

SECTION 22 13 36
PACKAGED, WASTEWATER PUMP UNITS

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. Contractor shall furnish and install one factory built, automatic duplex pump unit. The unit shall be complete with all equipment specified herein, factory assembled on a common steel baseplate.
- B. The principal items of equipment shall include two self priming, horizontal, centrifugal, v belt motor driven sewage pumps, valves, and piping. A pump motor control panel with thermal magnetic circuit breakers, magnetic motor starters, automatic liquid level control systems for normal and standby operation, and internal wiring.
- C. PERFORMANCE CRITERIA: Pumps must be designed to handle raw, unscreened, domestic sanitary sewage. Pumps shall have 4" suction connection, and 4" discharge connection. Each pump shall be selected to perform under following operating conditions:
 - 1. Capacity (GPM): 400
 - 2. Total Dynamic Head (FT): 58.3
 - 3. Total Dynamic Suction Lift(FT):19.7
 - 4. Maximum Repriming Lift (FT): 25.0
 - 5. Maximum Static Suction Lift(FT): 18.9
 - 6. Total Discharge Static Head (FT): 4.0
 - 7. Minimum Submergence Depth (FT): 2.0
 - 8. NPSH Available (FT): 9.8
- D. Power Requirements: 3 phase, 60 hertz, 208 volts.
- E. Pump unit shall be Gorman-Rupp or approved equal.

1.2 RELATED WORK

- A. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- B. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.
- C. Section 22 05 23, General Duty Valves for Plumbing Piping
- D. Section 22 13 00, Sanitary Sewrage Facilities
- E. Section 33 30 00, Sanitary Sewerage Utilities
- F. Electrical, Division 26.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: Catalog cuts sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor and v-belt drive data, pump characteristic

curves showing the design duty point capacity (GPM), head (FT), net positive suction head required (NPSHr), and hydraulic brake horsepower (BHP). Liquid level control shall be fully described.

- C. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for equipment baseplate. The electrical ladder logic drawings shall illustrate motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.
- D. Operations Maintenance Manuals
 - 1. Installation shall be in accordance with written instructions provided by the pump unit manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.
 - 2. Documentation shall be specific to the pump unit supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the unit manufacturer. **Support data for any equipment supplied on or as part of the pumping unit shall be provided.** Instructions shall include the following as a minimum:
 - a. Functional description of each major component, complete with operating instructions.
 - b. Instructions for operating pumps and pump controls in all modes of operation.
 - c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.
 - d. Support data for commercially available components not produced by the unit manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.
 - e. Electrical schematic diagram of the pump unit circuits shall be in accordance with NFPA70. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the unit operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams,

and simplified schematics shall not be provided in lieu of an overall system diagram.

- f. Mechanical layout drawing of the pump unit and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.
- 3. Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.
- E. Certified copies of all the factory and construction site test data sheets and reports.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Std. Institute (ANSI) / American Water Works Assoc. (AWWA)
 - 1. ANSI B16.1 Cast iron pipe flanges and flanged fittings.
 - 2. ANSI/AWWA C115/A21.51 Cast/ductile iron pipe with threaded flanges.
 - 3. ANSI 253.1 Safety Color Code for Marking Physical Hazards.
 - 4. ANSI B40.1 Gages, Pressure and Vacuum.
 - 5. AWWA C508 Single Swing Check Valves.
- C. American Society for Testing and Materials (ASTM)
 - 1. ASTM A48 Gray Iron Castings.
 - 2. ASTM A126 Valves, Flanges, and Pipe Fittings.
 - 3. ASTM A307 Carbon Steel Bolts and Studs.
 - 4. ASTM A36 Structural Steel.
- D. Institute of Electrical and Electronics Engineers (IEEE)
 - 1. ANSI/IEEE Std 100 Standard Dictionary of Electrical Terms.
 - 2. ANSI/IEEE Std 112 Test Procedure for Polyphase Induction Motors.
 - 3. IEEE Std 242 Protection of Industrial and Control Power Systems.
- E. National Electric Code (NEC) / National Electrical Manufacturers Assoc. (NEMA)
 - a. NEC National Electric Code.
 - b. NEC 701 National Electric Code article 701.
 - c. ICS6-93 (R2006) Industrial Control and Systems Enclosures
 - d. 250-2008 Enclosures for Electrical Equipment (1000 Volts Maximum)
- F. Miscellaneous References

