PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for furnishing and installing submersible sewage pumping units, together with base elbows, guide rail systems, variable frequency drives, liquid level controls, control panels, access covers and all appurtenances necessary for a complete installation.

B. Related Work Specified in Other Sections Includes:

1. Section 09900 - Painting

1.2 REFERENCES

A. Codes and standards referred to in this section are:

1. ASTM A 48 - Specification for Grey Iron Castings
2. Hydraulic Institute Standards
3. IEEE 82 - Test Procedure for Impulse Voltage Tests on Insulated Conductors
4. NEC - National Electric Code
5. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings
6. AFBMA 10 - Specifications for Metal Balls

1.3 SYSTEM DESCRIPTION

A. General: Provide pumps of the vertical, centrifugal, heavy duty, nonclog, close-coupled, submersible type, each driven by submersible electric motor mounted as an integral part of the pump. Design the pumping units to pump raw unscreened sewage. Arrange the pumping equipment guide rails and base elbow for installation in the spaces shown without appreciable revision of the piping or structure. Design the pumping units for continuous and intermittent duty with ten starts per hour per pump.

B. Operating Conditions: Provide pumps to operate at the capacities and heads and over the range of operating conditions specified without overloading, cavitation, and vibration. Furnish the pumps in accordance with the following requirements:
<table>
<thead>
<tr>
<th>Items</th>
<th>Requirements</th>
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<tr>
<td>Capacity at rating point, gpm</td>
<td>______</td>
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<tr>
<td>Total head at rating point, feet</td>
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<tr>
<td>Overall efficiency, wire to water, at rating point, minimum, percent</td>
<td>______</td>
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<tr>
<td>Shutoff head, feet</td>
<td>Maximum</td>
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<td>Capacity at secondary rating point, minimum, gpm</td>
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<tr>
<td>Total head at secondary rating point, feet</td>
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<td>Overall efficiency, wire to water, at secondary head, minimum, percent</td>
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<tr>
<td>Capacity at reduced speed rating point, gpm</td>
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<tr>
<td>Total head at reduced speed rating point, feet</td>
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<tr>
<td>Diameter of sphere that will pass through pump, minimum, inches</td>
<td>______</td>
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<td>Pump discharge diameter, minimum, inches</td>
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<td>Pump speed, maximum, rpm</td>
<td>______</td>
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<tr>
<td>Low water elevation for continuous operation, feet</td>
<td>______</td>
</tr>
<tr>
<td>Wet well floor elevation, feet</td>
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<tr>
<td>Motor horsepower, hp</td>
<td>Minimum</td>
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<td></td>
<td>______</td>
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<tr>
<td>Motor efficiency at full load, minimum, Percent</td>
<td>______</td>
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<tr>
<td>Motor power factor at full load, minimum</td>
<td>______</td>
</tr>
<tr>
<td>Locked rotor kVa/hp, maximum, (Motor) (NEMA) code letter B</td>
<td>______</td>
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C. Pump Curve: Design each pump to have a continuously rising characteristic curve from the rating point to shutoff which passes through the rating point, and which meets or exceeds the specified heads and capacities, all within the Hydraulic Institute tolerances.
D. Provide submersible units capable of sustaining full reverse runaway speed without damage.

1.4 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 1.

B. Shop Drawings: Submit working drawings, including arrangement and erection drawings of the equipment and equipment operating characteristics. Include the following:

1. Pump performance curves. Draw the curves for the specified conditions including those at reduced speed. Plot head, input kilowatts, and overall efficiency, as a function of capacity from zero to maximum capacity.

2. General arrangement drawing of pumping unit, base elbow and guide rail system. Include equipment weight and anchor methods and materials.

3. Cross section drawing of pumping unit.

4. Parts list with materials of construction identified.

5. Motor performance characteristics.

6. Spare parts list.

7. Painting procedure.

C. Quality Control Submittals: Submit 6 certified copies of the Shop Test results.

D. Operation and Maintenance: Submit the Operation and Maintenance manuals for the pumping equipment.

1.5 PUMP WARRANTY

A. The pump manufacturer shall warrant the pumps being supplied against defects in workmanship and materials for a period of five (5) years under normal use, operation and service. In addition, the manufacturer shall replace certain parts which shall become defective through normal use and wear on a progressive schedule of cost for a period of five (5) years; parts included are the seal, impeller, pump housing, wear ring, and bearings. The warranty shall be in published form and apply to all similar units.

