SECTION 11300

SUBMERSIBLE SEWAGE PUMPS AND CONTROLS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Contractor shall provide and install submersible, non-clog wastewater pumps complete with motors, bases, control panel, hatch and all related accessories.

B. Pump supplier shall bear the responsibility of supplying all equipment required for complete, operating, pumping systems including control panel and level controls.

1.02 REFERENCES

A. ANSI B16.1: Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

B. ASTM A48: Gray iron Castings.

C. ASTM A276: Stainless and Heat-Resisting Steel Bars and Shapes.

D. ASTM A311: Steel Bars, Carbon, Stress-Relieved Cold-Drawn, Subject to Mechanical Property Requirements.

E. ASTM A532: Abrasion-Resistant Cast Irons.

F. ASTM A576: Steel Bars, Carbon, Hot-Wrought, Special Quality.

G. The Hydraulic Institute: Standards.

1.03 PERFORMANCE

A. Make certain that equipment does not exceed space allocation and provide the manufacturer with Contract Drawings where necessary.

B. Pumps must operate at specific speeds below the “Upper Limits of Specific Speeds” established by the Hydraulic Institute so that the pumps may operate at the stated capacity, head, and suction lift with reasonable assurance of freedom from cavitation.

C. Pumps and motors shall conform to the requirements set forth in the following pages as to capacity, head, and other requirements. Motors shall be of ample size

to operate without overload through the entire range of the pump characteristic curve.

1.04 TESTS

A. Factory Test: Each pump and motor shall be given the following tests at the factory prior to shipment:
   1. The mechanical and electrical integrity of the pump shall be established by the use of physical inspection and the use of a megger for verification of the stator resistance to short circuit.
   2. The power leads shall be connected to the motor in accordance to the jobsite voltage and the pump started to verify rotation and no load amp readings.
   3. The pump shall be installed in a test tank on a wet pit discharge elbow and complete hydraulic tests conducted. The KW input, power factor, flow rate and head shall be measured and recorded. The pump shall be operated at the duty point for the project and checked for compliance with Hydraulic Institute Standards prior to being certified. The pump shall then be removed and given a physical inspection and additional megger insulation test to re-verify the mechanical and electrical integrity.
   4. Certified copies of the results of the pump performance tests run in the factory shall be submitted to the WSD for approval prior to pump delivery.

B. Field Test: Contractor is responsible for supplying water to fill the wet well for field testing of five (5) consecutive start-stops of each pump through a pump cycle prior to request of Substantial Completion. Should the equipment fail to operate as prescribed, the equipment shall be repaired and the field test procedures shall be repeated until the equipment operates as required by these documents.

1.05 SUBMITTALS

A. The submittals required in this section include (but are not limited to) the following:
   1. Certified characteristic pump curves
   2. Components and component materials of construction
   3. Seal descriptions
   4. Impeller diameter
   5. Maximum impeller permissible
   6. NPSH requirements
   7. Operating point
   8. Certified pump test
   9. Electrical characteristics of motors
   10. Outline dimensions.

1.06 WARRANTY

A. The pumps shall be warranted for a period of three (3) years.

PART 2 – PRODUCTS

2.01 SUBMERSIBLE, NON-CLOGGING SEWAGE PUMPS

A. Requirements: Furnish and install a minimum of two (2) submersible non-clog wastewater pumps. Each pump shall be equipped with a submersible electric motor connected for operation on 460 volts, 3 phase, 60 hertz, with submersible cable (SUBCAB) suitable for submersible pump applications. Three phase voltages other than 460 will only be approved by special condition by the Director of the Water & Sewer Department. The power cable shall be sized according to NEC and ICEA standards and have P-MSHA Approval. The pump shall be supplied with a mating cast iron discharge connection and be capable of delivering the flow and total dynamic head as listed in the pump characteristics. Each pump shall be fitted with stainless steel cable or lifting chain. The working load of the lifting system shall be 50% greater than the pump unit weight.

B. Pump Characteristics:
   1. Number of Units: Two – (2) unless otherwise noted.
   2. Design Condition: As dictated by the design engineer for site specific application.
   3. Rated Speed: min. 1170 rpm; max. 1800 rpm (3500 rpm only to be considered with pre-approval by the WSD).
   4. Rated Hp: As dictated by the design engineer for specific site application.
   5. Minimum Discharge Size: 3-inches (unless otherwise approved by the WSD).
   6. Voltage: 460 V (unless otherwise approved by the WSD)
   7. Phase: 3

C. Pump Design: The pump(s) shall be automatically and firmly connected to the discharge connection, guided by a 316 SS Schedule 40 guide bar extending from the top of the station to the discharge connection. Intermediate guide brackets shall be supplied for rail lengths over 15 feet. There shall be no need for personnel to enter the wet-well. Sealing of the pumping unit to the discharge connection shall be accomplished to provide non-leaking connection. No portion of the pump shall bear directly on the sump floor.

D. Pump Construction:
   1. Major pump components shall be grey cast iron, ASTM A-48, Class 35B or 40, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 304 or 316 stainless steel construction. All metal surfaces coming into contact with the sewage,

other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

2. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.
3. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

E. Cooling System: Each unit shall be provided with an adequately designed cooling system of water jackets or integrally cast motor cooling fins. Internal oil circulation or oil filled units for heat dissipation will not be allowed.

F. Cable Entry Seal: The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The entire end of the cable shall be sealed inside the cable entry housing through the use of a non-shrink epoxy resin. The assembly shall provide ease of changing the cable when necessary using the same entry seal.

G. Motor:
1. The pump motor shall be a NEMA B design induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and capable of up to 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125°C (260°F) shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The motor and the pump shall be produced by the same manufacturer.
2. The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for

operation up to 40°C (140°F) ambient and with a temperature rise not to exceed 80°C.

3. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.
4. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

H. Bearings: The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single roller bearing. The lower bearing shall be a single roller bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Bearings shall provide for B10 bearing life of a minimum of 100,000 hours.

I. Mechanical Seal

1. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating, corrosion resistant ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary and one positively driven rotating, corrosion resistant seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft.
2. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.
3. Seal lubricant shall be FDA Approved, nontoxic.

J. Pump Shaft: Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The shaft shall be AISI type 420 stainless steel.

K. Impeller: The impeller(s) shall be of gray cast iron, Class 35B or 40, dynamically balanced, semi-open, multi-vaned, non-clogging design having a long throughlet

without acute turns capable of passing a 3" (min) spherical solid.. The impeller(s) shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater. Impeller(s) shall be keyed or bolted to the shaft. All impellers shall be coated or hardened to provide long life.

L. Wear Rings: A wear ring system shall be used to provide efficient sealing between the volute and suction inlet of the impeller. Each pump shall be equipped with a brass, or nitrile rubber coated steel ring insert that is drive fitted to the volute inlet to insure long impeller life and continuing high efficiencies.

M. Volute: Pump volute(s) shall be single-piece grey cast iron, Class 35B or 40, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified.

N. Protection:
1. All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. The thermal switches shall open at 125°C (260°F), stop the motor and activate an alarm.
2. The thermal switches shall be connected to a monitoring unit. The unit shall be designed to be mounted in any control panel.

O. Pumps shall be manufactured by Flygt.

2.02 PUMP CONTROLS

A. A control system shall be supplied by the pump manufacture containing all the mechanical and electrical equipment necessary to provide for the operation of the submersible pump or pumps as depicted on the drawings.

B. Enclosure:
1. The control panel enclosure shall be rated Nema 4X stainless steel with cam-lock and of sufficient size to enclose all other devices required for operation of the system.
2. The enclosure door shall be gasketed with a rubber composition material around the perimeter and shall be installed with a retainer to assure a positive weatherproof seal. The door shall open a minimum of 180 degrees. A padlock hasp shall be provided.
3. A polished inner door shall be mounted on a continuous aluminum aircraft type hinge and shall contain cutouts for the protrusion of the circuit breakers and provide protection of the personnel from internal live voltages. All control switches, pilot indicators, elapsed time meters and other operational devices shall be mounted on the external surface of the dead front.
4. The dead front door shall open a minimum of 150 degrees to allow for access to the equipment for maintenance. A ¾" break shall be formed around the perimeter of the dead front to provide rigidity.

5. A back plate shall be manufactured from 12 gauge sheet steel and be finished with a primer coat and two {2} coats of baked-on white enamel. All hardware shall be mounted using stainless steel machine thread screws. Sheet metal screws shall not be acceptable.
6. All installed devices will be permanently identified with engraved legends.
7. Panel shall be sized to accommodate mounting of flow meter transmitter.
8. The control panel shall be provided with a panel for telemetry interface. At a minimum, the telemetry interface shall monitor the following:
    a. High water level alarm in wet well
    b. Motor thermal overload
    c. Seal leakage
    d. Pump motor on/off (for each pump)
    e. Five (5) spare interface connections.
9. Furnish with appropriate overcurrent/overload protection for all devices.
10. Furnish with a suitable transient voltage surge suppression (TVSS) device.
11. Panel construction shall comply with NFPA 79 and applicable NEC codes.