- a. Ten-State Standards Recommended Standards for Sewage Works.
- b. Hydraulic Institute Std for Centrifugal, Rotary and Reciprocating Pumps.
- c. NMTBA and JIC Std. National Machine Tool Builders Association and Joint Industrial Council Standards
- G. ISO 9001 International Organization for Standardization.
- H. Underwriters' Laboratories, Inc. (UL):
508-99 (R-2008)..... Standards For Industrial Control Equipment

1.5 QUALITY ASSURANCE

- A. The pumps and pump unit manufacturer must be iso 9001 certified, with scope of registration including design control and service after sales activities.
- B. The term "pump manufacturer" or "pump unit manufacturer" shall be defined as the entity which designs, machines, assembles, hydraulically tests and warranties the final product. Any entity that does not meet this definition will not be considered a "pump manufacturer" or "pump unit manufacturer" and is not an acceptable supplier. For quality control reasons and future pump and parts availability, all major castings of the pump shall be sourced and machined in north america.
- C. Pump performance certifications
 - 1. All internal passages, impeller vanes, and recirculation ports shall pass a 3" spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the COR, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.
 - 2. Reprime performance:
 - A. Consideration shall be given to the sanitary sewage service anticipated, in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.
 - B. During unattended operation, the pump shall retain adequate liquid in the casing to insure automatic repriming while operating at its rated speed in a completely open system. **The need for a suction check valve or external priming device shall not be required.**

- C. Pump must reprime. Reprime lift is defined as the static height of the pump suction above the liquid, while operating with only one-half of the liquid remaining in the pump casing. The pump must reprime and deliver full capacity within five minutes after the pump is energized in the reprime condition. Reprime performance must be confirmed with the following test set-up:
1. A check valve to be installed down stream from the pump discharge flange. The check valve size shall be equal (or greater than) the pump discharge diameter.
 2. A length of air release pipe shall be installed between pump and the discharge check valve. This line shall be open to atmosphere at all times duplicating the air displacement rate anticipated at a typical pump unit fitted with an air release valve.
 3. The pump suction check valve shall be removed. No restrictions in the pump or suction piping will prevent the siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a 2 feet minimum horizontal run, a 90° elbow and vertical run at the specified lift. Pipe size shall be equal to the pump suction diameter.
 4. Impeller clearances shall be set as recommended in the pump service manual.
 5. Repeatability of performance shall be demonstrated by testing five consecutive reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.
 6. Liquid to be used for reprime test shall be water.
- D. Upon request from the COR, certified reprime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be submitted for approval prior to shipment.
- D. Factory System Test
1. All components including the pumps, motors, valves, piping and controls will be tested as a complete working system at the manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed and horsepower. Factory operational test shall duplicate actual performance anticipated for the complete unit.
 2. Upon request from the COR, the operational test may be witnessed by the COR at the manufacturer's facility.

- E. The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment as described in Part 3 of this section.

1.6 MANUFACTURER'S WARRANTY

- A. The pump unit manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.
 - 1. All other equipment, apparatus, and parts furnished shall be warranted for sixty (60) months, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O rings, etc. The pump unit manufacturer shall be solely responsible for warranty of the unit and all components.
- B. Components failing to perform as specified or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.
- C. All equipment supplied as part of the pump unit shall be covered under the warranty.
- D. The warranty shall become effective on the date of acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment from the factory, whichever occurs first.

PART 2 - PRODUCTS

2.1 WASTEWATER PUMP UNITS

- A. UNITARY RESPONSIBILITY: In order to unify responsibility for proper operation of the complete pumping unit, it is the intent of these Specifications that all system components be furnished by a single supplier (unitary source). The pumping unit must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.
- B. The specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company which are deemed most suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. The contractor shall prepare his bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.

- C. After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be equal or superior in construction and performance to that specified in the contract, and the equal or higher quality must be demonstrated by a list of current users of the proposed equipment in similar installations.
- D. In event the contractor obtains engineer's approval for equipment substitution, the contractor shall, at his own expense, make all resulting changes to the buildings, piping or electrical systems as required to accommodate the proposed equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer prior to acceptance. Contractor must also include detailed drawings for any required modifications to the buildings, piping or electrical systems.
- E. It will be assumed that if the cost to the contractor is less for the proposed substitution, then the contract price shall be reduced by an amount equal to the savings.
- F. UNIT BASE
 - 1. The unit base shall be comprised of structural steel with a perimeter flange and reinforcements. Perimeter flange and reinforcements shall be designed to prevent flexing or warping under operating conditions. Perimeter flange shall be drilled for hardware used to secure unit base to concrete floor. Hardware shall be stainless steel. Unit base shall contain provisions for lifting the complete pump unit during shipping and installation.
- G. PUMP DESIGN
 - 1. Pumps shall be horizontal, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Pump solids handling capability and performance criteria shall be in accordance with requirements listed under PART 1 - GENERAL of this section. Pump shall be Gorman-Rupp Super T Series or approved equal.
 - 2. Materials and Construction Features:
 - A. Pump casing: Casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate following features:
 - 1. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.
 - 2. Fill port coverplate, 3 1/2" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detent lugs. A Teflon

gasket shall prevent adhesion of the fill port cover to the casing.

3. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.
 4. Liquid volume and recirculation port design shall be consistent with performance criteria listed under PART 1 - GENERAL of this section.
- B. Coverplate: Coverplate shall be cast iron Class 30. Design must incorporate following maintenance features:
1. Retained by hand nuts for complete access to pump interior.
Coverplate removal must provide ample clearance for removal of stoppages, and allow service to the impeller, seal, wearplate or check valve without removing suction or discharge piping.
 2. A replaceable wearplate secured to the coverplate by weld studs and nuts shall be AISI 1015 HRS.
 3. In consideration for safety, a pressure relief valve shall be supplied in the coverplate. Relief valve shall open at 75-200 PSI.
 4. Two O-rings of Buna-N material shall seal coverplate to pump casing.
 5. Pusher bolt capability to assist in removal of coverplate.
Pusher bolt threaded holes shall be sized to accept same retaining capscrews as used in rotating assembly.
 6. Easy-grip handle shall be mounted to face of coverplate.
- C. Rotating Assembly: A rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, sealplate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate following features:
1. Sealplate and bearing housing shall be cast iron Class 30.
Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.
 - a. The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.

- b. The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.
 - c. Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.
- 2. Impeller shall be ductile iron, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lockscrew and conical washer.
 - 3. Shaft shall be AISI 17-4 pH stainless steel shall be supplied.
 - 4. Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.
 - 5. Shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be tungsten titanium carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design; an external O-ring secures the stationary seat to the sealplate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be viton. Cage and spring to be stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. Seal shall be warranted in accordance with requirements listed under PART 1 - GENERAL of this section.
 - 6. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same capscrews as used for retaining rotating assembly.
- D. Adjustment of the impeller face clearance (distance between impeller and wearplate) shall be accomplished by external means.
- 1. Clearances shall be maintained by a four point external shimless coverplate adjustment system, utilizing a four collar

and four adjusting screw design allowing for incremental adjustment of clearances by hand as required. Each of the four points shall be lockable to prevent inadvertent clearance increases or decreases due to equipment vibration or accidental operator contact. The four point system also allows for equal clearance gaps at all points between the impeller and wear plate. Requirement of realignment of belts, couplings, etc., shall not be acceptable. Coverplate shall be capable of being removed without disturbing clearance settings. Clearance adjustment systems that utilize less than four points will not be considered.

2. There shall be provisions for additional clearance adjustment in the event that adjustment tolerances have been depleted from the coverplate side of the pump. The removal of stainless steel shims from the rotating assembly side of the pump shall allow for further adjustment as described above.
3. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.

E. Suction check valve shall be molded Neoprene with integral steel and nylon reinforcement. A blow-out center shall protect pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished through the coverplate opening, without disturbing the suction piping. Sole function of check valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.

F. Spool flanges shall be one-piece cast iron, class 30 fitted to suction and/or discharge ports. Each spool shall have one 1-1/4" NPT and one 1/4" NPT tapped hole with pipe plugs for mounting gauges or other equipment.

3. Serviceability

- A. The pump manufacturer shall demonstrate to the COR's satisfaction that consideration has been given to reducing maintenance costs by incorporating the following features.
- B. No special tools shall be required for replacement of any components within the pump.

4. Spare parts kit

- A. There shall be furnished with the pump unit the following minimum spare parts:

1. One spare pump mechanical seal (complete), and with it all gaskets, seals, sleeves, O rings, and packing required to be replaced during replacement of the seal.
2. One set of impeller clearance adjustment shims.
3. One set cover plate O ring.
4. One rotating assembly O ring.

H. Gauge kit

1. Each pump shall be equipped with a glycerin filled compound gauge to monitor suction pressures, and a glycerin filled pressure gauge to monitor discharge pressures. Gauges shall be a minimum of 4 inches in diameter, and shall be graduated in feet water column. Rated accuracy shall be 1 percent of full scale reading. Compound gauges shall be graduated -34 feet to +34 feet water column minimum. Pressure gauges shall be graduated 0 to 140 feet water column minimum.
2. Gauges shall be mounted on a resilient panel and frame assembly which shall be firmly secured to pumps or piping. Gauge installations shall be complete with all hoses and stainless steel fittings, and shall include a shutoff valve installed in each gauge inlet at the point of connection to suction and discharge pipes.

I. Contractor must insure all pipes connected to the pump units are supported to prevent piping loads from being transmitted to pumps or unit piping.

J. DRIVE UNIT - MOTORS

1. Pump motors shall be 15 HP, 3 phase, 60 hertz, 208 VAC, horizontal ODP, 1800 RPM, NEMA design B with cast iron frame with copper windings, induction type, with class F insulation and 1.15 SF for normal starting torque and low starting current characteristics, suitable for continuous service. The motors shall not overload at the design condition or at any head in the operating range as specified.
2. Motors shall be tested in accordance with provisions of ANSI/IEEE Std 112.

K. FINISH

1. Pumps, piping, and exposed steel framework shall be cleaned prior to painting. Exposed surfaces to be coated with one coat gray W.R. non lift primer and one coat white acrylic alkyd W.R. enamel. Paint shall be low VOC, alkyd based, high solids, semi gloss white enamel for optimum illumination enhancement, incorporating rust inhibitive additives. The finish coat shall be 1.0 to 1.2 MIL dry film thickness (minimum), resistant to oil mist exposure, solvent contact,

and salt spray. The factory finish shall allow for over-coating and touch up after final installation.

L. ELECTRICAL CONTROL COMPONENTS:

1. The pump unit control panel will be tested as an integral system by the pump unit manufacturer. The control panel shall also be tested with the pump unit as a complete working system at the pump unit manufacturer's facility.
2. The electrical control components shall be provided by the pump unit supplier and shall be provided with the following features.
3. Panel enclosure
 - A. Enclosure shall be constructed in conformance with applicable section of National Electrical Manufacturers Association (NEMA) standards for type 1 electrical enclosures. Enclosure shall be fabricated of steel having a minimum thickness of not less than 0.075 Inch (14 gauge). All seams shall be continuously welded, and shall be free of burrs and voids. Interior and exterior surfaces shall be coated with a paint finish suitable for the NEMA classification of the enclosure. There shall be no holes through the external walls of the enclosure for mounting the enclosure or any components contained within the enclosure. Panel enclosure up to 60" x 36" x 12" shall be mounted on floor stands and secured to pump base.
 - B. Enclosure shall be equipped with a door mounted on a continuous steel hinge, and sealed around its perimeter. Door shall be held closed with clamps that are quick and easy to operate. The door shall accommodate the mounting of switches and indicators.
 - C. Enclosure shall be furnished with a removable back panel, fabricated of steel having a thickness of not less than 0.106 Inch (12 gauge), which shall be secured to the enclosure with collar studs. Such panel shall be of adequate size to accommodate all basic components.
 - D. All control components shall be securely fastened to a removeable back panel with screws and lock washers. Switches, indicators and instruments shall be mounted through the control panel door. All control devices and instruments shall be secured to the sub-plate with machine screws and lockwashers. Mounting holes shall be drilled and tapped; Self tapping screws shall not be used to mount any components. All connections from the back panel to door mounted or remote devices shall be made through terminal blocks. All control devices shall be clearly labeled to indicate function.

4. UL Label Requirement:

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

5. Auxiliary Power Transformer:

- A. The pump unit shall be equipped with a 3 KVA step-down transformer to supply 115 volt, AC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer to be protected by a thermal magnetic circuit breaker, sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door. and a padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

6. Motor Branch Components:

A. Main connections

- 1. A main terminal block and ground lug shall be furnished for field connection of the electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the pump unit loads. The main terminal block shall be mounted to allow incoming wire bending space in accordance with article 373 of the National Electric Code (NEC). A separate terminal strip shall be provided for 115 volt, single phase control power and shall be segregated from the main terminal block. Ten percent of the control terminals shall be furnished as spares.
- 2. All motor branch and power circuit components shall be of highest industrial quality. The short circuit current rating of all power circuit devices shall be a tested combination or evaluated per the National Electrical Code Article 409. The lowest rated power circuit component shall be the overall control panel short circuit rating and shall not be less than the fault current available. The minimum control panel rating shall not be less than 10 kA, rms symmetrical. Control assemblies operating at 120 volts nominal or less may be provided with transformers which limit the fault current and

may be rated less than the minimum required short circuit rating.

B. Circuit breakers and operating mechanisms

1. A properly sized heavy duty air circuit breaker shall be furnished for each pump motor. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering.
2. A padlocking operating mechanism shall be installed on each motor circuit breaker. Operator handles for the mechanisms shall be located on the exterior of the control compartment door, with interlocks which permit the door to be opened only when circuit breakers are in the "off" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

C. Motor Starters

1. An open frame, across the line, NEMA rated magnetic motor starter shall be furnished for each pump motor. Starters of NEMA size 1 and above shall be designed for addition of at least two auxiliary contacts. Starters rated "0", "00", or fractional sizes shall not be acceptable. Power contacts shall be double break and made of cadmium oxide silver. All motor starters shall be equipped to provide undervoltage release and overload protection on all three phases. Motor starter contacts shall be easily replaceable without removing the motor starter from its mounted position.
2. Overload relays shall be solid state block type, having visual trip indication with trip-free operation. Electrically resetting the overload will cause one (1) normally open and one (1) normally closed isolated alarm/control contact to reset, thus re establishing a control circuit. Trip setting shall be governed by solid state circuitry and adjustable current setting. Trip classes shall be 10, 15 and 20. Additional features to include phase loss protection, selectable jam/stall protection and selectable ground fault protection.
3. Overload reset pushbuttons shall be mounted through the door of the control panel in such a manner as to permit resetting the overload relays without opening the control panel door.

7. Three Phase Voltage Monitor:

- A. The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, high voltage, low voltage, and voltage unbalance. An adjustable time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart, following an adjustable time delay, when power conditions return to normal.
- 8. Transient Voltage Surge Suppressor
 - A. The control panel shall be equipped with a transient voltage surge suppressor to minimize damage to the pump motors and control from transient voltage surges. The suppressor shall utilize thermally protected silicon oxide varistors encapsulated in a non conductive housing. Mechanical indicators shall be provided on each phase to indicate protection has been lost. The suppressor shall have a surge current rating of 100,000 Amps per phase and a 100kA interrupting rating
- 9. Other Control Components:
 - A. The control circuit shall be fused, and shall be provided with a disconnect switch connected in such a manner as to allow control power to be disconnected from all control circuits.
 - B. Pump mode selector switches shall be connected to permit manual start and manual stop of each pump motor individually. Manual operation shall override shutdown systems supplied with the level control system except motor overload.
 - C. Pump alternation shall be integral to the liquid level controller. Provisions for automatic alternation or manual selection shall also be integral to the liquid level controller.
 - D. A pushbutton switch shall be provided to silence one of the 115 volt AC alarm circuits while corrective actions are underway. Depressing the alarm silence pushbutton shall also cause the high water alarm circuit (low water alarm optional) to reset when the liquid level has been lowered.
 - E. High pump temperature shutdown circuit
 - 1. The control panel shall be equipped with circuitry to override the level control system and shut down the pump motor(s) when required to protect the pump from damage caused by excessive temperature.
 - 2. A thermostat shall be mounted on each pump to detect its temperature. If the pump temperature should rise to a level which could cause pump damage, the thermostat shall cause the

shutdown circuit to drop out the motor starter. An indicator, visible on the front of the control panel shall indicate that the pump motor has been stopped because of a high temperature condition. The pump shall remain locked out until the pump has cooled and the circuit has been manually reset. Automatic reset of such a circuit shall not be acceptable.

- F. Six digit elapsed time meters (non reset type) shall be connected to each pump motor starter to indicate the total running time of each pump in "hours" and "tenths of hours".
 - G. A duplex ground fault indicating utility receptacle providing 115 VAC, 60 hertz, single phase current shall be mounted on the side of the control enclosure. Receptacle circuit shall be protected by a 15 ampere thermal magnetic circuit breaker.
 - H. Indicating lights shall be oil tight type and equipped with integral step down transformers for long lamp life. Lamps shall be incandescent type rated 14 volts or less. Lamps shall be replaceable from the front without opening the control panel door and without the use of tools. Indicating lights will be provided for the following functions:
 - 1. Pump #1 high pump temperature shutdown
 - 2. Pump #2 high pump temperature shutdown
 - 3. High wet well level
 - 4. Alarm silenced
 - 5. Pump #1 run
 - 6. Pump #2 run
 - 7. 115 volt power available
 - I. Provide an integral 0 - 60 second adjustable on-time delay relay interfaces in each motor control circuit. Coordinate staggered time delay setting with the electrical contractor.
 - J. Provide summary alarm contact consisting of a form c set of dry auxiliary relay contacts for remote monitoring of all local alarm /monitoring controller functions.
 - K. When discharging to the emergency wastewater storage tank the pump(s) shall be shutdown and not allowed to run when the level in the tank reaches a predetermined level. The level signal shall be from the ultrasonic level indicator. Contractor shall be responsible for insuring pump unit controller and ultrasonic level indicator supplied can adequately communicate with each other.
10. Wiring

- A. The pump unit components, as furnished by the manufacturer, shall be completely pre-wired. (Note: If control panel is opted to be shipped loose, the pump unit as furnished by the manufacturer shall be completely pre-wired except for the power feeder lines and final connections to pump motors, engine, and remote alarm devices. The interconnecting wire, conduit, and other materials required shall be furnished and installed by the electrical contractor.)
- B. All wiring, workmanship, and schematic wiring diagrams shall be in compliance with applicable standards and specifications for industrial controls set forth by the Joint Industrial Council (JIC), National Machine Tool Builders Association (NMTBA), and the National Electric Code (NEC).
- C. All user serviceable wiring shall be type MTW or THW, 600 volts, and shall be color coded as follows:
 - 1. Line and load circuits, AC or DC power.....black
 - 2. AC control circuit less than line voltage.....red
 - 3. DC control circuit.....blue
 - 4. Interlock control circuit, from external source.....yellow
 - 5. Equipment grounding conductor.....green
 - 6. Current carrying ground.....white
 - 7. Hot with circuit breaker open.....orange
- D. Wire identification and sizing
 - 1. Control circuit wiring inside the panel, with the exception of internal wiring of individual components, shall be 16 gauge minimum, type MTW or THW, 600 volts. Wiring in conduit shall be 14 gauge minimum. Motor branch wiring shall be 10 gauge minimum.
 - 2. