# SECTION 11199
# SUBMERSIBLE PUMPS

## PART 1 - GENERAL

### 1.01 SCOPE

A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of all submersible pumps including wet and dry pit installations and their respective variable frequency drives which are specified elsewhere. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications and the manufacturer's recommendations and as shown on the Drawings.

B. Contract Drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.

C. Related work specified elsewhere:

1. Section 09900 - Painting.
2. Section 15060 - Piping and Appurtenances
3. Section 15100 - Valves and Piping Appurtenances
4. Division 13 - Instrumentation and Control
5. Division 16 - Electrical

### 1.02 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

1. Relevant experience references per requirements of paragraph 1.03 B.
2. Manufacturer's Certifications.
3. Mill certificates of materials used in the construction of pumps showing ASTM compliance shall be submitted to the Engineer prior to factory witness testing of the pumps.
4. Factory testing procedures, sketch of test setup and results of certified performance and witness testing.
5. Field testing procedures, equipment to be used and calibration certificates. Submit a minimum of 2 weeks prior to field testing.
6. Manufacturer's data: Dimensions; materials; size and location of all loads imposed on supporting structures; size and location of any concrete blockouts; size and location of anchor bolts, certified setting plans, with tolerances, for anchor bolts and any required

clearances. Provide details of all pump protective control devices, leakage sensors, bearing temperature sensors, motor temperature sensors, etc. to define all components to be included.

7. Data, regarding pump and motor characteristics and performance including:
   a. Guaranteed performance curves (prior to fabrication and testing) based on actual shop tests of mechanically similar pumps, showing they meet specified requirements for head, capacity, horsepower, efficiency and NPSHR.
   b. Provide curves for a single unit only for units of same size and type.
   c. Provide catalog performance curves at required speed showing maximum and minimum impeller diameters available.
   d. Variable speed curves for pumps controlled by variable speed drives.
8. Submit curves for guaranteed performance, certified test and witness tests on 8-1/2-in. by 11-in. sheets, one curve per sheet.
9. Certified results of hydrostatic testing.
10. Certified results of dynamic balancing.
11. Pump shop test results.
12. Motor shop test results.
13. Bearing Life: Certified by the pump manufacturer. Include design data.
14. Complete wiring and control diagrams, wiring sizes and wiring specifications.
15. List of recommended spare parts, including those specified herein.
16. Qualifications of field service technician.
17. Location of nearest authorized pump service center.
18. Recommendations for short and long-term storage.
19. The pump manufacturer shall submit a start cycle calculation for the specific pump/motor combination with the specific piping/discharge system required by this Project and as specified herein. The calculation shall graphically present system load torque and motor start torque as a function of time throughout the motor/pump start cycle. The calculation shall prove satisfactory motor start (breakdown torque exceeding load torque) under anticipated starting conditions. For pumps equipped with variable frequency drives load torque shall be plotted against the appropriate reduced motor start torque.
20. The pump manufacturer shall submit their requirements for pump exercising during extended periods when process operation is not required as described herein.
21. Installation and start-up report for each pump.

## 1.03 QUALITY ASSURANCE

A. Reference Standards. Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:

1. NEC, National Electric Code.
2. NEMA, Standards of National Electrical Manufacturers Association.
3. OSHA, Occupational Safety and Health Act.

4. ANSI, American National Standards Institute.
5. ASTM, American Society for Testing Materials.
6. AISI, American Iron and Steel Institute.
7. HI, Hydraulic Institute Standards.
8. ABMA, American Bearing Manufacturer's Association.
9. NFPA, National Fire protection Association.

B. Experience: Equipment furnished under this Section shall be of a design and manufacture that has been successfully used in similar applications. The manufacturer shall have a demonstrated record of successful operation of furnished equipment for a minimum period of 5 years, and a minimum of five similar applications. Provide a list of such installations complete with installation description, contact names, addresses, and telephone numbers. Contact information shall be up to date and current as of the date of bid opening. This reference list shall be submitted with the bid documents.

C. Single Source Responsibility: The pump supplier shall supply the following components and systems, and be responsible for the integration and proper system operation of these components:

1. Submersible (dry and wet pit) pumps.
2. Variable Frequency Drives.
3. Power and signal cables from motors to the first junction box.
4. Power and signal cable handling, support and storage systems.
5. Pump control and monitoring system.
6. Pump base, guide rail support brackets and other ancillary items

D. The Variable Frequency Drives shall be supplied by the pump supplier. The units shall comply with the Specification Section 16489 and the electrical drawings showing these units.

## 1.04 QUALITY STANDARDS

A. All submersible pumps specified in this Section shall be furnished by a single supplier who shall assume sole responsibility for providing a complete, operating system designed for long life with minimum required maintenance, meeting the requirements specified herein and as shown on the Drawings.

B. Manufacturer shall provide written certification that the equipment provided under this Specification has been amply designed and is a suitable application for these service conditions.

C. Manufacturers offering products that comply with these Specifications include:

1. ITT Flygt Corporation.
2. KSB
3. Or Equal

## 1.05 WARRANTY

A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

## 1.06 STORAGE AND PROTECTION

A. Pumps and accessories shall be stored and protected in accordance with the requirements of the General Conditions of the Contract Documents and manufacturer's recommendations.

B. Pump suction and discharge ports shall be provided with plugs or wooden bolted blind flanges. Each pump shall be secured to a wooden skid to facilitate handling and storage.

# PART 2 - PRODUCTS

## 2.01 GENERAL

A. Pumps shall be of the heavy duty, submersible, centrifugal non-clog type and shall be supplied with motor, discharge elbow or support base, guide bar system and accessories. Guide wires are not acceptable in lieu of guide bars.

B. Pumps shall be suitable for pumping raw sewage and/or stormwater containing solids consisting of grit and organic materials and small quantities of petroleum products and greases, and shall be designed and fully guaranteed for this use. The fluid temperature range shall be from 40° to 104° F. The pumps supplied under this specification shall be suitable for continuous operation under submerged or partially submerged conditions. Without derating the motor, the pumps shall be able to pump continuously with the minimum water level at the bottom of the motor housing, under full load, without the need of spray system or air moving equipment.

C. Dry pit pumps shall be capable of operating in a continuous non submerged condition in vertical position in a dry pit installation and permanently connected to inlet and outlet pipes. Pump shall be of submersible construction and will continue to operate satisfactorily should the dry pit be subjected to flooding.

D. Pumps installed in wet pit locations shall be automatically and firmly connected to the discharge connection elbow when lowered into place. Pumps shall be easily removable for inspection or service, requiring no bolts, nuts or other fasteners to be removed for this purpose and no need for personnel to enter the pump wet well. Sealing of the pumping unit to the discharge elbow shall be accomplished by a simple linear downward motion of the pump with the entire weight of the pumping unit guided to and pressed tightly against the discharge elbow.

E. Wet pit pumps and appurtenances, including the pump, motor, guide system, monitoring devices and wiring, shall be suitable for operation in the state of Georgia for explosion proof service. Pumps and appurtenances, including the pump, motor, guide system and wiring shall be approved by a national approved testing agency for installation in the state of Georgia for explosion proof service. The system shall be rated for Class 1, Division 1, Group D service as determined by the National Electrical Code and approved by a nationally recognized testing agency (U.L. or F.M.) at the time of bidding of this Project.

## 2.02 OPERATING CONDITIONS

A. Refer to the Contract Drawings for general arrangements and dimensional limitations. Provide complete submersible pump units designed for the indicated service and free of excessive vibration or hydraulic instability from minimum TDH to shutoff head when operating continuously or intermittently under the conditions herein specified.

B. The operating range of the pump shall include the duty points and shut-off head conditions. The pumps shall be non-overloading throughout the entire pump operating range.

C. All operating points listed in the performance tables below, with the exception of the shut-off head condition shall be located within the preferred operating region of pumps as established by pump manufacturer in accordance with ANSI/HI 9.6.3 and as published in the manufacturer's application data for the specific pump model being proposed for this application.

| Parameter | Value | Value |
|---|---|---|
| Description | Diversion Pumps | Equalized Flow Return Pumps |
| Installation Type | Wet Pit | Dry Pit |
| No. of Pumps (total) | 6 | 3 |
| Equipment Tag Numbers | P-201, P-202, P-203, P-301, P-302, P-303 | P-531, P-532, P-533 |
| Service | Raw Sewage | Raw Sewage |
| Min. Shutoff Head, Ft. | 140 | 140 |
| Solids Handling Capacity, in | 4 | 3 |
| Discharge Connection Size, in | 16 | 14 |
| Suction Connection Size, in | N/A | 16 |
| Max. Pump Speed, rpm | 1200 | 1200 |
| Motor Horsepower Rating, Max. | 335 | 215 |
| Min. Motor Efficiency – full load / 50% load | 94/92.5 | 93.5/93 |
| Power Requirements | 480V, 3-phase, 60 Hz | 480V, 3-phase, 60 Hz |
| Electrical Classification | Class 1 Div.1 | Class 1 Div. 2 |
| Type of Drive | Variable Frequency | Variable Frequency |
| Pump Mfg./Model No. or equal | FLYGT N3400/835 | FLYGT N3356/735 |
| Hydraulic Conditions | | |
| Design Point | | |
| Flow, gpm / MGD | 9300/13.4 | 7000/10 |
| TDH, ft | 98 | 90 |
| Static Head, ft | 75 | 64 |
| Minimum Efficiency, % | 75 | 80 |
| Minimum NPSHa , ft | 30 | 28 |
| | | |
| Minimum Head Condition | | |
| Nominal Flow, gpm | 6600 | 4000 |
| TDH, ft | 17 (15 feet from pressure control valve) | 30 |
| Static Head, ft | 2 | 25 |
| Minimum Efficiency, % | 60 | 75 |
| Minimum NPSHa , ft | 30 | 45 |
| Pump Operating Condition | Variable Speed – ~30 Hz | Variable Speed – ~30 Hz |
| | | |
| Maximum Head Condition | | |
| Nominal Flow, gpm | 5000 | 3000 |
| TDH, ft | 115 | 110 |
| Static Head, ft | 80 | 65 |
| Minimum Efficiency, % | 55 | 50 |
| Minimum NPSHa , ft | 30 | 28 |
| Pump Operating Condition | Synchronous Speed | Synchronous Speed |

## 2.03 MATERIALS AND CONSTRUCTION

A. Pump Construction

1. All major parts (except for the impeller), such as the stator casing, oil casing, sliding bracket and discharge base assembly connection shall be of ASTM A-48 Class 35 minimum gray iron. All exposed bolts and nuts shall be 316 stainless steel. All mating surfaces of major parts shall be machined and fitted with rubber O-ring seals where watertight sealing is required, except at discharge elbow connection for wet pit pumps. O-rings shall be of materials suitable for use with and in raw sewage environment. All parts shall be interchangeable and watertight sealing shall not require additional machining of replacement parts, sealing compounds, or the application of specific torques to connectors.

2. All parts exposed to abrasive wear, other than volute and impeller, shall have a minimum Brinell hardness of 200.

3. In wet pit installations, no portion of the pump unit shall bear directly on the floor of the sump. There shall be no more than one 90-degree bend allowed between the volute discharge flange and the station piping.

4. A spark proof guide system shall be an integral part of the wet pit pump unit. The volute casing shall have a discharge flange and sliding bracket 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. The guide system shall be certified by Factory Mutual (FM) to be suitable for Class 1, Division 1, groups C &D environments, when the discharge elbow is not submerged.

5. Provide an ASTM A-48 Class 35 cast iron discharge base assembly for wet pit pumps including a 90 degree elbow as indicated and base to support the entire weight of the pump and motor and to secure the lower end of the guide rails. Provide base with 125-lb ANSI B16.1 flange discharging vertically as indicated. Base shall be machined to receive sliding bracket of pump discharge.

6. Dry pit pumps shall be provided with a cast iron or fabricated steel support base for installation on the concrete foundations as shown on the drawings. Base shall be designed for the maximum possible loads of the pumps provided.

B. Impeller

1. The impeller shall be a high chrome casting per ASTM A-532 with a minimum hardness of 55 HRC, of non-clogging design, capable of handling solids, fibrous material, heavy sludge and other matter found in normal sewage applications. The casting shall have smooth surfaces devoid of blow holes or other irregularities. The impeller shall be constructed with a long throughlet without acute turns. The impeller shall be dynamically balanced. Static and dynamic balancing operations shall not deform or weaken it.

C. Pump Shaft: Pump and motor shaft shall be a solid continuous shaft. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The pump shaft shall be of ASTM A276, type 420 or AISI 431 stainless steel and shall be completely isolated from the pumped liquid by ASTM A 276, type 420 SS sleeve. The shaft shall be of sufficient section to limit the deflection at the shaft seal to not more than 1.5 mils when operating at any continuous duty point defined in the operating conditions. Provide calculations to document that the shaft

thickness design meets the deflection requirements. Calculations shall be sealed by a Professional Engineer licensed in the state of Georgia.

D. Volute

1. Pump volutes shall be single-piece gray cast iron, Class 35B, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. The casting shall have smooth surfaces devoid of blow holes or other irregularities. Minimum inlet and discharge size shall be as specified.

2. The pump volute shall be coated on the inside surface with tungsten carbide applied with an HVOF process to provide maximum density and strength. The hardness of the coating shall be 60 HRC minimum. Coating shall have a thickness of .005 to .015 inch.

E. Mechanical Seal

1. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The lower seal shall be independent of the impeller hub. 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 silicon-carbide seal 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 silicon-carbide seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal.

2. Should both seals fail and allow fluid to enter the stator housing, a port shall be provided to direct that fluid immediately to the stator float switch to shut down the pump and activate an alarm. Any intrusion of fluid shall not come into contact with the lower bearings.

3. The following seal types shall not be considered acceptable or equal to the dual independent seal specified: Shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to affect sealing shall be used.

4. 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.

F. Guide Bars System

1. Stainless steel guide bars shall be provided as shown on the Drawings and shall be 3-inch diameter, Schedule 40 316L stainless steel pipes attached to the automatic discharge connection at the lower end and to an upper guide bar bracket at the upper end. Intermediate guide bar supports shall be provided as shown on the Drawings and as required to ensure a secure installation. Two guide bars shall be provided for each pump. Guide bars shall not support any of the weight of the pump. Guide bars, upper and intermediate supports, and

anchor bolts shall be provided by the Contractor. All guide bar support components shall be of 316 SS. Cable type guide systems shall not be acceptable.

2. Pump guide rails and supports shall be designed to be adequate to withstand forces associated with pump installation and operation.

G. Additional Accessories: Suction flow vanes shall be provided for all pumps where shown on the Drawings. The pump manufacturer shall review the location and dimensions of flow vanes as shown on Drawings and shall recommend changes as required to improve the hydraulics of flow entry into pumps. Flow vanes may be omitted based on pump manufacturer's recommendation.

## 2.04 MOTOR

A. Pump Motor

1. Pump motors shall be designed in accordance with the standards of NEMA. Refer to paragraph 2.02 of the Specification for additional pump characteristics. Motors shall be suitable for operation in hazardous areas as specified above provided the provisions of 2.01 D are met. The motor and the pump shall be produced by the same supplier. Motors shall also meet the additional requirements as specified in Section 16150.

2. 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 motor shall be able to operate continuously while non-submerged without damage while pumping under load.

3. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the Vacuum Pressure Impregnation (VPI) or trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable.

4. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31.

5. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable.

6. The motor shall be specifically designed for submersible pump usage and designed for continuous duty pumping media of up to 40°C (104°F) with an 80°C temperature rise and capable of at least 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum.

