall be enclosed in NEMA 4X stainless steel panel. Panels shall be dead front door-in-door construction with swing-out inner panel and stud-mounted backpan. Provide print pocket with accepted drawings of control and power wiring. Pump control panel shall have the following additional features.

1. Top-mounted audible-visible alarm that shall be energized from the high level float switch. Provide top hub for mounting alarm to cabinet. Provide interior alarm silence pushbutton.

2. Externally operable main disconnect handle rated NEMA 4X. In addition, provide panel mounted disconnect for each motor starter.

3. Control wiring shall be SIS and trained into wire chases that shall be backpan mounted. Each control wire shall be labeled with waterproof plastic labels at each and every connection.

4. Provide panel mounted HOA selector switches, each with engraved function and position identification.

5. Provide panel mounted alarm silence pushbutton, selector switches, run lights, moisture alarm pilot lights, elapse time meter for each motor control circuit. Each device shall be equipped with engraved metal surround to identify function.

Note to Specifier: The subparagraph below is for a three pump station. Modify to meet project conditions.

6. Provide solid-state **[triplexor or duplexor]** for alternating pumps.

7. Provide time delay relays for on-delay of each pump starting cycle.

8. Provide phase protection relay that shall afford protection from line unbalance, over and under voltage. Device shall be immune to line notching caused by VFD and other external electronic devices, up to 10 percent total harmonic distortion.

9. Control voltage shall be 120 VAC and provided by fused control power transformer with panel mounted primary breaker.

10. Provide master terminal blocker for termination of all external power and control wiring. Each terminal shall be labeled. Terminals shall be plated copper.

11. Pump control panel shall be manufactured by U.L. approved shop and shall have a U.L. label.

D. Incoming power is 480 V, 3 phase derived from **[480-volt wye, grounded, neutral supply] [480-volt delta]**. Provide equipment ground lug, and insulated barriered phase lugs for accepting field wiring.

E. All wiring shall be in accordance with Division 26 of the Specifications and NFPA 70 (NEC).

F. Pump manufacturer and electrical supplier shall coordinate the size of the pumps with the required electrical equipment. If the Contractor provides pumps larger than those indicated, all modifications to the electrical (such as starter size, conductor size, transformer size, generator size, VFD size, etc.) shall be solely at the Contractor's expense.

G. Auto Control:

Note to Specifier: See Note 5.

1. Wet Well Level-Responsive Automatic Pump and Alarm Control System: An automatic pump control system shall operate the pumps in accordance with variations in the wet well liquid level. The automatic control system shall employ a ____-type level transmitter to sense the liquid level in the wet well. The transmitter shall generate a 4-20 mA signal that shall be used by the pump controller for control of the lift pumps. It shall also provide a 4-20 mA output signal that shall be connected to the SCADA system for remote indication.

Note to Specifier: If a bubbler system is used, keep the bold, bracketed sentence in the subparagraph below. Otherwise, it should be deleted.

a. Level Transmitter: The liquid level of the wet well shall be sensed by a type level transmitter. **[The transmitter shall include a duplex air compressor unit with automatic switchover and associated bulk head fittings.]** The transmitter shall be a loop powered type to produce an instrumentation signal in direct proportion to the measured level excursion in the wet well. The sensor shall be mounted as shown on the Drawings.

b. Liquid Level Pump/Alarm Controller: This specification is intended to cover a complete and operational automatic pump and alarm control system that responds to the wastewater pumping station wet well level excursions.

Note to Specifier: Modify subparagraphs below to be project specific.

i. The system shall sense the station wet well liquid level over a calibrated range, display it on a 4-inch LED bar graph on the face of the controller, graphically display eight level adjustments for automatic pump control and abnormal level alarm in a coordinated arrangement with the level display and provide automatic operation of the station pumps and alarms as herein described.

ii. The pump/alarm Controller shall accept a single, level-proportional analog input signal and provide level-differential automatic operation of pumps. It shall also provide a contact closure for high level alarm.

iii. The Controller shall display the sensed control level on a 40-segment LED bar graph display. The level shall be displayed in a 0- to 20-foot range with 6-inch resolution.

iv. The Controller shall operate directly with the level sensing transmitter. The Controller shall include transmitter excitation voltage regulation, signal spanning, offsetting and “quelling” (rate-of-change-limiting).

v. Directly aligned with the calibrated L.E.D. bar graph display shall be eight vertical receptacles with programming pins and adjacent range scales to match the calibrated bar graph giving full-range, level-differential, On/Off operation of pumps and alarms from the sensed level excursion. The receptacles and programming pins shall be gold-plated to insure reliable, long-term operation.

vi. The left receptacle of each control stage shall receive the low level programming pin. The right receptacle shall receive the high level programming pin. A red LED

indicator shall be provided on the front of the controller as part of each control/alarm stage to indicate when the stage output is activated.

vii. The arrangement of the level and programming display with an integral wet well level scaled mylar overlay shall allow easy setting and viewing of all control adjustments from the front of the controller which shall be mounted on the inner door of the enclosure.

viii. A three-position “raise-auto-lower” manual level simulator shall allow the manual creation of a “false signal” when the switch is raised or lowered from the central auto position. By use of this switch, the effective operation of each pump shall be confirmed and the station returned to normal without danger of leaving the station in a “non-automatic” condition.

ix. The input power and the control outputs shall be wired to screw/clamp barrier type terminals on the back of the controller housing able to accept one or two #12 AWG or smaller conductors per terminal. The controller shall operate with a power supply that shall accept 120-VAC input power and include fusing and transient protection.

x. The controller shall also provide an adjustable level-responsive alarm output. The controller shall include high level alarm annunciation with a front accessible silence push button and a light mounted on the exterior of the panel. A battery back-up shall be provided to provide power to the alarm system in the event of normal power loss.

xi. Upon power-up, the controller shall go through a timing routing which allows the analog signal and display to stabilize before any control or alarm outputs are enabled. After the stabilization period, the control circuits of the Controller shall be sequentially enabled on a time-step arrangement.

xii. In addition to the time delay upon power up, the differential-level control circuits shall each be forced to an Off condition upon power up so that a level excursion will need to go past their turn-on elevation for them to operate.

xiii. The controller shall include an integral solid-state automatic alternator [(duplex) or (triplex)] with an auto alternator override switch mounted on the front of the controller.

xiv. The controller front face measurements shall be approximately 8-1/2 inches high by 8 inches wide. It shall semi-flush mount in a control panel inner door and have a depth behind the panel of not greater than 3-1/2 inches.

xv. It is the specific intention of this functional requirements that a standard controller will be employed with features as herein described and that it be a fully-integrated assembly. That is, the furnishing of similar functions using a generic programmable controller with custom software, a multiplicity of setpoint modules or extensive relay/timer logic to accomplish control sequences, etc., is specifically precluded by this specification and shall not be acceptable.

xvi. An inner door mounted ground fault interrupter (GFI) type convenience receptacle rated at 15 amperes shall be supplied for the operating of trouble

lights, drill, etc. It shall be protected by a separate 15-ampere trip rated circuit breaker.

xvii. Seal Failure Alarm/Over-Temperature Pump Protection: Over-temperature protection/seal failure sensing modules shall be provided by the pump supplier to the control manufacturer for mounting and wiring in the control panel. The module shall operate in conjunction with an over-temperature and moisture sending switch in each pump motor. The control shall provide pump lockout of operation upon occurrence of high temperature. The circuitry shall also include a yellow over-temperature failure indicating light and manual reset push button on the inner door for each pump. Inner door mounted pilot lights shall be provided to indicate a seal failure alarm condition for each sewage pump. These lights shall be operated by a contact closure from each pump protection module. The control equipment manufacturer shall supply any additional control devices necessary for the proper operation of the pump protection modules (transformers, relays, lights, push buttons, etc.). Dry contact closures for remote alarm through an automatic telephone dialer shall be provided for each alarm.

329.21 Construction Methods

A. Installation

1. Installation shall be in accordance with the Manufacturer's instructions. Any modification to the structure as a result of requiring different size access door hatchways is the responsibility of the Contractor.

B. Field Quality Control

1. Upon completion of installation of the equipment, an acceptance test to verify the satisfactory operation of each unit shall be conducted. The Contractor shall provide the services of authorized representative to conduct all field tests. The test shall be conducted in a manner approved by and in the presence of the Engineer. The unit shall be checked for excessive noise, vibration, alignment, general operation, ease of removal, etc. All automatic and manual controls shall be tested to verify that they function in accordance with the requirements. Verify that drive equipment operates without being overloaded. The unit must perform in a manner acceptable to the Engineer before final acceptance will be made by the Owner.

C. Painting

1. Pumps, motors, baseplates, discharge elbows, and guiderails shall be painted in accordance with Item No. 530 "High-Performance Coatings" of these Specifications.

D. Schedules:

	Location No. 1	Location No. 2	Location No. 3
Location			
Equipment No.			
Number of Units			

Rated Capacity (gpm)			
Rated Head, TDH (ft.)			
Minimum Capacity (gpm)*			
Min. Cap. Rated Head, TDH (ft.)			
Minimum Shutoff Head (ft.)			
Maximum Speed (rpm)			
Minimum Pump Speed (rpm)	40-50 percent of max. speed		
Minimum Motor HP			
Minimum Pump Efficiency			
Minimum Overall Efficiency (pump and motor)			
Normal Operating Head Range (ft.)			
Minimum diameter of test sphere (in.)			
Minimum shutoff head (ft.)			
Maximum NPSHR at duty (ft.)			
Maximum Motor pole number			
Minimum Rated (FL) Power Factor (%)			
Maximum Locked Rotor Power Factor (%)			
Minimum pump discharge size (in.)			
Include the system curve in each specification and shade the "area" of operation. Delete this note prior to printing or distribution.			

Note to Specifier: Insert system curve on this page.

329.22 Measurement

All types of Submersible Pumps will be measured per each.

329.23 Payment

A. **[Pump Vendor]** shall submit Applications for Payment filled out and signed by **[Vendor]** and accompanied by such supporting documentation as is required by the Procurement Documents and also as the Owner's representative may reasonably require. The first Application for Payment will be submitted to the Owner after review and acceptance by Owner's representative of all Shop Drawings, Product Data, and Samples required by the Procurement Documents. The Application for Payment will be limited to 5 percent of the total contract amount.

Milestone	Cumulative % of Contract Price
Approval of Shop Drawings & Product Data	5%

Milestone	Cumulative % of Contract Price
Delivery of pre-installation materials to the Project Site (**[barrels,] [sole plates,]** anchor bolts)	**[10%] [Invoice value as materials on hand]**
Approval of factory performance tests (pump and motor), Delivery of equipment to job site in good condition and approved Preliminary Operation and Maintenance Manuals	80%
Installation, Testing, Completion of Installation reports, submittal of final Operation and Maintenance Manuals, Completion of special services	95%
Final acceptance of the installed and tested equipment, approved Final Operation and Maintenance Manuals, completed Owner personnel training and other required information	100%

B. The next Application for Payment will be submitted after review and acceptance of the preliminary operation and maintenance manuals by the Engineer, satisfactory completion of all factory tests, and after delivery of the Goods has been accepted by the Buyer, and will be accompanied by a bill of sale, a Certification of Acceptable Delivery, Unloading, and Storage signed by the Contractor and other documentation satisfactory to the Buyer warranting that the Goods are delivered free and clear of all liens, charges, security interests, and encumbrances. Such documentation shall include releases and waivers from all parties who, during Vendor's performance under the Procurement Documents, might have obtained or filed any such lien, charge, security, or encumbrance. The Application for Payment will be limited to 80 percent cumulative of the total contract amount. Portions of this amount may be paid in monthly pay estimates following partial deliveries proportionate to the amount of Goods delivered provided an itemized Schedule of Values has been submitted and approved.

C. The next Application for Payment will be submitted after completion of equipment installation, testing, completion of the specified Installation Report, submittal of the final operation and maintenance manuals, and completion of Special Services. The Application for Payment will be limited to 95 percent cumulative of the total contract amount.

D. Final payment will be submitted after final acceptance of the pump and motors following the 30-day satisfactory operational test.

END

ATTACHMENT A

SUBMITTAL DATA SHEET

Submit the following data with Shop Drawings for each size of Pumping Unit:

Submersible Sewage Pumps

Location of Pumps (To be changed by Engineer)		
Item No.	**Description**	**Pump Numbers (To be Filled by Engineer)**
1	Make and Type Design	
2	Rated Speed	
3	Casing Material	
4	Impeller Diameter and Material	
5	Max. Impeller Diameter for Casing	
6	Diameter of Suction Flange	
7	Diameter of Discharge Flange	
8	Shutoff Head	
9	Diameter of Shaft at Impeller	
10	Maximum Brake Horsepower	
11	NPSH Required at Rated Head	
12	NPSH Required at Minimum Head	
13	Suction Specific Speed	
14	Specific Speed	

Motor Data

Item No.	Description	Pump Numbers (To be Filled by Engineer)
1	Rated Brake Horsepower	
2	Rated Full Load Speed	
3	Full Load Efficiency	
4	3/4 Load Efficiency	
5	Full Load Power Factor	
6	3/4 Load Power Factor	
7	Maximum Thrust Rating	
8	Locked Rotor KVA	
9	Frame Size	

10	Enclosure Type	
11	Locked Rotor Amperes (LRA) at rated voltage	
12	NEMA Starting Code Letter	

Weight

Item No.	Description	
1	Complete Pumping Unit	

Adjustable Frequency Drive

Item No.	Description	
1	Manufacturer	
2	Model	
3	Dimensions (L x W x H)	
4	Horsepower Rating	
5	Amperage Rating	
6	Voltage Rating	

END OF ATTACHMENT