C. Power Distribution:
1. The panel power distribution shall include all necessary components and be wired with stranded copper conductors rated at 90 degrees “C”. Conductor terminations shall be as recommended by the device manufacture.
2. The power system shall contain incoming power terminals, motor circuit breakers and control circuit breaker.
3. All circuit breakers shall be heavy duty thermal magnetic or motor circuit protector similar and equal to Square “D” type “FAL”. Each breaker shall be sized to adequately meet the operating conditions of the load and have a minimum interrupting capacity of 10,000 amps at 230v and 18,000 at 460v.
4. Breakers shall be indicating type, providing an “on-off-tripped” position of the handle. They shall be quick make-quick break on manual and automatic operation and have inverse time characteristics.
5. Breakers shall be designed so that tripping of one pole automatically trips all poles.
6. Motor starters shall be open frame, across the line, NEMA rated with individual overload protection in each phase. Motor starter contacts and coil shall be replaceable from the front of the starter without removal of the starter from its mounted position. Reduced voltage starters shall be used for pumps in excess of 15 HP or as directed by the local electrical system provider.
7. Overload heaters shall be block type, utilizing melting alloy spindles, sized for the full load amperage of the load. Adjustable overloads, definite purpose contactors, fractional size starters and horsepower rated contactors or relays shall not be used.
8. A lightning-transit protector shall be provided. The device shall be a solid state device with a response time of less than 5 nano-seconds with a

withstanding surge capacity of 6500 amperes. Units shall be instant recovery, long life and have no holdover currents.

9. The following components will be supplied as standard equipment:
    a. 12 pin plug in phase/voltage monitor shall be supplied with two double pole
    b. double throw contacts
    c. NEMA 4 rated Hand Off Auto or spring loaded Hand Auto switches for bypass of each pump
    d. control depending on the control selections
    e. Run/ failure lights as required for each pump
    f. Non-resettable, elapsed time meters for each pump
    g. Alternation with lead /lag selector/ test switch/indicators
    h. Minimum 50 watt condensation heater and thermostat.
    i. Control wiring to be 18 AWG copper-tinned rated at 105 degrees C.
    j. Each wire shall be numbered corresponding to the wiring diagram.
    k. Single phase capacitor banks will be provided when required.

D. Control Voltage Devices
1. Control transformers shall be provided to provide the 120 VAC and/or 24 VAC for control circuits. Transformers shall be fuse on the primary and secondary circuits. The secondary circuits shall be grounded.
2. A line voltage rated, adjustable phase monitor shall be installed to sense low and high voltage, loss of power, reversed phasing and loss of a phase. Control circuit shall de-energize upon sensing any of the faults and shall automatically restore service upon return to normal power.

E. Level Control System:
1. A 24vac control system shall be provided for the level control system. The system shall provide for the automatic and manual control and alternation of the pumps to maintain a pumped down condition of the wet well.
2. Levels shall be sensed by stainless steel submersible liquid level transmitter adjusted to the levels as shown on the plans.
3. Each pump shall be controlled by the level control system. The pump(s) shall remain “on” until a common “off” level is reached.
4. Three (3) back-up float, mercury-type regulators shall also be provided.
5. At the conclusion of each pump cycle, an alternator shall switch the pumps on the next cycle to equalize run time on the pumps.
6. In the event the submersible transducer fails, the system shall sense the failure and switch the “off/on” level to the float regulators.
7. The system shall provide indication for the regulators and indicate a failure of the submersible transducer.
8. Controls contingent on the “off” float regulator supplying control power to the other regulators is not acceptable.
9. The third float regulator shall serve as a back-up high water alarm in the event of failure of the submersible transducer.

10. Level Control System Controller shall include the following features.
    a) Bar graph level display – 30 segment LED
    b) All level settings may be viewed or changed from front of unit
    c) Analog level input source
    d) Level input zero and span calibration
    e) 24 vdc power supply
    f) Phoenix style connectors
    g) Two (2) pump call relay outputs
    h) High level and low level alarm relay outputs
    i) Duplex alternation
    j) 10 second power-up delay
    k) 5 second lag pump delay
    l) 90 second low level alarm delay
    m) Level simulation

11. Controller shall be Motor Protection Electronics Station Controller SC100, or approved equal.

F. Pump Protection Features
1. Thermals or Clixons in the pump that will de-energize the pump starter and allows for automatic restart when the condition clears.
2. Moisture sensing and thermal failure solid state plug in control devices shall be installed to measure out of tolerance conditions in the pump motor. Failure indicators shall be provided. In addition, the alarm circuit shall be activated and show the cause of failure.

G. High Level Alarm Features
1. A high level alarm horn shall be provided with alarm silence button and relay. The alarm horn shall be mounted on the left side of the enclosure with a back box. The alarm horn shall provide a signal of not less than 90db at 10 feet.
2. A 40W high level alarm light shall be provided with globe, guard and mounting hardware. Mount externally on top of control panel or other location as designated by the WSD.

H. Provide the following spare circuit breakers in the Control Panel
1. 1 – 120 V SPST, 20 amp breaker for GCFI convenience outlet.
2. 1 – 120 V SPST, 20 amp breaker for telemetry.
3. 1 – 120 V SPST, 20 amp breaker for flow meter.
4. 1 – 120 V SPST, 20 amp breaker (spare).

2.03 Access Hatches

A. Hatch shall be sized by the pump manufacturer to insure adequate opening and clearance for removal of either pump. Hatches shall be manufactured by BILCO Company.

B. Cover: Shall be reinforced to support a minimum live load of 150 psf.

C. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of the opening and closing.

D. Operation of the cover shall not be affected by temperature.

E. Entire door, including all hardware components, shall be highly corrosion resistant consisting of aluminum or stainless steel.

F. Cover: Shall be ¼" aluminum diamond pattern.

G. Frame shall be extruded aluminum with drain coupling under the frame for a pipe connection to a disposal system.

H. Hinges: Shall be specifically designed for horizontal installation and shall be through bolted to the cover with tamperproof Type 316 stainless steel lock bolts and shall be through bolted to the frame with Type 316 stainless steel bolts and locknuts.

I. Hardware:
   1. Hinges: Heavy forged aluminum with ¼" type 316 stainless steel hinge pins.
   2. Cover shall be equipped with a hold open arm which automatically locks the cover in the open position.
   3. Latch shall be type 316 stainless steel slam lock with fixed interior handle and removable exterior turn/lift handle and locking mechanism.

2.04 Pressure Gauges

A. Provide two (2), four-inch diameter, oil-filled pressure gauges with snubbers. Gauge shall be marked incrementally to 100 psi (or higher if pump design conditions exceed this point). Gauges shall be tapped and mounted on the discharge header for each pump in the valve vault.

2.05 Miscellaneous

A. A final as built drawing(s) of the control panel schematic encapsulated in Mylar shall be attached to the inside of the front door. A list of all legends shall be included.

B. All control panels shall be listed by a nationally recognized testing laboratory [NRTL] and apply the certification necessary to indicate the NRTL approval.

C. All intrinsically safe controls shall be certified under UL Hazardous location with UL913 devices acceptable for use in class I, II, III, division I locations in addition to the NRTL recognition.

D. All equipment shall be guaranteed for a period of three (3) years from the date of shipment. The guarantee is effective against all defects in workmanship and / or defective components. The warranty is limited to the replacement or repair of the defective equipment.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install base elbows with embedded anchor bolts. Use of expanding anchor bolts to secure base elbows is not permitted. Pour wet well invert to slope sewage to the pumps.

B. Install pumps in accordance with manufacturer's instructions.

C. Provide for connection to electrical service.

D. Lubricate pumps before start-up. Insure wiring is correct for correct pump rotation.

E. Set level set points and back-up float to levels as designated by the drawing or as directed by the WSD.

3.02 FIELD QUALITY CONTROL

A. Perform field inspection testing.

B. Manufacturer's Field Services: Furnish factory-authorized service representatives to inspect equipment during installation, to assist in adjusting and testing, to supervise initial operation, and to make final adjustments as necessary to assure satisfactory operation.

C. Minimum Length of Field Services: 2 trips, 1 day per trip, exclusive of travel time from pump manufacturer.

D. Test pumps in presence of the WSD to verify specified capacities and operating characteristics are developed. A minimum of 72 hours notice shall be provided to the WSD for scheduling observation of pump testing. Failure to notify WSD of pump testing will require re-scheduling of testing. Trips made by manufacturer representative without proper advance notice will not be considered as meeting the requirements of this section.

E. Make repairs and retest pumps and drives until specified capacities and operating characteristics are achieved.

F. Furnish labor, piping, equipment, and materials necessary for conducting tests.

3.03 DEMONSTRATION

A. Equipment demonstrations and instructions are in addition to other Manufacturer's Field Services specified in Paragraph 3.02.

B. Check each pump for correct rotation.

C. Check each pump motor for amperage draw.

D. Check each pump for specified discharge head and flow rate. Cross-check pump drawdown in wet well versus the flow rate given by the flow meter.

E. Check all level controllers for proper sequencing and operation. Check back-up level switches for operation. Check for all alarm conditions by simulating failures.

3.04 INSTRUCTION MANUALS

A. Manufacturer shall furnish, prior to initial testing, two (2) copies of an indexed maintenance manual composed of maintenance manuals on all equipment and suppliers' brochures on all specialty equipment, including performance curves with size, model, figure number, etc., indicated to identify unit furnished. Maintenance manuals are to be of a hardback, loose-leaf type and of a durable quality. Manuals are to be for the specific equipment provided. Manuals describing general equipment lines will not be accepted.

B. Each set is to include the following:
   1. Manufacturer's parts list identified with the make, model and serial number of the equipment furnished.
   2. Control and wiring diagrams.
   3. Installation, operation, lubrication and maintenance instructions.
   4. Manufacturer's recommended spare parts lists.

END OF SECTION