1.6 QUALITY ASSURANCE

A. Qualifications: Provide pumping equipment produced by a manufacturer who regularly engages in the design, manufacture, assembly and production of
submersible sewage pumping equipment of the size and type as specified for not less than five years.

B. Regulatory Requirements: Rate the motor unit, and wet well wiring for service in hazardous Class 1, Division 1 locations.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle all products and materials as specified in Division 1.

1.8 PARTS

A. Special Tools: Furnish a complete set of special wrenches, spanners, eyebolts and other special tools sufficient to completely dismantle and reassemble each kind and size of pumping unit. Provide tools of forged steel, case hardened, and full finished. Furnish the sets with a metal tool case with a handle and provision for padlocking.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers are listed below.

1. Flygt Corporation
2. ABS Pumps, Inc.

2.2 GENERAL CONSTRUCTION

A. Materials: Provide stainless steel fasteners, bolts, nuts and washers where exposed to the pumped liquid.

B. Component Joints: Provide machined metal-to-metal joints on component parts that are assembled together. Fit with an "O"ring seal where watertight joints are required. Arrange the "O"ring seal for automatic compression and sealing without adjustment or bolt torquing procedures. Do not use flat gaskets or sealing compounds to obtain watertight joints. Furnish machined rabbet fits on component joints as required to provide automatic alignment of rotating parts.

2.3 CASING

A. General: Provide pump casing of the centrifugal single volute, centerline discharge type. Do not use diffusion vanes.

B. Materials: Construct pump casing of ASTM A48, Class 30B or 35B cast iron.

C. Wear Ring: Construct renewable wear rings of stainless steel.
2.4 IMPELLER

A. General: Design impeller of the enclosed nonclog type. Provide pump-out vanes or a back ring, arranged with minimum clearances so as to preclude solids and stringy material from damaging the mechanical seal, on the back of the impeller.

B. Materials: Construct the impeller of cast iron ASTM A48, Class 30B or 35B.

C. Balance: Dynamically balance the impellers.

D. Wear Ring: Construct renewable impeller wear ring of brass.

E. Assembly: Secure the impeller to the shaft with a stainless steel key and lock nut in such a way that it cannot unscrew or become loosened due to rotation in either direction.

2.5 OIL CHAMBER

A. General: Provide an oil chamber to function as a buffer between the pumped liquid in the casing and the motor. Arrange the oil chamber to accommodate thermal expansion of the oil. Furnish an oil chamber drain plug that is accessible from outside the pump unit and permits changing oil without dismantling pump components.

B. Materials: Construct the oil chamber of ASTM A48 cast iron, Class 30B or 35B.

2.6 MECHANICAL SEAL

A. Design: Provide each pump with double tandem mechanical seals. Design the upper seal unit, between the oil chamber and motor housing, with one stationary tungsten-carbide ring and one positively driven rotating carbon ring. Design the lower seal unit, between the pump casing and oil chamber, with one stationary ring and one positively driven rotating ring. Furnish these rings made of tungsten-carbide. Use type 316 stainless steel for metal parts. Protect the spring element of the lower seal from solids contained in the pumped liquid. Do not rely upon the pumped liquid for lubrication. No seal damage is to result from operating the pumping unit out of its liquid environment. Conventional double mechanical seals with a single or double constant differential pressure to effect sealing and subject to opening and penetration by pumping forces will not be acceptable.

2.7 MOTOR

A. General: Provide submersible pump motor of 460-volt, 3-phase, 60-hertz as specified in Section 16155.

B. Ratings: Design the motor to have suitable output torque and speed characteristic to start and operate the pump over the range of specified conditions. For constant speed pumping units do not exceed the nameplate horsepower rating under maximum load conditions. For pumping units operated from variable frequency
drives, provide a motor nameplate horsepower rating at least 15 percent greater than the maximum load conditions. Base the nameplate horsepower rating on an 80 degrees C temperature rise above an ambient temperature of 40 degrees C. Design the motor for continuous load operation and continuous on-off cycling of ten starts per hour minimum without exceeding the 80 degree C temperature rise.