7. Ambient compensated RTDs, PT100 shall be embedded in the stator end turns in each phase to monitor the temperature of each phase winding. These ambient compensated RTDs shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel.

8. An ambient compensated RTD type temperature sensor shall be provided for the lower (main) bearing. The sensor shall directly contact the outer race of the thrust bearing providing for accurate temperature monitoring.

9. A leakage sensor shall be provided to detect water in the stator chamber. The Float Leakage Sensor (FLS), a small float switch, shall be used to detect the presence of water in the stator chamber. When activated, the FLS will stop the motor and activate an alarm.

10. Vibration sensors shall be provided in the pumps.

11. The stator RTDs, temperature switches, FLS, vibration sensors and the lower bearing RTD for each pump shall all be connected to the pump monitoring unit for that pump. Provide individual pump monitoring units for each pump to be mounted as shown on the Drawings.

12. The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and control cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable.

13. A leakage sensor shall be provided to detect water in the junction box.

14. A leakage sensor shall be provided to detect water in the inspection chamber.

15. The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15 except motors for inverter duty that shall have a service factor of 1.0. The motor shall have a voltage tolerance of plus or minus 10%.

16. A performance chart shall be provided showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.

17. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from run-out condition through shut-off.

18. Any additional alarm or control device, including wiring, conduit, controls, etc., which the pump supplier recommends or requires for warranty, shall be furnished by the Contractor at no additional cost to the City.

19. The Contractor shall adhere strictly to the manufacturer recommended installation procedure and wiring requirements for pump control units.

B. Bearings

1. The pump shaft shall rotate on at least three sealed grease-lubricated bearings. The upper bearing, provided for radial forces, shall be a single roller bearing. The lower bearings shall consist of at least one roller bearing for radial forces and one or two angular contact ball bearings for axial thrust. Upper bearing outer races shall be insulated from the housing to prevent flow of circulating currents caused by VFD operation of pumps.

2. The minimum L10 bearing life shall be 100,000 hours for the Design Point condition specified in Par. 2.02.

C. Cooling System

1. Each pump/motor unit shall be provided with an integral, self-priming and self-supplying cooling system. The motor water jacket shall encircle the stator housing and shall be of cast iron, ASTM A-48, Class 35B.

2. The water jacket shall provide heat dissipation for the motor regardless of whether the motor unit is submerged in the pumped media or surrounded by air. The impeller back vanes shall provide the necessary circulation of the cooling liquid, a portion of the pumpage, through the cooling system.

3. Two cooling liquid supply pipes, one discharging low and one discharging high within the jacket, shall supply the cooling liquid to the jacket. An air evacuation tube shall be included to provide automatic air removal from within the jacket. Any piping internal to the cooling system shall be shielded from the cooling media flow allowing for unobstructed circular

flow within the jacket about the stator housing. Two cooling liquid return ports shall be provided.

4. The internals to the cooling system shall be non-clogging by virtue of their design.
5. The cooling jacket shall be equipped with two flanged and bolted inspection ports of not less than 4"Ø located 180° apart. The inspection port shall be sealed with an O-ring seal. No gaskets shall be allowed.
6. The cooling system shall provide for continuous submerged or completely non-submerged pump operation in liquid or in air having a temperature of up to 40°C (104°F), in accordance with NEMA standards. Restrictions limiting the ambient or liquid temperatures at levels less than 40°C are not acceptable.
7. Cooling water may be required for the Equalized Flow Return Pumps P-531/532/533 due to the low speed operation of the pumps under some conditions. The pump manufacturer shall provide a complete cooling water system with flow meter, solenoid valve, pressure regulator, loss of flow indicator and any other components required for the cooling water supply. Cool water system shall operate from the city water supply but downstream of the backflow preventer. The cooling water will be piped into the cooling jacket and discharge into the pump volute.

D. Cables

1. Power and control cables shall be suitable for submersible pump applications and shall be indicated by a code or legend permanently embossed on the cable.
2. 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. Power cable shall be similar as vertical riser cable with messenger wires attached to it. Messenger wires shall be of adequate length and shall be supported from top of pump station. Power cable for VFD driven pumps shall be approved by the VFD Manufacturer.
3. The motor control cable shall be designed specifically for use with submersible pumps and shall be equal to SUBCAB (Submersible Cable). The cable shall be shielded, multi-conductor type with a chloroprene outer jacket and the tinned copper conductors insulated with ethylene-propylene rubber. The conductors shall be arranged in twisted pairs. The cable shall be rated for 750 Volts and 90°C (194°F) with a 40°C (104°F) ambient temperature and shall be approved by Factory Mutual (FM). The cable length shall be adequate to reach the junction box without the need for splices.
4. The cable entry sealing fitting shall relieve stress on conductors and provide a watertight and submersible seal, without the use of sealing compounds and without the application of specific torques to connectors. The conductors shall connect to a terminal board, which shall be provided with a moisture tight seal between the cable entry junction chamber and the motor.
5. The cable entry water seal design shall preclude specific torque requirements to ensure a watertight and submersible seal. The cable entry shall be comprised of a dual cylindrical elastomeric grommet, flanked by stainless steel washers all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the entry body containing a strain relief function, separate from the function of sealing the cable. The assembly shall bear against a shoulder. The cable entry junction chamber and motor shall be

separated by a stator leading sealing gland or terminal board, which shall isolate the motor interior from foreign material gaining access through the pump top.

6. Power and Control Cable Protection System: The pump supplier shall provide a support and protection system for the power and control cables for each of the pumps supplied. This system shall be a part of, and integrated into each pump unit. The supplier shall assume full responsibility for its function and provide a functional guarantee, as detailed below. The system shall consist of the following components and functions:
   a. The pump supplier shall guarantee that this system functions in an automatic and effortless way while a pump is lifted or installed, that no wear, tear or damage be inflicted to either of the flexible electrical cables. Any cable wear or operational problems that occur within a 5-year period shall be repaired and improved by the pump supplier without cost to the Owner.
   b. Appropriate cable support brackets shall be supplied by the pump supplier and permanently installed by the contractor at the deck level to provide support and strain relief function. These brackets shall be capable of supporting the entire length of cables contained within the wet-well, with a safety margin of no less than 3.5. The cable support brackets shall be fabricated from 316 stainless steel plates and shall be specifically designed to support the cables. Pump manufacturer shall coordinate brackets details with those shown on the drawings and finalize dimension and spacing of brackets. All edges of the bracket that come in contact with the cables shall be rounded and ground smooth to avoid any damage to the cables.

## 2.05 CONTROLS

A. Variable Frequency Drives for the variable speed pumps shall be furnished by the pump supplier. The pump supplier shall be responsible for coordinating with the drive manufacturer to verify that the current rating of the drives is suitable for all flow and head conditions. Pump supplier shall also ensure that the drive will be satisfactory for accelerating the motor. Variable frequency drives shall be in accordance with the Electrical Drawings and specifications.

B. Control of pumps shall be provided for under Division 13 and as specified under Article 2.04.

C. Pump Monitoring and Control System

1. The pump supplier shall supply an integrated pump monitoring and control system, containing the following sensors (indicated quantities are per pump), components and functions:
   a. Stator winding temperature sensor (platinum RTD) x 3 (one per motor phase).
   b. Stator housing leakage (ball float switch).
   c. Motor temperature switch (PTC) for each phase.
   d. Support bearing temperature (platinum RTD)
   e. Motor junction box leakage (ball float switch).
   f. Main bearing temperature (platinum RTD).
   g. Pump vibration sensor (2 axis vibration with velocity readout).
   h. Pump electronic ID module with runtime and start counters.
   i. Shielded flexible submersible signal cable from pump to first junction box.
   j. Control panel mounted monitoring and status unit with inputs for the above sensor signals. This unit shall be powered by 120VAC and contain user settable warning and

shutdown alarm levels for each sensor input. A "long lead" temperature compensation function shall be provided for all RTD inputs. The device shall have an embedded web-server and all settings shall be accessible via Microsoft Internet Explorer either locally or remotely. The device shall be "provided" with communication via RS 232 and RS 485 ports as well as Modbus protocols to higher level SCADA systems.

k. Each pump shall be equipped with a pump monitoring and control system unit and a panel mounted remote user display (a local input/output device).

l. The pump monitoring and control system shall be MAS unit as manufactured by ITT FLYGT or Equal.

D. Provide individual monitoring and control unit for each pump. Provide control panels in individual enclosures for each monitoring and control unit. Each unit shall be provided with 120V power from the respective pump VFD or RVSS. Control panel shall be provided with required DC power supply. Monitoring and control units shall provide required RS 485 connections to the DCS system and interlock to the VFD or RVSS.

## 2.06 SPECIAL OPERATING CONDITIONS

A. The pumping systems may not be required to operate to meet the process requirements for extended periods of up to several months when there is no flow into the pump station. The manufacturer shall consider these conditions and specify any special maintenance requirements necessary to guarantee the long term operability of the equipment. It is anticipated that during the extended periods of inactivity, the pumps will be cycled or "bumped" for short periods for maintenance purposes. This process will occur "dry" with no water in the wet well. The pump manufacturer shall specify the frequency and duration required for each pump cycle for each set of pumps. These settings will be included in the main control system. The manufacturer shall also include any other special maintenance requirements for their equipment to meet these conditions. This information will be submitted with the shop drawings as specified above.

## 2.07 FACTORY INSPECTION AND TESTING

A. The pump supplier shall conduct full scale, full range factory performance tests as specified herein. The Engineer shall witness the pump tests and certified test reports shall be submitted for approval, prior to shipment of the pumps. Tests shall be conducted in accordance with the latest edition of the Submersible Pump Test Standard, ANSI/HI 11.6

B. The Contractor shall provide for witnessing of the factory performance testing by three representatives of the Owner, and shall provide all transportation (economy class), lodging, meals and miscellaneous expenses necessary for the Owner's representatives to attend the factory performance tests. Factory testing shall be conducted at a location to be determined by the pump manufacturer within the continental US.

C. Each pump shall be tested for performance at the factory as specified herein.

D. Testing shall include but not limited to the following:

1. Impeller, motor rating and electrical connections shall first be checked for compliance to specific requirements. Impeller shall be visually inspected to certify that it is free of defects.
2. Conduct mechanical and electrical motor integrity tests in accordance with ANSI/HI 11.6.
3. Motor and cable insulation test for moisture content or insulation defects.

4. After a submerged test run of 30 minutes, item 2 shall be retested.
5. If any deviation of above is found, the pump shall be rejected.

E. Pump Tests

1. Hydrostatically test each pump casing under a hydrostatic head of 100 psig or 150 percent of rated shutoff head, whichever is greater. Tests shall be performed using the complete pump system to be furnished, including the Project motor and variable speed drive for units supplied with variable speed drives. Testing of prototype models will not be acceptable.
2. All tests, including the $NPSH_R$ tests shall be in accordance with ANSI/HI 11.6. Required test acceptance level shall be ANSI/HI Acceptance Level: A.

F. Testing

1. Run pump at full speed rating point for 60 minutes prior to start of any testing.
2. Full Speed Tests: Test pump at the specified conditions and record and tabulate readings of flow, differential pressure, BHP, efficiency, $NPSH_R$, input kW, voltage, frequency, and power factor for each test point.
3. At a minimum, tests shall be carried out at each of the operating points listed in Article 2.02 including the Design Point, Minimum Flow/Maximum Head Point and Maximum Flow Minimum Head Point.
4. Operate each pump for not less than one hour and take readings to verify that the pump will operate as specified without cavitation or excessive vibration and with no more than the specified NPSHA, where such is stated.
5. Run each pump at minimum speed rating point for 6 hours.
6. Run a test with each pump operating with its minimum recommended submergence.
7. Testing of pumps at specified points shall be accomplished with the pumps submerged for wet pit pumps.
8. In the event that specified tests indicates that a pump or motor does not meet specifications, The Owner reserves the right to require witnessed re-testing tests for that pump and motor at no additional cost to the Owner.
9. Furnish certified performance tests as specified for all pumps.
10. Furnish a certification that the pump horsepower demand did not exceed the rated motor horsepower beyond a 1.0 service rating at any of the test points.

## 2.08 FACTORY PAINTING

A. All metal surfaces coming into contact with the pumped media, other than stainless steel, shall be protected by a factory applied coating in accordance with Specification Section 09900.

B. The pump manufacturer shall provide extra finish coat similar to the factory applied finish coating for Contractor touch up painting in the field.

## 2.09 SPARE PARTS

A. The pump supplier shall provide a list of recommended spare parts and shall indicate what items are stocked and which items are special orders. The spare part list below shall be supplied with the pumps at a minimum.

| Item | Qty. for each pump set |
|---|---|
| Bearing set | 1 |
| O-ring service set | 2 |
| Pump Monitoring and Control System | 1 |

# PART 3 - EXECUTION

## 3.01 INSTALLATION

A. Equipment Installation: All equipment shall be installed in accordance with approved shop drawings and manufacturer's recommendations.

B. Anchorage: Stainless steel anchor bolts, nuts and washers, as well as any templates necessary for setting the anchorage, shall be furnished by the equipment manufacturer. Placement of the anchor bolts shall be done by the Contractor from certified dimension shop drawings supplied by the equipment manufacturer.

C. Leveling and Grouting

1. Level and align pump and guide bars in accordance with the respective manufacturer's published data.
2. Grout pump mounting base as required with non-shrink grout in accordance with the ACI, equipment manufacturer's and grout manufacturer's published specifications.

## 3.02 PAINTING

A. After installation and approved field testing by the Engineer, the Contractor shall apply touch-up paint to all scratched, abraded and damaged shop painted surfaces. Coating type and color shall match shop painting.

## 3.03 MANUFACTURER SERVICES

A. Furnish the services of trained service technician, certified by the manufacturer, to service the type of equipment specified in accordance with the requirements of the General Conditions of the Contract Documents and as specified herein.

B. The service representative must have a minimum of five years of experience, all within the last seven years, supervising the installation and inspection of the type and size of equipment specified.

C. The service representative must be present on site for all items listed below. Work-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

D. Provide assistance to the Contractor during equipment installation including, but not limited to observation, guidance, instruction of contractor's assembly, erection, installation or application procedures, inspection and checking of installation and furnishing of written approval of installation.

1. 6 work-days over a minimum of two trips.

E. Assistance during functional and performance testing and startup demonstration, and product acceptance by the Owner.

1. 7 work-days over a minimum of two trips.

F. Training of Owner's personnel in the operation and maintenance of equipment as required. Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom session.

1. 1 work-day.

G. For the purposes of this paragraph, a work day is defined as an eight hour period at the Project site, excluding travel time. The Engineer may request that a work day be furnished in a maximum of two trips. All unused work days shall be credited to the Owner at the manufacturer's published field service rate.

H. Any additional time required of the factory trained service technician to assist in placing the equipment in operation or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

## 3.04 FIELD TESTING

A. The Contractor shall obtain water for field testing of pumps from a source approved by the Owner. The Contractor shall be responsible, at no additional cost to the Owner for provision of temporary piping, pumping, and other ancillary equipment necessary for delivery of water to the pump station for pump testing purposes. Test water shall be disposed of as directed by the Owner.

B. Contractor shall provide all labor, piping, equipment, portable flow meters, calibrated gauges or calibrated test gauges, and materials for conducting tests. Tests will not be acceptable if equipment calibration is not within 60 days of the field testing.

C. The pumps shall be tested at start-up by the pump supplier or its authorized representative. The pump supplier shall provide a formal test procedure and forms for recording the test data. The person designated and provided by the manufacturer for start-up services shall be authorized by U.L or F.M. for the service.

D. Each pump system shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, damaging cavitation, or overheating of bearings and to demonstrate the indicated head, flow, and efficiency at the design rating point.

E. Test removal and replacement of all pumps to prove the pumps and guiderail systems are properly installed and aligned using the bridge crane installed under Section 14600.

F. Pump control devices including but not limited to pump start delay timers, vibration monitors/switches, etc shall be tested and adjusted in the field by the manufacturer service representative.

G. After installation of pumping equipment, and after inspection, operation, testing and adjustment have been completed by manufacturer's service representative, conduct running test for each pump in presence of the Engineer to determine its ability to deliver its rated capacity under specified conditions.

1. Field testing shall not be conducted without an approved procedure and calibration certificates for all testing equipment, gauges and flow meters.
2. Contractor shall provide, operate and maintain temporary pumps, piping, gauges and other components necessary to recirculate water from the pump station to the diversion structure or pump station inlet chamber for recycle throughout the testing period.
3. Startup, check and operate each pump system over its entire range of operation. For pumps controlled with variable speed drives, increase the speed range at 100 RPM increments. Vibration shall be within the amplitude limits recommended by the Hydraulic Institute Standards at a minimum of four pumping conditions defined by the Engineer.
4. During tests, observe and record speed/frequency, head, capacity and input kW. Calculate BHP and efficiency for each observation.
5. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.
6. Submit a table of results with a listing of a minimum of 10 test points throughout the pump range including rating points through shut-off head.

## 3.05 SERVICE CAPABILITY

A. Service Facility and Maintenance Agreement

1. The pump supplier shall have a service and repair facility, equipped with proper tools and lifting equipment that is owned and operated by the pump supplier, within a 50-mile radius of the pump station. This facility shall have been in operation for a minimum of 10-years, and shall be staffed with factory certified maintenance personnel. The facility shall have F.M. certified mechanics on staff for servicing of explosion proof pumps. This facility shall be available for inspection by the Engineer during any working hour of a normal business day.
2. The facility shall stock complete sets of seals, bearings, O-rings and wear rings for each pump model to enable a maximum of 72-hour repair after receipt of pump for maintenance or repair.
3. The facility shall have U.L. or F.M. certified mechanics on staff to service the pumps.
4. A scheduled 5-year preventative maintenance and service agreement shall be included in the manufacturer's price with the supply of pumps. Each pump shall be inspected once per year, or every 5,000 hours, whichever comes first. The inspection shall consist of a complete and thorough 20 point mechanical and electrical check of each pump followed by a complete report of the findings. This agreement includes all labor and fluids and grease used for the inspections outlined by the maintenance agreement for each of the pumps for the full 5-year period and assures that all requirements for fulfillment of the pump warranty have been met.

5. The pump supplier shall be responsible for raising the pumps from the wet well; servicing the pumps on the pump station top deck and lowering the pumps back down into the wet well as required for the inspections.

END OF SECTION 11199

# SECTION 11200
# CHOPPER PUMPS

## PART 1 - GENERAL

### 1.01 SCOPE

A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of all chopper pumps and accessories for installation submerged in the Diversion Pump Station wet well and exposed in the Jet Mix Building pump room. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.

B. Contract Drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.

C. Related work specified elsewhere:

1. Section 09900 - Painting.
2. Section 15060 - Piping and Appurtenances
3. Section 15100 - Valves and Piping Appurtenances
4. Division 13 - Instrumentation and Control
5. Division 16 - Electrical

### 1.02 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

1. Manufacturer's data: Dimensions; materials of construction; size and location of anchor bolts, pump base and guide rails, support frame, etc. Provide details of all pump protective control devices, leakage sensors, bearing temperature sensors, motor temperature sensors, etc. to define all components to be included.
2. Data, regarding pump and motor characteristics and performance including:
   a. Guaranteed performance curves (prior to fabrication and testing) based on actual shop tests of mechanically similar pumps, showing they meet specified requirements for head, capacity, horsepower, efficiency and NPSHR.
   b. Provide catalog performance curves at required speed showing maximum and minimum impeller diameters available.
3. Submit curves for guaranteed performance and certified test on 8-1/2-in. by 11-in. sheets, one curve per sheet.

4. Certified results of hydrostatic testing and dynamic balancing.
5. Complete wiring and control diagrams, wiring sizes and wiring specifications.
6. List of recommended spare parts, including those specified herein.
7. Location of nearest authorized pump service center.
8. Recommendations for short and long-term storage.
9. Manufacturer's Certifications.
10. Factory testing procedures, sketch of test setup and results of certified performance testing.
11. Field testing procedures, equipment to be used and calibration certificates. Submit a minimum of two (2) weeks prior to field testing.
12. The pump manufacturer shall submit their requirements for pump exercising during extended periods when process operation is not required as described herein.

B. Submit manufacturer's Installation and Start-up Report upon completion of start-up services.

## 1.03 QUALITY ASSURANCE

A. Reference Standards. Comply with all Federal, State, and local laws and regulations and/or regulatory agency requirements including the partial listing below:

1. NEC, National Electric Code.
2. NEMA, Standards of National Electrical Manufacturers Association.
3. OSHA, Occupational Safety and Health Act.
4. ANSI, American National Standards Institute.
5. ACI, American Concrete Institue
6. ASTM, American Society for Testing Materials.
7. AISI, American Iron and Steel Institute.
8. HI, Hydraulic Institute Standards.
9. ABMA, American Bearing Manufacturer's Association.
10. NFPA, National Fire protection Association.

B. Experience: Equipment furnished under this Section shall be of a design and manufacture that has been successfully used in similar applications. The manufacturer shall have a demonstrated record of successful operation of furnished equipment for a minimum period of five (5) years, and a minimum of five (5) similar applications. Provide a list of such installations complete with installation description, contact names, addresses, and telephone numbers. Contact information shall be up to date and current as of the date of bid opening.

## 1.04 QUALITY STANDARDS

A. All chopper pumps specified in this Section shall be furnished by a single supplier who shall assume sole responsibility for providing a complete, operating systems designed for long life with minimum required maintenance, meeting the requirements specified herein and as shown on the Drawings.

B. Manufacturer shall provide written certification that the equipment provided under this Specification has been amply designed and is a suitable application for these service conditions.

C. Manufacturers offering products that comply with these Specifications include:

1. Vaughan Corporation.
2. Or Equal.

## 1.05 WARRANTY

A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

## 1.06 STORAGE AND PROTECTION

A. Pumps and accessories shall be stored and protected in accordance with the requirements of the General Conditions of the Contract Documents and manufacturer's recommendations.

B. Pump suction and discharge ports shall be provided with plugs or wooden bolted blind flanges. Each pump shall be secured to a wooden skid to facilitate handling and storage.

# PART 2 - PRODUCTS

## 2.01 GENERAL

A. Submersible Chopper Pumps.

1. The submersible chopper pump shall be specifically designed to pump waste solids at heavy consistencies without plugging or dewatering of the solids. Materials shall be chopped/macerated and conditioned by the pump as an integral part of the pumping action.
2. The pump must have demonstrated the ability to chop through and pump high concentrations of solids such as plastics, heavy rags, grease and hair balls, wood, paper products and stringy materials without plugging, both in tests and field applications. The pumps supplied under this specification shall be suitable for continuous operation under submerged or partially submerged conditions. Without de-rating the motor, the pumps shall be able to pump continuously with the minimum water level at the bottom of the motor housing, under full load, without the need of spray system or air moving equipment.
3. The pumps shall be automatically and firmly connected to the discharge connection elbow when lowered into place. Pumps shall be easily removable for inspection or service, requiring no bolts, nuts or other fasteners to be removed for this purpose and no need for personnel to enter the pump wet well. Sealing of the pumping unit to the discharge elbow shall be accomplished by a simple downward motion of the pump with the entire weight of the pumping unit guided to and pressed tightly against the discharge elbow.

4. Pumps and appurtenances, including the pump, motor, guide system and wiring, shall be suitable for operation in the state of Georgia for explosion proof service. Pumps and appurtenances, including the pump, motor, guide system, and wiring shall be approved by a national approved testing agency for installation in the state of Georgia for explosion proof service. The system shall be rated for Class 1, Division 1, Group D service as determined by the National Electrical Code and approved by a nationally recognized testing agency (U.L. or F.M.) at the time of bidding of this Project.

B. Dry Pit Chopper Pumps.

1. The pump shall be specifically designed to pump waste solids at heavy consistencies. Materials shall be macerated and conditioned by the pump as an integral part of the pumping action.
2. The pump must have demonstrated the ability to chop through, mix and pump high concentrations of solids such as plastics, heavy rags, grease and hair balls, wood, paper products and stringy materials without plugging, both in tests and field applications.
3. The dry pit pumps shall be vertical, pedestal mounted or provided with a support frame. Standard TEFC motors will be supplied for dry pit pumps.

## 2.02 OPERATING CONDITIONS

A. Submersible Chopper Pumps.

1. Refer to the Contract Drawings for general arrangements and dimensional limitations. Provide complete submersible pump units designed for the indicated service and free of excessive vibration or hydraulic instability from minimum TDH to shutoff head when operating continuously or intermittently under the conditions herein specified.
2. The operating range of the pump shall include the duty points and shut-off head conditions. The pumps shall be non-overloading throughout the entire acceptable pump operating range.
3. All operating points listed in the performance table below, with the exception of the shut-off head condition shall be located within the preferred operating region of the pump as established by pump manufacturer in accordance with ANSI/HI 9.6.3 and as published in the manufacturer's application data for the specific pump model being proposed.

| PUMP PERFORMANCE TABLE – Submersible Chopper Pumps | |
|---|---|
| Parameter | Value |
| Description | Diversion Pump Station<br>Wet Well Drainage Pumps |
| No. of Pumps (total) | 2 |
| Equipment Tag Numbers | P-204, P-304 |
| Service | Raw Sewage |
| Fluid Temperature | Ambient |
| Min. Shutoff Head, Ft. | 43 |
| Discharge Connection Size, in | 3 |
| Max. Pump Speed, rpm | 1750 |
| Motor Horsepower Rating, Max. | 5 |
| Power Requirements | 480V, 3-phase |
| Type of Drive | Synchronous Speed |
| Pump Mfg./Model No. or equal | Vaughan SE3G-060 |
| Hydraulic Conditions | |
| Design Point | |
| Flow, gpm | 300 |
| TDH, ft | 26.5 |
| Static Head, ft | 19 |
| Minimum Efficiency, % | 45 |
| Minimum NPSHa , ft | 30 |
| Maximum Flow/Minimum Head Condition | |
| Flow, gpm / MGD | 440 |
| TDH, ft | 13.1 |
| Minimum NPSHa , ft | 30 |
| Minimum Flow/Maximum Head Condition | |
| Flow, gpm / MGD | 200 |
| TDH, ft | 33.2 |
| Minimum NPSHa , ft | 30 |

B. Dry Pit Chopper Pumps.

1. Refer to the Contract Drawings for general arrangements and dimensional limitations. Provide complete dry pit pump units designed for the indicated service and free of excessive vibration or hydraulic instability from minimum TDH to shutoff head when operating continuously or intermittently under the conditions herein specified.
2. The operating range of the pump shall include the duty points and shut-off head conditions. The pumps shall be non-overloading throughout the entire acceptable pump operating range.
3. All operating points listed in the performance table below, with the exception of the shut-off head condition shall be located within the preferred operating region of the pump as established by pump manufacturer in accordance with ANSI/HI 9.6.3 and as published in the manufacturer's application data for the specific pump model being proposed.

| PUMP PERFORMANCE TABLE – Dry Pit Chopper Pumps | |
|---|---|
| Parameter | Value |
| Description | Equalization Drainage Pumps |
| No. of Pumps (total) | 2 |
| Equipment Tag Numbers | P-534, P-535 |
| Service | Raw Sewage |
| Fluid Temperature | Ambient |
| Min. Shutoff Head, Ft. | 150 |
| Discharge Connection Size, in | 4 |
| Max. Pump Speed, rpm | 1800 |
| Motor Horsepower Rating, Max. | 50 |
| Power Requirements | 480V, 3-phase |
| Type of Drive | Synchronous Speed |
| Pump Mfg./Model No. or equal | Vaughan PE4P6 |
| Hydraulic Conditions | |
| Design Point | |
| Flow, gpm | 750 |
| TDH, ft | 107.5 |
| Static Head, ft | 80 |
| Minimum Efficiency, % | 55 |
| Minimum NPSHa , ft | 26 |
| Maximum Flow/Minimum Head Condition | |
| Flow, gpm / MGD | 1100 |
| TDH, ft | 87 |
| Minimum NPSHa , ft | 25 |
| Minimum Flow/Maximum Head Condition | |
| Flow, gpm / MGD | 400 |
| TDH, ft | 125 |
| Minimum NPSHa , ft | 30 |

## 2.03 MATERIALS AND CONSTRUCTION

A. Submersible Chopper Pumps.

1. Pump Construction
   a. Casing and Back Pull-Out Plate: The pump casing shall be of volute design, spiraling outward to the flanged centerline discharge. Back pull-out design shall incorporate jacking bolts for accurate adjustment of impeller-to-cutter bar clearance. Casing & backplate shall be ductile iron with all water passages to be smooth, and free of blowholes and imperfections for good flow characteristics. Backplate shall include a replaceable Rockwell C 60 steel cutter adjustable for 0.005-0.015" clearance to cut against the rotating impeller pumpout vanes for removing fiber and debris.
   b. No portion of the pump unit shall bear directly on the floor of the sump. There shall be no more than one 90-degree bend allowed between the volute discharge flange and the station piping.
   c. A spark proof guide system shall be an integral part of the pump unit. The volute casing shall have a discharge flange and sliding bracket 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. The guide system shall be certified by Factory Mutual (FM) to be suitable for Class 1, Division 1, groups C &D environments, when the discharge elbow is not submerged.

d. Provide an ASTM A-48 Class 35 cast iron discharge base assembly including a 90 degree elbow as indicated to support the entire weight of the pump and motor and to secure the lower end of the guide rails.

e. Provide base with 125-lb ANSI B16.1 flange discharging vertically as indicated.

2. Impeller
   a. Impeller: Shall be semi-open type with pump out vanes to reduce seal area pressure. Chopping/maceration of materials shall be accomplished by the action of the cupped and sharpened leading edges of the impeller blades moving across the cutter bar at the intake openings, with a maximum set clearance between the impeller and cutter bar of 0.015-0.025" cold. Impeller shall be cast alloy steel heat treated to minimum Rockwell C 60 and dynamically balanced. The impeller shall be keyed to the shaft and shall have no axial adjustments and no set screws.

3. Pump shafting shall be heat-treated alloy steel.

4. Cutter Bar Plate: Shall be recessed into the pump bowl and shall contain at least 2 shear bars extending diametrically across the intake opening to within 0.010-0.020" of the rotating cutter nut tooth, for the purpose of preventing intake opening blockage and wrapping of debris at the shaft area. Cutter bar shall be alloy steel heat-treated to minimum Rockwell C 60.

5. Cutter Nut: The impeller shall be secured to the shaft using a cutter nut, designed to cut stringy materials and prevent binding using a raised, rotating cutter tooth. The cutter nut shall be cast steel heat treated to minimum Rockwell C 60.

6. Upper Cutter: Shall be threaded into the back pull-out adapter plate behind the impeller, designed to cut against the pump-out vanes and the impeller hub, reducing and removing stringy materials from the mechanical seal area. Upper cutter shall be cast steel heat treated to minimum Rockwell C 60. The upper cutter teeth are positioned as closely as possible to the center of shaft rotation to minimize cutting torque and nuisance motor tripping. The ratio of upper cutter cutting diameter to shaft diameter in the upper cutter area of the pump shall be 3.0 or less.

7. Guide Bars System
   a. Stainless steel guide bars shall be provided as shown on the Drawings and shall be schedule 40, 316L stainless steel pipes attached to the discharge connection at the lower end and to an upper guide bar bracket at the upper end. Intermediate guide bar supports shall be provided at maximum 10 ft spacing. Two guide bars shall be provided for each pump. Guide bars shall not support any of the weight of the pump. Guide rail system shall be non-sparking.

   b. Pump guide rails and supports shall be designed to be adequate to withstand forces associated with pump installation and operation.

B. Dry Pit Chopper Pumps.

1. Casing and Back Pull-Out Adapter Plate: The pump casing shall be of semi-concentric design, with the first half of the circumference being cylindrical beginning after the pump outlet, and the remaining circumference spiraling outward to the 150 lb. flanged centerline

discharge. Back pull-out adapter plate shall allow removal of pump components from the casing, and allow external adjustment of impeller-to-cutter bar clearance. Casing and adapter plate shall be ductile cast iron with all water passages to be smooth, and free of blowholes and imperfections for good flow characteristics.

2. Impeller: Shall be semi-open type with pump out vanes to reduce seal area pressure. Chopping/maceration of materials shall be accomplished by the action of the cupped and sharpened leading edges of the impeller blades moving across the cutter bar at the intake openings, with a set clearance between the impeller and cutter bar of .010" to .015". Impeller shall be cast steel heat treated to minimum Rockwell C 60 and dynamically balanced. The impeller shall be keyed to the shaft and shall have no axial adjustments or set screws required. Open type impellers or impellers without pump out vanes shall not be allowed on this project.

3. Cutter Bar Plate: Shall be recessed into the pump bowl and shall contain at least 2 shear bars extending diametrically across the intake opening to within 0.010-0.015" of the rotating cutter nut tooth, for the purpose of preventing intake opening blockage and wrapping of debris at the shaft area. Cutter bar shall be ASTM A 829, 8620 plate steel heat-treated to minimum Rockwell C 60. Pumps with bolt on cutter bar segments shall not be allowed on this project.

4. Cutter Nut: The impeller shall be secured to the shaft using a special cutter nut, designed to cut stringy materials and prevent binding. The cutter nut shall be cast steel heat treated to minimum Rockwell C 60. Nuts, bolts, or other impeller securing devices that lack the ability to cut debris from the pump suction shall not be allowed on this project.

5. Upper Cutter: Shall be threaded into the back pull-out adapter plate above the impeller, designed to cut against the pump-out vanes and the impeller hub, reducing and removing stringy materials from the mechanical seal area. Upper cutter shall be cast steel heat treated to minimum Rockwell C 60. The upper cutter shall be a replaceable item and be separate from the casing back plate.

6. Pump Shafting: The pump shaft and impeller shall be supported by ball bearings. Shafting shall be heat treated steel, with a minimum diameter of 1.5 inches in order to minimize deflection during solids chopping.

7. Bearings: Shaft thrust in both directions shall be taken up by two back-to-back mounted single-row angular contact ball bearings. Two single-row radial bearings shall also be provided. Bearings shall provide a minimum B10 bearing life of 100,000 hours.

8. Bearing Housing: Shall be ductile cast iron, and machined with piloted bearing fits for concentricity of all components. Bearing housing shall have oil bath lubrication using ISO Gr 46 turbine oil with reservoir, to provide a permanently lubricated assembly. Viton® double lip seals riding on chromed stainless steel shaft sleeves are to provide sealing at each end of the bearing housing.

9. Flushless Mechanical Seal shall be required and be designed to require no seal flush through the elimination of the stuffing box. The seal shall be cartridge-type with Viton O-rings and silicon carbide faces. The cartridge seal shall be pre-assembled and pre-tested so that no seal settings or adjustments are required. Any springs used to push the seal faces together must be shielded from the fluid to be pumped. The cartridge shall also include a 17-4PH, heat-treated seal sleeve and an ductile iron or 316 SS seal gland. The mechanical seal faces shall be lubricated and cooled by a separate oil chamber.

10. The pump assembly shall be mounted vertically on a 90 degree forged steel elbow with 150 lb. standard inlet flange, cleanout and pedestal base. The pedestal base shall support the pump and drive motor.

11. Shaft Coupling: The bearing housing and motor stool design provides accurate, self-aligning mounting for a C-flanged electric motor. Alignment between pump and motor shafts shall be accomplished through the use of a T.B. Woods Sureflex elastomeric type coupling.

12. Stainless Steel Nameplates: Shall be attached to the pump and drive motor giving the manufacturer's model and serial number, rated capacity, head, speed and all pertinent data.

## 2.04 MOTOR

A. Submersible Chopper Pump.

1. Submersible Electric Motor: Shall be U/L listed explosion proof for Class 1, Group D, Division 1 hazardous locations with a 1.15 service factor and Class F insulation. Motor shall be equipped with tandem independently mounted mechanical seals in oil bath and with dual moisture sensing probes. The inner and outer seals shall be separated by an oil-filled chamber. The oil chamber shall act as a barrier to trap moisture and provide sufficient time for a planned shutdown. The oil shall also provide lubrication to the internal seal. The inner seal shall be a standard UL listed John Crane Type 21 or equal, with carbon rotating faces and ceramic stationary faces. The outer seal construction shall be designed for easy replacement. Outer mechanical seal shall be 316 stainless steel metal bellows type with silicon carbide or tungsten carbide faces. Seal shall be positively driven by set screws. Elastomers shall be of Viton. Motor shall include two normally closed automatic resetting thermostats connected in series and imbedded in adjoining phases. Motor frame shall be cast iron, and all hardware and shaft shall be stainless steel.

2. Cables
   a. Power and control cables shall be suitable for submersible pump applications and shall be indicated by a code or legend permanently embossed on the cable.
   b. 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.

B. Dry Pit Chopper Pump.

1. Drive motor shall be 50 HP, 1800 RPM, 460 volts, 3 phase, 60 hertz, Premium Efficient, Severe Duty, 1.15 service factor, C-flange mounted, in a TEFC enclosure. The motor shall be sized for non-overloading conditions. See Section 16150 for additional motor requirements.

## 2.05 SPECIAL OPERATING CONDITIONS

The pumping systems may not be required to operate to meet the process requirements for extended periods of up to several months when there is no flow into the pump station. The manufacturer shall consider these conditions and specify any special maintenance requirements necessary to guarantee the long term operability of the equipment. It is anticipated that during the extended periods of inactivity, the pumps will be cycled or "bumped" for short periods for maintenance purposes. This process will occur "dry" with no water in the wet well. The pump manufacturer shall specify the frequency and duration required for each pump cycle for each set

of pumps. These settings will be included in the main control system. The manufacturer shall also include any other special maintenance requirements for their equipment to meet these conditions. This information will be submitted with the shop drawings as specified above.

## 2.06 FACTORY PAINTING

A. All metal surfaces coming into contact with the pumped media, other than stainless steel, shall be protected by a factory applied coating in accordance with Specification Section 09900.

B. The pump manufacturer shall provide extra finish coat similar to the factory applied finish coating for Contractor touch up painting in the field.

## 2.07 SPARE PARTS

A. The pump supplier shall provide a list of recommended spare parts and shall indicate what items are stocked and which items are special orders. The spare part list below shall be supplied at a minimum.

| Item | Qty. for each pump set |
|---|---|
| Bearing set | 1 |
| Gasket or O-ring service set | 2 |
| Cutters and Cutter Bar Plate | 2 |
| Mechanical Seal Assembly | 1 |

# PART 3 - EXECUTION

## 3.01 INSTALLATION

A. Equipment Installation: All equipment shall be installed in accordance with the approved shop drawings and manufacturer's recommendations.

B. Anchorage: Stainless steel anchor bolts, nuts and washers, as well as any templates necessary for setting the anchorage, shall be furnished by the equipment manufacturer. Placement of the anchor bolts shall be done by the Contractor from certified dimension shop drawings supplied by the equipment manufacturer.

C. Leveling and Grouting

1. Level and align pump and guide bars in accordance with the respective manufacturer's published data.
2. Grout pump mounting base as required with non-shrink grout in accordance with the ACI, equipment manufacturer's and grout manufacturer's published specifications.

## 3.02 FACTORY INSPECTION AND TESTING

A. Each pump shall be tested for performance at the factory as specified herein. Submersible pumps shall include additional testing as described under item C. below

B. Impeller, motor rating and electrical connections shall first be checked for compliance to specific requirements. Impeller shall be visually inspected to certify that it is free of defects.

C. Submersible Testing shall include but not limited to the following:

1. Conduct mechanical and electrical motor integrity tests in accordance with ANSI/HI 11.6
2. Motor and cable insulation test for moisture content or insulation defects.
3. After a submerged test run of thirty (30) minutes, Item 2 shall be retested.
4. If any deviation of above is found, the pump shall be rejected.

D. Hydrostatic Test

1. Hydrostatically test each pump casing under a hydrostatic head of 100 psig or 150 percent of rated shutoff head, whichever is greater. Tests shall be performed using the complete pump system to be furnished. Testing of prototype models will not be acceptable.

E. Capacity Testing

1. Run pump at full speed rating point for sixty (60) minutes prior to start of any testing.
2. Full Speed Test: Test pump at the specified conditions and record and tabulate readings of flow, differential pressure, BHP, efficiency, NPSHR, input kW, voltage, frequency, and power factor for each test point.
3. Furnish certified performance tests as specified for all pumps.
4. Furnish a certification that the pump horsepower demand did not exceed the rated motor horsepower beyond a 1.0 service rating at any of the test points.

## 3.03 PAINTING

A. After installation and approved field testing by the Engineer, the Contractor shall apply touch-up paint to all scratched, abraded and damaged shop painted surfaces. Coating type and color shall match shop painting.

## 3.04 MANUFACTURER SERVICES

A. Furnish the services of trained service technician, certified by the manufacturer to service the type of equipment specified in accordance with the requirements of the General Conditions of the Contract Documents and as specified herein.

B. The service representative must be present on site for all items listed below. Work-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

C. Assistance during functional and performance testing and startup demonstration, and product acceptance by the Owner.

1. 1 work-day.

D. Training of Owner's personnel in the operation and maintenance of equipment as required. Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom session.

1. ½ work-day.

E. For the purposes of this paragraph, a work day is defined as an eight (8) hour period at the Project site, excluding travel time.

## 3.05 FIELD TESTING

A. The Contractor shall obtain water for field testing of pumps from a source approved by the owner. The Contractor shall be responsible, at no additional cost to the Owner for provision of temporary piping, pumping, and other ancillary equipment necessary for delivery of water to the pump station for pump testing purposes. Test water shall be disposed of as directed by the Owner.

B. Contractor shall provide all labor, piping, equipment, portable flow meters, calibrated gauges or calibrated test gauges, and materials for conducting tests. Tests will not be acceptable if equipment calibration is not within sixty (60) days of the field testing.

C. The pumps shall be tested at start-up by the pump supplier or its authorized representative. The pump supplier shall provide a formal test procedure and forms for recording the test data.

D. Each pump system shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, damaging cavitation, or overheating of bearings and to demonstrate the indicated head, flow, and efficiency at the design rating point.

E. Test removal and replacement of all pumps to prove the pumps and guiderail systems are properly installed and aligned using the bridge crane installed under Section 14600.

F. After installation of pumping equipment, and after inspection, operation, testing and adjustment have been completed by manufacturer's service representative, conduct running test for each pump in presence of the Engineer to determine its ability to deliver its rated capacity under specified conditions.

G. Field testing shall not be conducted without an approved procedure and calibration certificates for all testing equipment, gauges and flow meters.

1. Startup, check and operate each pump system over its entire range of operation. Vibration shall be within the amplitude limits recommended by the Hydraulic Institute Standards at a minimum of three pumping conditions defined by the Engineer.
2. During tests, observe and record head, capacity and input kW. Calculate BHP and efficiency for each observation.
3. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.
4. Submit a table of results with a listing of a minimum of four (4) test points throughout the pump range including rating points through shut-off head.

## 3.06 SERVICE CAPABILITY

A. Service Facility and Maintenance Agreement

1. The pump supplier shall have a service and repair facility, equipped with proper tools and

lifting equipment that is owned and operated by the pump supplier, within a fifty (50)-mile radius of the pump station.

2. The facility shall stock complete sets of seals, bearings, O-rings and cutter parts, etc. for each pump model to enable a maximum of seventy-two (72) hour repair after receipt of pump for maintenance or repair.

3. The facility shall have U.L. or F.M. certified mechanics on staff to service explosion proof pumps.

END OF SECTION 11200

# SECTION 11221
# JET MIX SYSTEMS

## PART 1 - GENERAL

### 1.01 SCOPE

A. Work under this section includes furnishing, installing and testing of the jet mixing system for the equalization tank. The jet mixing system shall be comprised of the jet manifolds, manifold supports, recirculation pumps, nozzles, control description and all necessary appurtenances as specified herein. All internal piping shall be designed and supplied by the Manufacturer to the connection at the tank wall internal nozzles. The jet mixing nozzles, headers and mixing pumps shall be provided as a complete system by the jet mix system supplier.

B. The Contractor shall be responsible for the overall design and operation of the jet mix system based on the performance information specified herein.

C. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.

D. Related Sections include but are not necessarily limited to:

1. Section 01600: General material and Equipment Requirements
2. Section 09900: Painting and Protective Coatings
3. Section 13150: Instrumentation and Controls Logic Description

### 1.02 SUBMITTALS

A. Submittals shall include, as a minimum, the following information as it relates to the equipment and operating system:

1. Shop drawings shall indicate totally the scope of the work included with the jet mix system and contain an itemized list of all deviations or exceptions to the specifications, structural configuration, drawings and details.
2. Data sheets and performance requirements for all ancillary equipment, including but not limited to mixing pump performance, construction and required support details, in-basin piping system and foundation and anchor bolt requirements.
3. Drawings showing dimensions and details of all major components and minimum recommended spacing, equipment arrangements and piping drawings.
4. Schedule of shop and field coating systems.
5. Recommended spare parts.
6. O&M Manuals.

7. List of consumables.
8. Start-up and installation requirements.
9. Installation and start-up report for each system.

## 1.03 ACCEPTABLE MANUFACTURERS

A. Mixing Systems, Inc.

B. Kla Systems

C. Or Equal.

## 1.04 WARRANTY

A. The Contractor shall furnish Manufacturer's certification and warranty that the system will perform as described in these Specifications and warrant the jet mix system, complete to be free from defects in materials or workmanship for a period of one (1) year from Owner's acceptance. The Contractor shall repair or provide replacement of any defective components under this warranty.

# PART 2 - PRODUCTS

## 2.01 GENERAL

A. The Contractor shall be responsible for the design of the system to achieve the performance requirements specified herein.

B. The Jet Mixing system shall consist of two submerged directional jet mixer(s), each provided with in-basin liquid distribution piping, and necessary supports and hardware. Liquid recirculation shall be provided by two external centrifugal dry pit vertical immersible pumps.

C. All pumps, in-tank piping, pipe supports, and appurtenances required for a complete and operable jet mixing system shall be provided by the Manufacturer.

D. The Directional Jet Mixer shall be Model DJM as manufactured by Mixing Systems, Inc., Dayton, Ohio or equal.

E. Design Criteria

| | |
|---|---|
| Tank Volume | 10 Million Gallons |
| Tank Internal Diameter | 185 feet |
| Bottom Slope | 1 : 12 |
| Tank Maximum Water Depth | 50 feet (vertical wall height) |
| Number of Mixing Headers | 2 |

F. The Directional Jet Mixing System shall be designed to completely mix the entire tank/basin contents once every 100 minutes and shall be designed to operate from a tank empty (pump stop

elevation) to full tank condition. With the tank full, the bulk fluid velocity shall be 0.6 fps or greater with a circular mix flow pattern in the tank.

G. Coordinate dynamic thrusts and other forces imparted on tank walls with tank design/manufacturer.

## 2.02 PUMPS

A. Jet Mix System Manufacturer shall determine the final recirculation pump capacity and discharge head according to the performance requirement of the System's jet nozzles, piping and requirements set forth herein. System shall effectively maintain homogenous mixture of raw sewage that has passed through grinding equipment as specified in Section 11332. The Jet mix system manufacturer shall be responsible for selecting pumps suitable for the pumping conditions and installation requirements.

B. Pumps shall be suitable for raw sewage service. Pumps shall be submersible type designed for vertical installation in a dry-well as shown on the drawings. The pumps will run continuously in air. No cooling water is provided.

C. All major parts of the pump such as the pump casing, stator casing, oil casing, etc. shall be of ASTM A-48 Class 35 minimum gray iron. All exposed bolts and nuts shall be 316 stainless steel.

D. The impeller shall be ASTM A-48 Class 35 minimum gray iron, of non-clogging design, capable of handling solids, fibrous material, heavy sludge and other matter found in normal sewage applications. The casting shall have smooth surfaces devoid of blow holes or other irregularities. The impeller shall be dynamically balanced. Static and dynamic balancing operations shall not deform or weaken it.

E. Pumps shall be nominal 100 HP suitable for operation on 460 Volt, 3 phase, 60 Hertz service.

F. Provide any and all piping, electrical, and structural adjustments necessary to suit the jet mix system components and required configuration.

G. Pumps shall be provided with a cast iron or fabricated steel support base for installation on the concrete foundations as shown on the drawings. Base shall be designed for the maximum possible loads of the pumps provided.

## 2.03 JET HEADER

A. Each Directional Jet Mixer shall be comprised of integrally fabricated liquid headers equipped with 48 jet nozzles. The jet nozzles shall be mounted on one side of the liquid header, equally spaced along the length of the manifold. Recirculated liquid shall enter the liquid header through a 24 inch flanged connection and the induced circulation shall enter through individual entrainment openings located on each jet nozzle.

B. The jet mixer shall be designed to provide uniform distribution of the recirculated liquid to each jet nozzle. The recirculated liquid and induced circulation shall be combined in the secondary jet nozzle and the resultant stream shall be discharged horizontally as a high energy jet in the lower regions of the basin. Each jet manifold assembly shall be shipped in the maximum lengths practical for transport and filed installation.

C. The liquid duct shall be a cylindrical member that shall be internally smooth and free from protrusions that might collect stringy material. The jet nozzles shall be aligned on a common horizontal plane. Resin to be used for the construction of the jet mixers shall be Ashland 922.

D. Individual feeds shall ensure uniform liquid distribution to each jet. Supports shall be provided as necessary. The liquid header shall be fabricated of corrosion resistant, structurally sound, filament wound, fiberglass reinforced thermosetting resin pipe conforming to ANSI/ASTM specification D-2996-81. Each jet nozzle shall consist of an inner liquid nozzle and outer liquid discharge nozzle fabricated from fiberglass reinforced plastic in accordance with NBS specifications PS-15-69. Wall thicknesses shall be as follows:

| Diameter | Wall Thickness, inches |
|---|---|
| 14-inch ∅ I.D. | 0.31 |
| 16-inch ∅ I.D. | 0.31 |
| 18-inch ∅ I.D. | 0.36 |
| 20-inch ∅ I.D. | 0.36 |
| 24-inch ∅ I.D. | 0.41 |
| Nozzles | 0.38 |

E. The piping used for the construction of jet mixers and liquid pipes shall have a 100 mil corrosion liner on the pipe inside diameter.

F. The jets shall be molded and assembled to be concentric with the inner liquid and outer discharge nozzle in axial alignment. The secondary discharge nozzles shall be of constantly decreasing cross-sectional area so as to increase the velocity of the secondary mixture originating from the inner nozzle and the induced flow chamber.

G. The outlets of both the inner and outer nozzles shall be circular and shall be capable of passing a 1.5 inch spherical solid and be free from all protrusions which may collect stringy material. The secondary discharge nozzle shall have a circular orifice outlet having a diameter of from 1.7 to 1.9 times the primary liquid nozzle outlet diameter. The diameter of the secondary nozzle shall increase in the direction of the inner liquid nozzle with an included angle which shall be greater than 10° and less than 30° for at least 6-inches along the horizontal flow path of the secondary nozzle. Nozzles shall have an abraision resistant coating on the nozzle annular space. Attachment hardware for the flanges and supports shall be Type 18-8 stainless steel.

## 2.04 IN-TANK PIPING

A. All in-tank piping shall be provided as a part of the system. The piping shall be of adequate length and diameter to transport the motive liquid from each flange on the inside of the tank wall to the jet headers. In-tank piping shall be machine filament wound, fiberglass reinforced thermosetting resin pipe fabricated using Vinyl Ester resins in strict accordance with ASTM Specification D-2996. Design working pressure for the piping system shall be 100 psi minimum.

B. Flanged connections shall be provided for connecting the jet system headers to the out-of-basin piping (by others). Gaskets and Type 18-8 stainless steel connection hardware shall be supplied for all connections except supplier/contractor interface. Piping shall be assembled in the field by the installation contractor. Installation hardware and FRP field wraps are to be supplied by the installation contractor.

C. The limits of in-tank liquid piping to be provided shall be from the jet header to the tank mounted nozzle connection and shall include a flexible coupling at the tank nozzle connection.

## 2.05 SUPPORTS

A. All necessary supports and hardware for installation of the System in the tank shall be provided as part of the System by the manufacturer. All hardware supplied shall be Type 316L stainless steel.

B. All submerged supports shall be constructed of Type 316 stainless steel and spaced on a maximum of ten (10) feet centers.

C. Pipe supports shall include a contoured saddle welded to a supporting base. The support base shall be anchored to the tank floor with epoxy set anchor bolts. A bolted clamp shall hold the piping to the saddle. The saddle and clamp shall be provided with Neoprene rubber pads to prevent abrasion. Stainless steel anchor bolts of minimum 1/2 inch shall be provided by the System manufacturer.

## 2.06 ADDITIONAL EQUIPMENT

A. Flexible coupling between tank nozzles and internal piping and other appurtenances as detailed and specified.

## 2.07 MISCELLANEOUS

A. Nuts, bolts, and washers shall be ASTM A276 18-8 type 304 stainless steel. Other non-welded parts shall be ASTM A473 Type 316L stainless steel. Threaded assemblies shall be chemically treated or lubricated prior to assembling to prevent galling.

# PART 3 - EXECUTION

## 3.01 FABRICATION:

A. All fiberglass reinforced plastic molding and lamination shall be done in factory. No field molding and lamination shall be permitted. Liquid manifold sections shall be shipped in the longest lengths possible. The manifold sections shall be field connected utilizing flange by flange connections.

## 3.02 INSTALLATION

A. The system shall be installed and adjusted/leveled in accordance with the manufacturer's written instructions.

B. Contractor shall provide all recommended oils, greases and lubricants required for initial start-up and operation.

## 3.03 PERFORMANCE TESTS

A. The test procedures specified in this section are a valid basis for determining the ability of the jet mix system to meet the performance requirements specified.

B. After complete installation of the jet mix system, the Contractor, under the direction of the manufacturer's representative, shall conduct in the presence of the Owner, or Owner's

representative, such tests as are necessary to ensure that jet mix system operation conforms to the Specifications. Field tests shall include all testing and measurement equipment. Field tests shall validate compliance with specified performance requirements.

C. Verify a bulk fluid velocity of 0.6 fps or greater for a circular mix flow pattern in the tank when filled (full) with water or other Contractor supplied test medium. The velocity measurements shall represent a spatial average of no less than 4 elevations and 4 radial locations (16 points) within the lower 8 feet of the tank depth. Measurement locations shall be equally spaced vertically and radially. Radial locations shall be at a 45° angle between mix headers throughout the tank utilizing a Doppler or propeller type velocity meter. Submit details for monitoring and recording data and mounting instrumentation. Alternate testing requirements can be proposed by the jet mix manufacturer for approval by the Engineer.

## 3.04 MANUFACTURERS SERVICES

A. A manufacturer's representative for the equipment specified herein shall be present at the jobsite and/or classroom designated by the Owner for installation assistance, start-up, testing and training. The minimum man-days listed for the services excluding travel time shall be:

1. Six, 8-hour days over three trips for installation assistance, inspection, testing and certification of the installation

B. Training of Owner's personnel shall be at such times as requested by the Owner.

## 3.05 CLEANING

A. Prior to acceptance of the Work of this Section, thoroughly flush and clean all installed equipment, materials and related areas.

## 3.06 PAINTING

A. The Contractor shall provide field paint touch-up of all installed in-tank equipment in accordance with the manufacturer's standard finish coating system. All equipment installed in the EQ pump station and external to the tanks shall be coated in accordance with Section 09900.

END OF SECTION 11221

# SECTION 11284
# SLUICE GATES

## PART 1 - GENERAL

### 1.01 SCOPE

A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of sluice gates. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings. The sluice gate manufacturer shall be responsible for the complete gate system including the design and supply of the electric gate operators.

B. Contract Drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the work shown and specified.

C. Related work specified elsewhere:

1. Section 01600, General Material and Equipment Requirements

### 1.02 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

1. Manufacturer's data, materials of constructions and dimensions drawings showing all details, dimensions, mounting requirements, operational clearances, and any other information required to completely define the gates to be provided.
2. Relevant experience references.
3. Complete wiring and control diagrams.
4. Operation and maintenance manuals.
5. Manufacturer's certification.
6. Installation and start-up report for each unit.

### 1.03 QUALITY ASSURANCE

A. Reference Standards: Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:

1. NEC, National Electrical Code.
2. NEMA, National Electrical Manufacturers Association

3. OSHA, Occupational Safety and Health Act.
4. ANSI, American National Standards Institute.
5. ASTM, American Society for Testing Materials.
6. AISI, American Iron and Steel Institute.
7. AGMA, American Gear Manufacturer's Association.
8. ABMA, American Bearing Manufacturer's Association.
9. AWWA, American Water Works Association

B. Experience: Equipment furnished under this Section shall be of a design and manufacturer that has been successfully used in similar applications. The manufacturer shall have furnished equipment for a minimum of five similar applications that have a demonstrated record of successful operation for a minimum period of 5 years. Provide a list of such installations with installation description, contact names, addresses and telephone numbers.

C. Should the gates not perform as required, the Contractor shall repair or replace any units as necessary to meet the Specifications. Costs for unit repair and retesting shall be the Contractor's responsibility.

## 1.04 QUALITY STANDARDS

A. The sluice gates shall be furnished by a single manufacturer who shall assume full responsibility for providing a complete, operating system designed for long life with a minimum of required maintenance meeting the requirements specified herein and as shown on the Drawings. The Contractor shall assign unit responsibility as specified in Section 01600, General Material and Equipment Requirements, to the sluice gate equipment manufacturer for equipment specified in this Section. A certificate of unit responsibility shall be provided.

B. Manufacturers shall provide written calculations and other data demonstrating that the equipment provided under this Specification has been amply designed and is a suitable application for these service conditions.

C. Manufacturers offering products that comply with these Specifications include:

1. Rodney Hunt Company
2. Whipps
3. Waterman Industries
4. Or equal.

## 1.05 WARRANTY

A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

## PART 2 - PRODUCTS

### 2.01 GENERAL

A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired only.

B. Specific information relative to the various sluice gates including gate type, identification numbers, design head conditions, gate sizes, mounting requirements, methods of operation, operator type, and other information is tabulated within the Gate Schedule as shown on the Process drawings.

C. All gates shall be complete including all gates, guides, frames, bench stands, floor stands, baseplates, brackets, anchor bolts, stems, stem guides, operators, and all other necessary appurtenances.

### 2.02 SLUICE GATES

A. General

1. Gates and appurtenances shall be supplied in accordance with the latest edition of ANSI/AWWA C560 Standard for Cast Iron Slide Gates as modified herein.
2. Leakage shall not exceed 0.01 gpm/ft of wetted seal perimeter in seating head and 0.02 gpm/ft of wetted seal perimeter in unseating head conditions
3. Sluice gates shall meet the design requirements shown in the Gate Schedule included on the Process Drawings.
4. All surfaces of gate in contact with concrete shall be shop coated with an alkali resistant coating.
5. All exposed surfaces shall be of corrosion resistant material or painted with a protective coating suitable for wastewater environment.

B. Materials of construction for sluice gate components are specified as follows:

1. Frame, Slide, Wall Thimble, Pedestal, Gear Housing, Wall Brackets, and Stem Guide Brackets: Ni-Resist cast iron, ASTM A436, Type 2 or 2b
2. Wedge and Wedge Blocks: Monel, Federal Spec. QQ-N-288, Composition A
3. Lift Nut Bronze: ASTM B584, Alloy C86500
4. Stem Block Stainless steel: ASTM A743, CF8M
5. Seating Faces: Monel, ASTM B164, UNS N04400 or N04405
6. Stems and Stem Couplings: Monel, ASTM B164, UNS N04400 or N04405, Cold Worked
7. Fasteners Stainless Steel: ASTM F593/F594, Alloy Group 2 (316)
8. Flush-Bottom Seal: Neoprene, ASTM D2000
9. Flush-Bottom Retainer Stainless steel: ASTM A276, Type 316

C. Guides and Frames

1. The gate frame and guides shall be one-piece integral cast iron casting.
   a. Frame design shall allow for mounting directly to a wall with stainless steel anchor bolts and grout or mounting to a wall, wall thimble, or a pipe flange. Frames with a spigot-back arrangement are not allowed. Mounting style shall be as shown on the Contract Drawings.
   b. Round opening gates shall have a circular flange cast as part of the frame for mounting to a wall or pipe flange.
   c. All wall thimble-mounted gates shall have a square or rectangular flanged-back frame. The frame shall be fully machined and drilled to match the wall thimble.
   d. The frame shall extend to support a minimum of one-half the entire height of the slide when the slide is in the fully opened position on upward opening gates or downward opening weir gates.
   e. On self-contained gates, a yoke shall be provided across the top of the frame. The yoke shall be cast iron or structural steel to provide a rigid assembly. The yoke shall be designed to allow removal of the slide. The yokes shall be bolted to machined pads on the gate frame.

D. Seating Faces

1. Corrosion-resistant seating faces shall be mounted around the perimeter of the slide and frame. They shall be impacted into dovetail slots and held in position without use of screws or other fasteners.

E. Wedges

1. Each gate shall be provided with a sufficient number of wedges to provide water-tightness.
   a. Side wedging devices shall be designed to make full metal-to-metal contact with the overhung portion of the frame-mounted wedge block.
   b. Wedges shall be fully adjustable and keyed to prevent any lateral rotation.
   c. Side wedges shall be machined with angled faces and secured with a stud bolt to prevent any slippage during operation of the gate.
   d. Gate shall be designed with adjustable top and bottom wedges attached to the frame and slide. Wedges shall be mounted in such fashion that prevents lateral rotation.
   e. For flush bottom seals, the differential pressure on the rubber seal shall be variable by adjustment of wedges on the gate.

F. Slide

1. The gate slide shall be cast iron and shall be of one-piece construction. The slide shall be square or rectangular in shape with integrally cast vertical and horizontal reinforcing ribs to ensure rigidity.
2. The slide shall be designed to operate under maximum specified unbalanced head with the minimum safety factory of five. Guide tongues along each side of the slide shall be machined all over. A nut pocket shall be cast on the vertical centerline of the gate and shall be provided with a threaded block for attaching the stem to the slide.

Pads for side wedges and top and bottom wedges, when required, shall be integrally cast on the slide and machined to receive the adjustable wedges.

G. Stem

1. A threaded operating stem shall be utilized to connect the operating mechanism to the slide. On rising stem gates, the threaded portion shall engage the operating nut in the manual operator or motor actuator. On non-rising stem gates the threaded portion shall engage the nut on the slide.
   a. The threaded portion of the stem shall have a minimum outside diameter of 1-1/2 inches. Stem extension pipes are not acceptable.
   b. The stem shall be constructed of solid stainless steel bar for the entire length, the metal having a tensile strength of not less than 75,000 psi.
   c. The stem shall be threaded to allow full travel of the slide unless the travel distance is otherwise shown on the Contract Drawings.
   d. Maximum L/R ratio for the unsupported part of the stem shall not exceed 200.
   e. The threaded portion of the stem shall have machine rolled threads of the full Acme type with a 16 microinch finish or better. Stub threads are not acceptable.
   f. Stems of more than one section shall be joined by stainless steel or bronze couplings. The coupling shall be bolted to the stems.
   g. Stems, on manually operated gates, shall be provided with adjustable stop collars to prevent over closing of the slide.

H. Stem Guides

1. Stem guide shall be provided when necessary to ensure that the maximum L/R ratio for the unsupported part of the stem is 200 or less.
   a. Stem guide brackets shall be fabricated of stainless steel and shall be outfitted with UHMW or bronze bushings.
   b. Stem Guides shall be adjustable as required to provide proper alignment.

I. Wall Thimbles

1. Wall thimbles shall be provided when shown or specified on the Contract Drawings.
   a. The wall thimble depth shall be equal to the thickness of the concrete wall in which the thimble is to be mounted.
   b. Wall thimble shall be a heavy, one-piece iron casting of an E, F or mechanical joint type configuration.
   c. The wall thimble shall be square and plumb and the front face is sufficiently flat to provide a proper mounting surface for the gate frame.
   d. A water stop shall be welded around the periphery of the thimble. Wall thimbles shall be designed to allow thorough and uniform concrete placement during installation.
   e. Studs and nuts shall be stainless steel.
   f. A suitable gasket or mastic shall be provided to seal between the gate frame and the wall thimble.

J. Flush-Bottom Seal

1. Flush-bottom gates shall be provided with a frame-mounted flush-bottom solid bulb resilient rubber seal.
2. The full length of the bottom edge of the slide shall make uniform contact with the seal.

K. Yokes

1. Yokes of self-contained gates shall be cast iron or structural steel. They shall be designed to withstand the thrust of the manual lift when a 40 pound pull is placed on the handwheel or crank with a safety factor of 5 based on the ultimate strength of the material used. The yokes shall be bolted to machined pads on the gate frame.

## 2.03 STEM COVERS

A. Each rising stem type gate shall be provided with a transparent plastic vented pipe stem cover and cap. Stem covers shall be guaranteed not to discolor, crack, or become opaque for at least 5 years after installation Provide stem covers with OPEN/CLOSED designators with 1-inch graduations on clear mylar pressure sensitive, adhesive tape, suitable for outdoor application.

## 2.04 GATE OPERATORS

A. General

1. Operators shall meet ANSI/AWWA C540, Standard for Power Actuating Devices for Valves and Slide Gates, except as otherwise specified, and shall be designated to meet the operating requirements specified in the gate schedule.
2. Unless otherwise indicated, operators shall be located 36 inches above the operating floor.

B. Motor Operator

1. Each motor operated gate shall include an electric gate actuating unit mounted on and assembled to the gate. Actuators shall be electric motor driven gear reducer with integral controls and thrust bearing. The actuator shall be sized to open and close the gate at the operating pressure as determined by the gate manufacturer.
2. Each unit shall consist of a motor, reduction gearing, handwheel gearing, operating limit switches and torque limiting switches within one NEMA rated enclosure. All actuators located outdoors shall have thermostatic strip heater to prevent condensation.
3. Each motor shall be high torque, totally enclosed in a NEMA rated housing. The motor starting torque shall be equal to 2-½ times the running torque. The motor shall have AIEE standard Class F insulation. The grease tight operation shall be assured by the use of dual motor shaft seals.
4. The gearing shall be combined helical/spur and worm gear type, accurately machined. Helical gears shall be alloy steel, hardened and ground. Gearing shall be grease lubricated, with high speed parts on antifriction bearings. An inspection plate on the housing shall be provided to allow inspection of the handwheel declutching mechanism, the motor gears, and for re-lubrication.

5. Each unit shall include a handwheel for manual operation of the valve drive sleeve through direct gearing. The handwheel shall not rotate during electrical operation. The motor shall not rotate during hand operation. In no case will the handwheel ever be connected with the motor. When the unit is being operated manually, it shall be automatically returned to the electric operation when the handwheel is released. Handwheel shall be lockable to prevent unauthorized access.

6. The transfer from electric to manual operation shall be accomplished by a declutching lever arm which will disengage the motor mechanically but not electrically. The unit shall be capable of being clutched or declutched when operated electrically with no damage to the clutch or gear mechanism.

7. The actuator shall operate on power supply specified on the electrical drawings and the Gate Schedule on Drawing D0-602. All controls shall operate on 115 volt AC power and a control power transformer shall be provided within the unit as required.

8. The controls shall provide a reversing actuator, mechanical and electrical interlock, and thermal overload relays. The contactor shall break all lines to the motor.

9. Position limit switches shall be provided for both open and close positions of travel and shall be connected directly to the gate through continuous gearing, and follow its position at all times. Mechanisms employing intermittent tooth gearing and rotary drive switches are not acceptable.

10. A double acting, adjustable torque limit switch shall be provided, capable of detecting excessive torque caused during seating, unseating, or obstructions. Torque control accuracy shall be within ± five percent.

11. The controls shall provide for local and remote operation. The local pushbutton control shall be provided with open, close and stop pushbuttons, open and close indicator lights, local/remote selector switch. In "REMOTE" actuator shall accept a form "C" dry contact for OPEN/CLOSE operation. In "REMOTE" the Selector Switch shall close a separate set of dry contacts to provide remote status that the Local-Off-Remote selector switch is in the REMOTE position.

12. Actuators shall be NEMA 6/IP68 rated for submerged service to 45 ft. for 96 hours.

13. When specified on the schedule, actuators shall include a lockable vandal resistant cover that will completely enclose the actuator as necessary to prevent unauthorized access to any of the actuator comonents.

14. Motorized actuators shall be Rotork, IQ, Limitorque MX Series or equal.

## 2.05 ACCESSORIES

A. All necessary attaching bolts, anchor bolts, mounting and assembly hardware shall be of Type 316 stainless steel and shall be furnished by the slide gate manufacturer.

# PART 3 - EXECUTION

## 3.01 INSTALLATION

A. Insofar as practical, the sluice gate assemblies shall be completely factory assembled, shipped as a unit, disassembled on site and installed in strict conformance with the manufacturer's recommendations. The parts and assemblies that are, of necessity shipped unassembled shall be

packaged and tagged in a manner that will protect the equipment from damage and facilitate the final identification and assembly in the field.

B. All anchor bolts and necessary bolt setting plates shall be provided by the manufacturer. Two nuts shall be provided for each anchor bolt, and anchor bolts shall be cast-in-place during

C. All stainless steel bolts shall be coated with an anti-galling compound before the nuts are attached and tightened.

D. All gates shall be thoroughly cleaned and shall operate without vibration or binding.

## 3.02 FIELD TESTS

A. Field leakage tests shall be performed as specified in AWWA C560.

B. Field leakage tests shall be conducted with no head on the side being tested.

## 3.03 MANUFACTURERS' SERVICES

A. Manufacturers' services shall be provided in accordance with Section 01600, General Material and Equipment Requirements. A manufacturer's representative for the equipment specified herein shall be present at the jobsite and/or classroom designated by the Engineer for the minimum days listed for the services herein, travel time excluded:

1. A minimum of two trips of 1 day duration each trip for installation assistance, inspection, functional and performance testing, and certification of the installation.

END OF SECTION 11284

# SECTION 11332
# OPEN CHANNEL ELECTRIC GRINDERS

## PART 1 - GENERAL

### 1.01 SCOPE

A. This section of the specification describes the submersible sewage grinders and controllers. The equipment shall be installed as shown on the plans, as recommended by the supplier, and in compliance with all OSHA, local, state and federal codes and regulations.

B. Contract Drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.

C. Related work specified elsewhere:

1. Division 13 – Instrumentation and Controls
2. Section 13150 Instrumentation and Controls – General Description
3. Section 13200 Control Panels
4. Section 13250 Control Panel Components
5. Section 13270 Surge and Lightning Protection
6. Section 13400 Programmable Controllers
7. Division 16 - Electrical

### 1.02 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

1. Manufacturer's data: Dimensions; materials; size and location of all loads imposed on supporting structures; size and location of any concrete blockouts; size and location of anchor bolts and any required clearances.
2. Performance data for grinder and motor including hydraulic performance curves showing flow rate and head loss, motor characteristics, etc.
3. Details of all grinder control panels, protective control devices, leakage sensors, bearing temperature sensors, motor temperature sensors, etc. to define all components to be included.
4. Factory testing procedures and factory test results.
5. Field testing procedures, equipment to be used and calibration certificates. Submit a minimum of 2 weeks prior to field testing.
6. Complete wiring and control diagrams, wiring sizes and wiring specifications.

7. List of recommended spare parts, including those specified herein.
8. Location of nearest authorized service center.
9. Recommendations for short and long-term storage.
10. Operation and Maintenance Manuals. The supplier shall provide three (3) printed copies Operation & Maintenance manuals and three (3) electronic copies on compact disk. The manuals shall include equipment descriptions, operating instructions, drawings, troubleshooting techniques, a recommended schedule, and the recommended lubricants.
11. Manufacturer's Certification as specified herein.
12. The grinder manufacturer shall submit their requirements for grinder exercising during extended periods when process operation is not required as described herein.
13. Installation and start-up report for each unit grinder unit/system.

## 1.03 QUALITY ASSURANCE

A. Reference Standards. Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:

1. NEC, National Electric Code.
2. NEMA, Standards of National Electrical Manufacturers Association.
3. OSHA, Occupational Safety and Health Act.
4. ANSI, American National Standards Institute.
5. ASTM, American Society for Testing Materials.
6. AISI, American Iron and Steel Institute.
7. SAE, Society of Automotive Engineers
8. ABMA, American Bearing Manufacturer's Association.
9. NFPA, National Fire protection Association.

B. Experience: Equipment furnished under this Section shall be of a design and manufacture that has been successfully used in similar applications. The manufacturer shall have a demonstrated record of successful operation of the furnished equipment for a minimum period of 5 years, and a minimum of five similar applications. Provide a list of such installations complete with installation description, contact names, addresses, and telephone numbers. Contact information shall be up to date and current as of the date of bid opening. This reference list shall be submitted with the bid documents.

C. Single Source Responsibility: The grinder supplier shall supply the following components and systems, and be responsible for the design, integration and proper system operation of these components:

1. Open channel grinders.
2. Submersible electric motor.
3. Grinder control panel.

4. Power and signal cables from motors to the first junction box.
5. Power and signal cable handling, support and storage systems.
6. Grinder installation and retrieval system.
7. Grinder control and monitoring system.

D. Manufacturers offering products that comply with these Specifications include:

1. Grinder and controller shall be a Model CDD5020-XDM2.5 as manufactured by JWC Environmental of Costa Mesa, CA
2. Or equal.

## 1.04 WARRANTY

A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

# PART 2 - PRODUCTS

## 2.01 GENERAL

A. One submersible motor-driven, guide rail mounted, open channel grinder shall be installed at each inlet to the Diversion Pump Station wet well. A total of four units shall be furnished. The unit shall shred and process rags, paper, chunks of wood, bottles, plastics, stringy material, and other solids common to municipal wastewater.

B. Each unit shall have a design capacity as follows:

1. Grinder shall be capable of processing 20 MGD with a maximum headloss of 28 inches of water column.
2. Grinder shall provide a minimum peak shaft torque of 3,700 lb-in/hp.
3. Grinder shall provide a minimum peak force at cutter tip of 990 lbf/hp.
4. Grinders shall cut debris into material that is a nominal 1/2" x 1/8" in size.

C. The unit shall be installed on slide rails such that the entire unit can be removed from the wet well without requiring any personnel to enter the wet well area. Slide rails and base support shall be provided by grinder manufacturer.

## 2.02 GRINDER

A. Grinders shall reduce or shred influent solids for protection of downstream equipment. Grinder shall be two shafted design consisting of individual cutters and spacers, with cutters on drive and driven shafts of equal diameter. The grinder shall have two rotating screen drums that shall collect solids too large to pass through the screen drums and direct them to the cutters for solids reduction. Grinder shall have individual motors and speed reducers for cutter drive shaft and each screen drum.

1. Cutters and Spacers
   a. Cutting stack shall be a nominal height of fifty (50) inches.
   b. Cutter shall be an individual disk constructed of AISI 8620 alloy steel surface ground to thickness of .875-inches +.000/-.001.
   c. Cutters shall be heat treated to produce a hardness of 60-65 Rockwell C.
   d. Cutters shall have 7 cam shaped teeth. Tooth height shall not be greater than 11/16-inch above root diameter of the cutter. OD shall be 7.50-inches.
   e. Spacers shall be an individual disk constructed of AISI 8620 alloy steel surface ground to a thickness of .884-inches +.001/-.000.
   f. Spacers shall have a hardness of 34-38 Rockwell C.
   g. Spacers shall have a smooth outside diameter with no tooth profiles.
2. Shafts
   a. Shafts shall be constructed from AISI 4140 alloy steel with a minimum tensile strength of 170,000 PSI.
   b. Shafts shall be a nominal 2-1/2inches across flats of hex.
   c. Shafts shall be hardened to 38-42 Rockwell C.
3. Intermediate Shaft Collars with Vertical Support Structure
   a. Intermediate shaft collars shall be constructed of ASTM A743 stainless steel, AISI 17-4 stainless steel and SAE 660 bearing bronze.
   b. Shaft collars shall be lubricated with high temperature marine grade grease at the factory.
   c. Grease fittings on the shaft collars shall be provided for periodic maintenance.
   d. Intermediate shaft collars shall provide radial support to the shafts during severe grinding demands.
   e. Vertical support structure shall be constructed of 304 stainless steel.
   f. Vertical support structure shall have brackets to locate and secure intermediate shaft collars within the cutter stack.
   g. Vertical support structure shall have a shape that coincides with the radial profile of the cutters to allow for a close interface.
   h. Vertical support structure shall have adjustable brackets for mounting to the top and bottom end housings.
4. Seal Cartridges
   a. Seal cartridges shall be rated to a maximum of 90 PSI.
   b. Seal cartridges shall not require flushing.
   c. Dynamic and rotating seal faces shall be constructed of tungsten carbide with 6% nickel binder.
   d. O-rings shall be constructed of Buna-N (Nitrile).
   e. Radial and axial loads shall be borne by sealed, oversized, deep-groove ball bearings.
5. Housings and Covers
   a. End housings and top cover shall be constructed of ASTM A536 ductile iron.
   b. End housings shall have integral bushing deflector to guide solids from seal cartridges.
   c. Bottom cover shall be constructed of ASTM A-36 rolled steel.

6. Side Rails
   a. Side rails shall be constructed of ASTM A536 ductile iron.
   b. Side rails shall have a UHMW sealing strip for creating an adjustable interface between the side rail and the rotating drum.
   c. Side rails shall have integral guide slot for installing into framework.
7. Coil Screen Drums
   a. Coil screen drums shall be constructed of helical wound ½-inch diameter AISI 304 stainless steel with ½-inch spacing between coils.
   b. Coil screen drums shall have vertical supports, center ring supports, end flanges, and stub shafts to properly support the coils.
   c. Coil screen drums shall have no shaft in center of drum.
   d. Coil screen drums shall be electro-polished.
8. Speed Reducer-Cutters
   a. Reducer shall be manufactured by Sumitomo Machinery Corporation of America.
   b. Reducer shall be internal planetary mechanism with trochoidal curved tooth profile.
   c. Reducer shall be a vertically mounted with 29:1 single reduction.
   d. Reducer shall be grease lubricated.
9. Speed Reducer-Screen Drums
   a. Reducer shall be manufactured by Sumitomo Machinery Corporation of America.
   b. Reducer shall be internal planetary mechanism with trochoidal curved tooth profile.
   c. Reducer shall be a vertically mounted 377:1 double reduction.
   d. Reducer shall be grease lubricated.
10. Motor-Cutters
   a. Motor shall be 10 HP, XPNV, 1765 rpm, 230/460 volt, 3 phase, 60 Hz
   b. Motor shall be U.L. rated NEMA 6P, Class I, Div. I Groups C&D,
   c. Motor shall have additional rating of 7 consecutive days of submergence at a maximum depth of 30 feet.
   d. Motor shall not utilize fan cooling at any time during operation when submerged or completely exposed in air.
   e. Motor shall utilize ceramic shaft seal requiring no oil lubrication.
   f. Motor shall have a minimum service factor of 1.15, 91% minimum efficiency factor at full load, minimum 80% power factor at full load.
11. Motor-Screen Drums
   a. Motor shall be 1 HP, XPNV, 1740 rpm, 230/460 volt, 3 phase, 60 Hz.
   b. Motor shall be U.L. rated NEMA 6P, Class I, Div. I Groups C&D.
   c. Motor shall have additional rating of 7 consecutive days of submergence at a maximum depth of 30 feet.
   d. Motor shall not utilize fan cooling at any time during operation.
   e. Motor shall utilize ceramic shaft seal requiring no oil lubrication.
   f. Motor shall have a minimum service factor of 1.15, 85.5% minimum efficiency factor at full load, minimum 70% power factor at full load.

## 2.03 FRAME AND SUPPORTS

A. General

1. Frame shall provide a method for properly securing the grinder in the wet well. The frame shall allow installation or removal without any disassembly of the frame or grinder.

B. Components

1. Frame and slide rail system shall be constructed of AISI 316 stainless steel.
2. Frame shall provide proper support and interface to prevent unwanted bypass.
3. Frame shall utilize guides that insert into the grinders side rail slots to properly position and locate the grinder.
4. Frame shall provide proper support and interface to prevent unwanted bypass and fit to the inner wall of the pump station as shown on the drawings. A guide rail shall be provided.
5. The unit will be fitted with a lifting bail system constructed of 304 Stainless Steel for removal of the grinder from the frame utilizing the guide rail system for ease of removal of the grinder from the wet well.

## 2.04 CONTROLLER

A. General

1. Controller shall provide control of the each grinding system. The controller shall provide control of the grinder motor and two screen drum motors. The controller shall have an Operator Interface Terminal, indicator lights, switches and other control devices.
2. Grinder operation shall be coordinated with the pump station controls as specified in Section 13150.

B. Components

1. Enclosures
   a. Enclosure shall be 316 stainless steel NEMA 4X.
   b. Enclosure shall house the OIT, control devices, motor starters, and PLC.
2. Operator Interface Terminal (OIT)
   a. OIT shall display equipment status, alarm and fail conditions.
   b. OIT shall provide operational information on reversals, jams, overloads and over temps.
3. Grinder ON-OFF-REMOTE three-position, NEMA 4X selector switch
   a. In the OFF position, the grinder shall not run.
   b. In the ON position, the grinder shall run continuously.
   c. In the REMOTE position, the grinder shall start and stop as controlled by an external input.
   d. In "REMOTE" the Selector Switch shall close a separate set of dry contacts to provide remote status that the Local-Off-Remote selector switch is in the REMOTE position
4. Screen Drum ON-OFF-AUTO three-position type, NEMA 4X selector switch

a. In the OFF position, the screen drum shall not run.

b. In the ON position, the screen drum shall run continuously.

c. In the AUTO position, the screen drum shall start and stop as controlled by grinder operation.

d. In "AUTO" the Selector Switch shall close a separate set of dry contacts to provide remote status that the ON-Off-AUTO selector switch is in the AUTO position.

5. Reset Pushbutton
   a. Pushbutton shall be momentary type 22 mm, rated NEMA 4X.
   b. Pushbutton shall be the only method of resetting the controller after failure.

6. Pilot Lights
   a. Lights shall be LED rated NEMA 4X.
   b. Lights shall indicate GRINDER RUN, SCREEN DRUM RUN, and FAIL.

7. Programmable Logic Controller (PLC)
   a. PLC shall be provided to control all grinder operations and provide feedback to the pump station local control panel.
   b. Programmable Logic Controller shall be manufactured by Allen-Bradley.

8. Motor Starters
   a. Starters shall be a full-voltage reversing type with 120 volt operating coils.
   b. Overload relays shall be adjustable and sized to full load amperes (FLA) of the motor.

9. Main Circuit Breaker Disconnect and Motor Branch Circuit Protection Circuit Breakers
   a. Circuit breakers shall be molded case type 3-pole, 480 volt.
   b. Circuit breakers shall be sized to applicable NEC and UL standards.

10. Control Component Requirements
    a. Control transformer shall be provided as required for grinder operations.
    b. Control transformer primary and secondary shall be fused for over current protection.
    c. Current transducers shall have adjustable set point from 1-135A with a 200ms or less response time.
    d. Control relays shall be rated for 10A (resistive load), DPDT, 120V with indicator light.
    e. Provide dry contacts for Grinder Running, Screen Drum Running, Common Trouble, Grinder ON-OFF-REMOTE selector switch in Remote, and Screen Drum ON-OFF-AUTO selector switch in AUTO.

C. Performance

1. When a grinder jam condition occurs, the controller shall stop the grinder and reverse the grinder rotation to clear the obstruction. If the jam is cleared, the controller shall return the grinder to normal operation. If three (3) reverses occur within a 30 second interval, the controller shall stop the grinder motor and activate the grinder FAIL indicator and relay.

2. When a Screen Drum jam condition occurs, the controller shall stop the screen drum and reverse the screen drum rotation to clear the obstruction. If the jam is cleared, the controller shall return the screen drum to normal operation. If two (2) reverses occur within a 30 second interval, the controller shall stop the screen drum motor and activate the FAIL indicator and relay. The grinder and other screen drum shall continue to operate.

3. When a power failure occurs while the grinder and screen drum is operating, the grinder and screen drums will resume operation once power is restored.

4. When a power failure occurs while the grinder or screen drum(s) is in a fail condition, once power is restored the fail indicator shall reactivate and remain until reset.

5. Reset of the grinder and drums shall be accomplished from the controller only.

## 2.05 SPECIAL OPERATING CONDITIONS

A. The open channel grinder systems may not be required to operate to meet the process requirements for extended periods of up to several months when there is no flow into the pump station. The manufacturer shall consider these conditions and specify any special maintenance requirements necessary to guarantee the long term operability of the equipment. It is anticipated that during the extended periods of inactivity, the grinders will be cycled or "bumped" for short periods for maintenance purposes. This process will occur "dry" with no water in the wet well. The equipment manufacturer shall specify the frequency and duration required for each grinder maintenance cycle. These settings will be included in the main control system. The manufacturer shall also include any other special maintenance requirements for their equipment to meet these conditions. This information will be submitted with the shop drawings as specified above.

## 2.06 IDENTIFICATION

A. Each unit of equipment shall be identified with a corrosion resistant nameplate, securely affixed in a conspicuous place. Nameplate information shall include equipment model number, serial number, manufacturer's name and location.

## 2.07 SPARE PARTS

A. The manufacturer shall have a local repair facility located within 50 miles of the project location. The facility shall have been in operation for greater than 30 years providing parts, service and repairs.

B. The manufacturer shall maintain a complete inventory of all spare parts at their local repair facility.

C. The manufacturer shall provide the service of rebuilding a unit for only the cost of the parts supplied.

# PART 3 - EXECUTION

## 3.01 INSTALLATION

A. Grinders and controllers shall be installed in accordance with manufacturer's installation instructions, the approved shop drawings and in accordance with all OSHA, local, state, and federal codes and regulations.

B. Installation shall include furnishing oil, grease, and lubricants required for initial operation. The grades of oil, grease, and lubricants shall be as recommended by the manufacturer.

## 3.02 PAINTING

A. After installation and approved field testing by the Engineer, the Contractor shall apply touch-up paint to all scratched, abraded and damaged shop painted surfaces. Coating type and color shall match shop painting.

## 3.03 MANUFACTURER SERVICES

A. Furnish the services of trained service technician, certified by the manufacturer to service the type of equipment specified in accordance with the requirements of the General Conditions of the Contract Documents, Section 01600 and as specified herein.

B. The service representative must have a minimum of five years of experience, supervising the installation and inspection of the type and size of equipment specified.

C. The service representative must be present on site for all items listed below. Work-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

D. Provide assistance to the Contractor during equipment installation including, but not limited to observation, guidance, instruction of contractor's assembly, erection, installation or application procedures, inspection and checking of installation and furnishing of written approval of installation.

1. 2 work-days.

E. Assistance during functional and performance testing and startup demonstration, and product acceptance by the Owner.

1. 2 work-days.

F. Training of Owner's personnel in the operation and maintenance of equipment as required. Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom session.

1. 1 work-day.

G. For the purposes of this paragraph, a work day is defined as an eight hour period at the Project site, excluding travel time. The Engineer may request that a work day be furnished in a maximum of two trips. All unused work days shall be credited to the Owner at the manufacturer's published field service rate.

H. Any additional time required of the factory trained service technician to assist in placing the equipment in operation or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

## 3.04 TESTING

A. Test removal and replacement of all grinders to prove the grinders and guiderail systems are properly installed and aligned using the bridge crane installed under Section 14600.

B. Test each grinder to demonstrate correct alignment and smooth operation. Operate each unit and demonstrate compliance with these specifications. Operation shall be free of excessive noise, vibration, leaks, high temperatures, or other malfunctions.

C. Test period shall demonstrate simulated jam conditions for both grinder and screen drums.

END OF SECTION 11332

# SECTION 11600
# PACKAGE GRINDER PUMP STATIONS

## PART 1 - GENERAL

### 1.01 SCOPE

A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of a package pump station, including wet and dry pit installations and appurtenances. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications and the manufacturer's recommendations and as shown on the Drawings.

B. Contract Drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.

C. Related work specified elsewhere:

1. Section 03000 - Concrete
2. Section 09900 - Painting.
3. Section 15060 - Piping and Appurtenances
4. Section 15100 - Valves and Piping Appurtenances
5. Division 13 - Instrumentation and Control
6. Division 16 - Electrical

### 1.02 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

1. Relevant experience references per requirements of paragraph 1.03 B.
2. Field testing procedures, equipment to be used and calibration certificates. Submit a minimum of 2 weeks prior to field testing.
3. Shop Drawings, Show fabrication and installation details for each packaged pumping station. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   a. Wiring Diagrams: Power, signal, and control wiring.

   Data, regarding pump and motor characteristics and performance including:
4. Complete wiring and control diagrams, wiring sizes and wiring specifications.
5. List of recommended spare parts, including those specified herein.

6. Location of nearest authorized pump service center.
7. Recommendations for short and long-term storage.
8. The pump manufacturer shall submit their requirements for pump exercising during extended periods when process operation is not required as described herein.
9. Maintenance Data: For packaged pumping stations to include in maintenance manuals.
10. Warranties: Special warranties specified in this Section.
11. Field test reports.

## 1.03 QUALITY ASSURANCE

A. Reference Standards. Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:

1. NEC, National Electric Code.
2. NEMA, Standards of National Electrical Manufacturers Association.
3. OSHA, Occupational Safety and Health Act.
4. ANSI, American National Standards Institute.
5. ASTM, American Society for Testing Materials.
6. AISI, American Iron and Steel Institute.
7. HI, Hydraulic Institute Standards.
8. ABMA, American Bearing Manufacturer's Association.
9. NFPA, National Fire protection Association.

B. Experience: Equipment furnished under this Section shall be of a design and manufacture that has been successfully used in similar applications. The manufacturer shall have a demonstrated record of successful operation of furnished equipment for a minimum period of 5 years, and a minimum of five similar applications. Provide a list of such installations complete with installation description, contact names, addresses, and telephone numbers. Contact information shall be up to date and current as of the date of bid opening.

C. Single Source Responsibility: The pump supplier shall supply the following components and systems, and be responsible for the integration and proper system operation of these components:

1. Submersible (wet pit) pumps.
2. Wet well structure.
3. Power and signal cables from motors to the first junction box.
4. Power and signal cable handling, support and storage systems.
5. Pump control and monitoring system.
6. Pump base, support brackets, and other ancillary items

## 1.04 QUALITY STANDARDS

A. All submersible pumps specified in this Section shall be furnished by a single supplier who shall assume sole responsibility for providing a complete, operating system designed for long life with minimum required maintenance, meeting the requirements specified herein and as shown on the Drawings.

B. Manufacturer shall provide written certification that the equipment provided under this Specification has been amply designed and is a suitable application for these service conditions.

C. Manufacturers offering products that comply with these Specifications include:

1. Environmental One Corporation (E/ One).
2. Or Equal

## 1.05 WARRANTY

A. Provide a 5-year warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

## 1.06 STORAGE AND PROTECTION

A. Pumps and accessories shall be stored and protected in accordance with the requirements of the General Conditions of the Contract Documents and manufacturer's recommendations.

# PART 2 - PRODUCTS

## 2.01 WET-WELL, PACKAGED PUMPING STATIONS WITH SUBMERSIBLE GRINDER SEWAGE PUMPS

A. Description: Factory fabricated, assembled, and tested with wet well for sewage pumps and collection of sanitary sewage and with dry equipment chamber for controls and accessories.

B. Orientation: Shell underground with dry equipment chamber underground with top 6 inches above grade

a. Shell: Factory fabricated from polyethylene or fiberglass.
b. Sewage Pumps: Two submersible grinder-type sewage pumps, with guide rail, quick-disconnect system, controls, and piping. Include stainless-steel grinder impeller and hermetically sealed motor with moisture-sensing probe, mechanical seals, and waterproof power cable.

C. Pumps shall be suitable for pumping raw sewage containing solids consisting of grit and organic materials and shall be designed and fully guaranteed for this use. The fluid temperature range shall be from 40° to 104° F. The pumps supplied under this specification shall be suitable for continuous operation under submerged or partially submerged conditions.

D. Pumps installed in wet pit locations shall be automatically and firmly connected to the discharge connection elbow. Pumps shall be easily removable for inspection or service, requiring no bolts, nuts or other fasteners to be removed for this purpose and without requiring physical entry into the confined area.

E. Wet pit pumps and appurtenances, including the pump, motor, guide system, monitoring devices and wiring, shall be suitable for operation in the state of Georgia for explosion proof service. Pumps and appurtenances, including the pump, motor, guide system and wiring shall be approved by a national approved testing agency for installation in the state of Georgia for explosion proof service. The system shall be rated for Class 1, Division 1, Group D service as determined by the National Electrical Code and approved by a nationally recognized testing agency (U.L. or F.M.) at the time of bidding of this Project.

## 2.02 OPERATING CONDITIONS

A. Refer to the Contract Drawings for general arrangements and dimensional limitations. Provide complete submersible pump units designed for the indicated service and free of excessive vibration or hydraulic instability from minimum TDH to shutoff head when operating continuously or intermittently under the conditions herein specified.

B. The operating range of the pump shall include the duty points and shut-off head conditions. The pumps shall be non-overloading throughout the entire pump operating range.

C. All operating points listed in the performance table below, with the exception of the shut-off head condition shall be located within the preferred operating region of pumps as established by pump manufacturer in accordance with ANSI/HI 9.6.3 and as published in the manufacturer's application data for the specific pump model being proposed for this application.

| Parameter | Value |
|---|---|
| Description | Sewage Pumps |
| Installation Type | Wet Pit |
| No. of Pumps (total) | 2 |
| Equipment Tag Numbers | P-11601, P-11602 |
| Service | Raw Sewage |
| Min. Shutoff Head, Ft. | 100 |
| Solids Handling Capacity, in | 3 |
| Discharge Connection Size, in | 1 1/4 |
| Suction Connection Size, in | N/A |
| Max. Pump Speed, rpm | 1800 |
| Motor Horsepower Rating, Max. | 1 |
| Power Requirements | 120V, 1-phase, 60 Hz |
| Electrical Classification | Class 1 Div.1 |
| Hydraulic Conditions | |
| Design Point | |
| Flow, gpm | 13 |
| TDH, ft | 51 |
| Static Head, ft | 3 |
| Minimum NPSHa , ft | 30 |
| Minimum Head Condition | |
| TDH, ft | 46 |

## 2.03 MATERIALS AND CONSTRUCTION

A. PUMP

1. The pump shall be a vertical rotor, motor driven, solids handling pump of the progressing cavity type with a single mechanical seal. All pump castings shall be cast iron, fully epoxy coated to 8-10 mil Nominal dry thickness, wet applied. The rotor shall be through-hardened, highly polished, precipitation hardened stainless steel. The stator shall be of a specifically compounded ethylene propylene synthetic elastomeric material suitable for domestic wastewater service. Buna-N is not acceptable as a stator material.

2. The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece motor shaft. The grinder impeller (cutter wheel) assembly shall be securely fastened to the pump motor shaft. The shredder ring shall be of the stationary type and the material shall be white cast iron. The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of "foreign objects," such as paper, wood, plastic, glass, wipes, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4" diameter discharge piping.

B. ELECTRIC MOTOR

1. The motor shall be maximum 1 HP, 1800 RPM, 120 Volt 60 Hertz, 1 Phase, capacitor start, ball bearing, air-cooled induction type with Class F installation, low starting current not to exceed 30 amperes. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor. This motor shall have been specifically listed by Underwriters Laboratories, Inc., for the application.

C. Mechanical Seal

1. Pumps shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless steel spring. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal.

D. TANK

1. Tank shall be either polyethylene or fiberglass construction.
   a. Polyethylene Construction: The tank shall be made of rotational molded polyethylene with high environmental stress cracking resistance. All seams created during tank construction are to be factory tested for leak tightness. The tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to 150 percent of the maximum external soil and hydrostatic pressure.
   b. Fiberglass Construction:
2. The overall basin capacity shall be minimum 400 gallons. The basin shall incorporate a tapered bottom reducing to a diameter to minimize the retained volume.

3. The access way shall include a lockable cover assembly, with vent, providing low profile mounting. The cover shall be aluminum, with a load rating of 300 pounds per square foot. The cover shall have an opening diameter of no less than 30 inches. Access way design and construction shall enable field extension of station height in 6-inch increments without the use of any adhesives or sealants requiring cure time before installation can be completed.

4. The tank shall be furnished with one EPDM grommet fitting to accept a 4.50" OD DWV or Schedule 40 pipe.

   The tank shall have one stainless steel duplex discharge manifold terminating outside the tank wall with a 1-1/4" female NPT pipe thread.

E. DISCHARGE HOSE AND DISCONNECT/VALVE

1. All discharge fittings and piping shall be constructed of polypropylene, EPDM or PVC. The discharge assembly shall include a shut-off valve rated for 200 psi WOG and a quick disconnect feature to simplify installation and pump removal.

F. CHECK VALVE

1. The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the discharge piping. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Moving parts will be made of a 300 Series stainless steel and fabric reinforced synthetic elastomer. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back-pressure. The valve body shall be an injection molded thermoplastic resin. The valve shall be rated for continuous operating pressure of 200 psi. Ball-type check valves are unacceptable

G. ELECTRICAL QUICK DISCONNECT

1. The grinder pump core shall include a factory-installed NEMA 6P electrical quick disconnect (EQD) for all power and control functions. The EQD shall require no tools for assembly, seal against water before the electrical connection is made, and include radial seals to assure a watertight seal regardless of tightening torque. Plug-type connections of the power cable onto the pump housing will not be acceptable.

H. Cables

1. Power and control cables shall be suitable for submersible pump applications and shall be indicated by a code or legend permanently embossed on the cable.

2. 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.

3. The motor control cable shall be designed specifically for use with submersible pumps and shall be equal to SUBCAB (Submersible Cable). The cable shall be shielded, multi-conductor type with a chloroprene outer jacket and the tinned copper conductors insulated with ethylene-propylene rubber. The conductors shall be arranged in twisted pairs. The cable shall be rated for 750 Volts and 90°C (194°F) with a 40°C (104°F) ambient temperature and shall be approved by Factory Mutual (FM). The cable length shall be

adequate to reach the junction box without the need for splices.

4. The cable entry sealing fitting shall relieve stress on conductors and provide a watertight and submersible seal, without the use of sealing compounds and without the application of specific torques to connectors. The conductors shall connect to a terminal board, which shall be provided with a moisture tight seal between the cable entry junction chamber and the motor.

5. Power and Control Cable Protection System: The pump supplier shall provide a support and protection system for the power and control cables for each of the pumps supplied. This system shall be a part of, and integrated into each pump unit. The supplier shall assume full responsibility for its function and provide a functional guarantee, as detailed below. The system shall consist of the following components and functions:
   a. The pump supplier shall guarantee that this system functions in an automatic and effortless way while a pump is lifted or installed, that no wear, tear or damage be inflicted to either of the flexible electrical cables. Any cable wear or operational problems that occur within a 5-year period shall be repaired and improved by the pump supplier without cost to the Owner.
   b. Appropriate cable support brackets shall be supplied by the pump supplier and permanently installed by the contractor at the deck level to provide support and strain relief function.

## 2.04 CONTROLS

A. Level monitoring

1. Wet well liquid level shall be accomplished by monitoring the pressure changes in an air column connected to a pressure switch. The air column shall be suitable for use in wastewater and shall have no moving parts in direct contact with the wastewater. Furnish a factory installed equalizer diaphragm that compensates for any atmospheric pressure or temperature changes. Tube or piping runs outside of the station tank or into tank-mounted junction boxes providing pressure switch equalization will not be permitted.

2. All fasteners throughout the assembly shall be 300 Series stainless steel. High-level sensing will be accomplished in the manner detailed above by a separate air column sensor and pressure switch of the same type. Closure of the high-level sensing device will energize an alarm circuit as well as a redundant pump-on circuit. For increased reliability, pump ON/OFF and high-level alarm functions shall not be controlled by the same switch.

B. Pump Control Panel

1. Furnish a fiberglass NEMA 4X, UL listed control and alarm panel enclosure suitable for wall or pole mounting.

2. The panel shall contain one 15-amp single pole circuit breaker for the alarm circuit, and shall contain one 15-amp double pole circuit breaker per pump unit for the power circuit.

3. The control/alarm panel(s) shall include the following features:
   a. Corrosion-proof fiberglass enclosure
   b. NEMA 4X rated enclosure
   c. Lockable latch
   d. Circuit breakers

e. Terminal blocks & ground lugs
f. Alarm Dry Contacts
g. Lead/Lag indicator lights
h. Alarm indicator lights
i. Run indicator lights
j. Manual Push-to-Run

4. The high-level alarm system shall operate as follows:
   a. The pumps will go into alarm mode if either pump alarm switch closes. During the initial alarm mode both pumps will run and the alarm light and horn will be delayed for 3-1/2 minutes. If the station is still in high-level alarm after 3-1/2 minutes the light and horn will be activated.
   b. Visual alarm remains illuminated until the sewage level in the wet well drops below the "off" setting of the alarm switch for both pumps. The visual alarm shall be inside a red fluted lens at least 2-5/8" in diameter and 1-11/16 in height. The visual alarm shall be externally mounted on the enclosure in such a manner to maintain NEMA 4X rating.
   c. The audible alarm shall be externally mounted on the enclosure, capable of 93 dB @ 2 feet. The audible alarm shall be capable of being deactivated by depressing a push-type switch (push-to-silence button).
5. Service Equipment/Main Service Disconnect Breaker – A separate, internal breaker rated and approved for use as "service equipment" and acts as a main service disconnect of the grinder pump station shall be provided.
6. Remote Alarm – A separate alarm signal shall be provided for remote monitoring. The Remote
7. Run-time/Hour Meter – Seperate run-time / hour meter to display the total run-time or operation time for each pump unit shall be provided.
8. Event/Cycle Counter – An event / cycle counter to display the number of operations of each pump unit shall be provided.

## 2.05 SPECIAL OPERATING CONDITIONS

A. Under normal conditions the pump station may not receive adequate flow to maintain proper operability due to long periods with minimal or no flow. To avoid these conditions, a solenoid operated valve will be periodically opened with discharge into the wet well to exercise the pumps and to flush the system. Provide control logic in the main control panel to open/close this valve with each 24 hour period that allows two cycles, adjustable between 0 and 15 minutes, each. This information will be submitted with the shop drawings as specified above.

## 2.06 FACTORY INSPECTION AND TESTING

A. The pump supplier shall conduct full scale, full range factory performance tests as specified herein. Tests shall be conducted in accordance with the latest edition of the Submersible Pump Test Standard, ANSI/HI 11.6

B. Each pump shall be tested for performance at the factory as specified herein.

C. Testing shall include but not limited to the following:

1. Motor rating and electrical connections shall first be checked for compliance to specific requirements and shall be visually inspected to certify no defects.
2. Conduct mechanical and electrical motor integrity tests in accordance with ANSI/HI 11.6.
3. Motor and cable insulation test for moisture content or insulation defects.
4. After a submerged test run of 30 minutes, item 2 shall be retested.
5. If any deviation of above is found, the pump shall be rejected.

D. Pump Tests

1. Run pump at full speed rating point for 60 minutes prior to start of any testing.
2. Full Speed Tests: Test pump at the specified conditions and record and tabulate readings of flow, differential pressure, BHP, efficiency, $NPSH_R$, input kW, voltage, frequency, and power factor for each test point.
3. Tests shall be carried out at each of the operating points listed in Article 2.02 including the Design Point, Minimum Flow/Maximum Head Point and Maximum Flow Minimum Head Point.
4. Operate each pump for not less than one hour and take readings to verify that the pump will operate as specified without cavitation or excessive vibration and with no more than the specified NPSHA, where such is stated.
5. Run a test with each pump operating with its minimum recommended submergence.
6. Testing of pumps at specified points shall be accomplished with the pumps submerged for wet pit pumps.
7. In the event that specified tests indicates that a pump or motor does not meet specifications, The Owner reserves the right to require witnessed re-testing tests for that pump and motor at no additional cost to the Owner.
8. Furnish certified performance tests as specified for all pumps.
9. Furnish a certification that the pump horsepower demand did not exceed the rated motor horsepower beyond a 1.0 service rating at any of the test points.

## 2.07 FACTORY PAINTING

A. All metal surfaces coming into contact with the pumped media, other than stainless steel, shall be protected by a factory applied coating in accordance with Specification Section 09900.

B. The pump manufacturer shall provide extra finish coat similar to the factory applied finish coating for Contractor touch up painting in the field.

## 2.08 SPARE PARTS

A. The pump supplier shall provide a list of recommended spare parts and shall indicate what items are stocked and which items are special orders. .

## PART 3 - EXECUTION

### 3.01 INSTALLATION

A. Equipment Installation: All equipment shall be installed in accordance with approved shop drawings and manufacturer's recommendations.

B. Anchorage: Stainless steel anchor bolts, nuts and washers, as well as any templates necessary for setting the anchorage, shall be furnished by the equipment manufacturer. Placement of the anchor bolts shall be done by the Contractor from certified dimension shop drawings supplied by the equipment manufacturer.

C. Leveling and Grouting

1. Level and align pump and guide bars in accordance with the respective manufacturer's published data.
2. Provide concrete mounting base as required in accordance with Specification 03000 and equipment manufacturer's recommendations.

### 3.02 PAINTING

A. After installation and approved field testing by the Engineer, the Contractor shall apply touch-up paint to all scratched, abraded and damaged shop painted surfaces. Coating type and color shall match shop painting.

### 3.03 MANUFACTURER SERVICES

A. Furnish the services of trained service technician, certified by the manufacturer, to service the type of equipment specified in accordance with the requirements of the General Conditions of the Contract Documents and as specified herein.

B. The service representative must have a minimum of two years of experience supervising the installation and inspection of the type and size of equipment specified.

Provide assistance to the Contractor during equipment installation including, but not limited to observation, guidance, instruction of contractor's assembly, erection, installation or application procedures, inspection and checking of installation and furnishing of written approval of installation.

C. Assistance during functional and performance testing and startup demonstration, and product acceptance by the Owner.

D. Training of Owner's personnel in the operation and maintenance of equipment as required.

E. Any additional time required of the factory trained service technician to assist in placing the equipment in operation or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

## 3.04 FIELD TESTING

A. The Contractor shall obtain water for field testing of pumps from a source approved by the Owner. The Contractor shall be responsible, at no additional cost to the Owner for provision of temporary piping, pumping, and other ancillary equipment necessary for delivery of water to the pump station for pump testing purposes. Test water shall be disposed of as directed by the Owner.

B. Contractor shall provide all labor, piping, equipment, portable flow meters, calibrated gauges or calibrated test gauges, and materials for conducting tests. Tests will not be acceptable if equipment calibration is not within 60 days of the field testing.

C. The pumps shall be tested at start-up by the pump supplier or its authorized representative. The pump supplier shall provide a formal test procedure and forms for recording the test data.

D. Each pump system shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, damaging cavitation, or overheating of bearings and to demonstrate the indicated head, flow, and efficiency at the design rating point.

E. Test removal and replacement of all pumps to prove the pumps and guide systems are properly installed and aligned.

F. Pump control devices shall be tested and adjusted in the field by the manufacturer service representative.

## 3.05 SERVICE CAPABILITY

A. Service Facility and Maintenance Agreement

1. A scheduled 5-year preventative maintenance and service agreement shall be included in the manufacturer's price with the supply of pumps. Each pump shall be inspected once per year, or every 5,000 hours, whichever comes first. The inspection shall consist of a complete and thorough mechanical and electrical check of each pump followed by a complete report of the findings. This agreement includes all labor and materials used for the inspections outlined by the maintenance agreement for each of the pumps for the full 5-year period and assures that all requirements for fulfillment of the pump warranty have been met.
2. The pump supplier shall be responsible for raising the pumps from the wet well; servicing the pumps and lowering the pumps back down into the wet well as required for the inspections.

END OF SECTION 11600