C. Insulation: Provide the motor with a minimum of NEMA Class F (155 degrees C) moisture resistant insulation. Construct stator coils with NEMA Class F insulated winding wire. Apply impregnation resin to stator assembly in three dip and bake steps.

D. Stator Housing: Provide the motor with an ASTM A48, Class 30B or 35B cast iron stator housing. For motors that employ cooling water jackets, design the water jacket passages to preclude clogging by solids contained in the pumped liquid.

E. Cables: Provide the motor cable entry with a mechanical locking ring or compression type cord grip to protect the cable jacket from being pulled out of the motor. Do not use epoxy for this purpose. Arrange the cable entry so as to provide a watertight seal with a terminal board and terminations next to the motor. Isolate the cable entry leads from the internal motor leads to prevent entry of water into the motor chamber by leakage or wicking. Provide cables suitable for submersible pump application and conforming to NEC specifications for cable sizing. Provide permanent label on cables.

F. Shaft

1. Design: Provide a one piece, fully machined pump and motor shaft. Design the shaft to limit shaft deflection under maximum pumping load to 0.002 inches at the lower mechanical seal face and to obtain a rotating assembly first critical speed of not less than 150 percent of the rated speed.

2. Material: Provide shafts of either carbon steel or stainless steel. Protect carbon steel shafts from exposure to the pumped liquid by employing a stainless steel sleeve or chrome plating.

G. Bearings

1. Design: Provide two anti-friction bearing assemblies. Design one assembly to carry only radial loads and to be free to float axially within the frame. Design the other assembly to carry both radial and axial loads and to be restrained from axial movement.

2. Bearing Life: Select bearings in accordance with AFBMA 9 and AFBMA 10, Load Ratings and Fatigue Life for Ball and Roller Bearings, to have a 20,000 hours minimum L_{10} bearing life at maximum pumping load that occurs under the specified operating conditions.
2.8 PROTECTION MONITORING SYSTEM

A. General: Provide each pumping unit with a monitoring system to protect critical machine functions during operation.

B. Motor Winding Temperature: Provide three thermoswitches, one per phase, to protect against overheating. Initiate an alarm and motor shutdown on high temperature.

C. Automatic Megger: All pumps 294 watt (30 HP) and larger shall be furnished and installed with one (1) completely enclosed solid state electronics module (automatic megger) to automatically monitor the motor winding resistance on each pump. Each automatic megger must have an individual disconnect terminal plug and manual shut off switch. Each automatic megger must have three (3) lights to indicate 10 M ohm, 5 M ohm, and 1 M ohm resistance values. Power source to be 110 VAC fused at ¼ amp. The D.C. test volt to be 500 to 700 volts. The output current to be limited to less than 1 micro amp. Must also have two (2) output circuits for external alarms. When the motor resistance drops to 1 M ohm, an alarm system must be activated by the internal circuit of the automatic megger. The automatic megger must monitor the motor resistance only when the motor is off. Each automatic megger must also include two (2) switches for manual testing. The automatic megger is to be manufactured by Automeg, Inc., or approved equal.

D. Sensor Monitoring Device: Provide a monitoring device or devices designed to be compatible with the sensors and motor controls. Locate monitoring devices in control panel.

2.9 GUIDE RAIL SYSTEM AND BASE ELBOW

A. Design: Provide each pump with a base elbow and guide rail system. Design the guide rail system to permit installation and removal of the pump from its base elbow discharge connection without requiring personnel to enter the wet well.

B. Guide Rail System: Provide a guide bracket which is an integral part of the pump casing and permits sliding the pumping unit, along two unthreaded 316 stainless steel guide rails. Provide the guide rails of 316 stainless steel pipe connected to the base elbow at the bottom. Support the guide rails at intermediate locations and at the top with stainless steel brackets bolted to the wall of the wet well or concrete slab. Fit each pump with a 316 stainless steel cable of adequate length and strength to permit the raising and lowering of the pump for inspection and removal.

C. Base Elbow: Provide a cast iron base elbow arranged for automatic pump connection. Provide the pump casing with a machined discharge flange which, when the pump is lowered into the pumping position, will automatically align and mate with the plain-end of the base elbow. Design the discharge connection such that no motion other than vertical is required to seat the mating flange of the casing to the base elbow. Accomplish sealing of the pump connection by metal to metal contact or
by a positive resilient seal of Buna-N attached to the pump casing discharge flange. Design the base elbow to support the weight of the pumping unit and prevent it from bearing directly on the wet well floor.

D. Mounting Accessories: Provide anchor bolts, nuts, washers, and accessories and other adapter equipment necessary for mounting the pumping equipment and appurtenances. Construct anchor bolts, nuts, washers, accessories and adaptor equipment of 316 stainless steel. Provide 3/8-inch minimum 316 stainless steel chain a minimum of 20 inches long attached to a minimum ¼-inch minimum 316 stainless steel wire rope which is to be hung on a 316 stainless steel rack at the top of the wet well.

2.10 OPERATION AND CONTROL

A. See Section 16160 for control panel requirements.

B. Each pumping station control system shall include a liquid level controller which shall sense the sewage level in the wet well and provide appropriate signals to the logic circuits to produce the required mode of operation for the pumping facilities. The standard level controls shall be five (5) non-mercury Rotofloats as manufactured by Anchor Scientific Inc. Long Lake, MN, or approved equal. At pump stations where there is a possibility of massive accumulation of floatables, oil and grease that may interfere with the proper operation of the floats, Lee County Utilities may require the installation of a bubbler type liquid level control system as manufactured by Digital Control Corporation or Lee County Utilities approved equal. All pump stations serving commercial and industrial facilities will be required to have a bubbler type liquid level control system unless specifically approved by Lee County Utilities.

C. Any alternative levels sensing and control system must be approved by Lee County Utilities. The bubbler type liquid level control system and any alternative levels sensing and control system shall include a high and a low level floats as a back-up system. Capability shall be provided for manual start-stop control for all pumping units as well as the normal automatic control from the liquid level sensing and logic circuits. An automatic alternator shall change the starting sequence on each pump cycle. A high water level, non-loathing alarm system shall be provided. Each sewage pump shall be provided with an elapsed time meter to indicate pump running time. The submersible station controls shall be housed within an exterior panel, pole-mounted or free-standing enclosure. The panel will be of NEMA 4X, stainless steel, weather-tight construction with double dead front outer doors fitted with hoop and padlock master keyed to County standard. Each panel shall be equipped with a service lock out switch to lock out alarm signals to the Telemetry System.

D. The requirement for variable speed controlling of sewage pumps shall be considered for all large capacity pumps for major installations; and when the hydraulic conditions indicate the requirement. The requirement for variable speed pump controls shall receive prior review with Lee County Utilities. Should such system be directed, the facility shall be equal to existing Lee County Utilities variable speed control units, or as approved by Lee County Utilities.
PART 3 EXECUTION

3.1 INSTALLATION

A. Install all equipment in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1. Complete all wiring and piping and make all necessary adjustments to equipment to provide a complete operational pumping installation.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Furnish the services of a qualified representative of the manufacturer to provide instruction on proper installation of the equipment, inspect the completed installation, make any necessary adjustments, participate in the startup of the equipment, participate in the field testing of the equipment and place the equipment in trouble-free operation, as specified in Division 1.

B. Tests: After installation of the pumping units, control equipment and all appurtenances, subject each unit to a field running test as specified in Division 1, under actual operating conditions. Perform the field tests in the presence of and as directed by the ENGINEER. Demonstrate that under all conditions of operation each unit:

1. Has not been damaged by transportation or installation.
2. Has been properly installed.
3. Has no mechanical defects.
4. Has been properly connected.
5. Is free of overheating of any parts.
6. Is free of overloading of any parts.

Test the pumps to demonstrate that the pumps and control system operate as specified. Promptly correct any defects in the equipment or failure to meet the requirements of the Specifications.

Conduct 24 hours of continuous operation test prior to acceptance.

3.3 CLEANING AND PAINTING

A. Paint as specified in Section 09900.

END OF SECTION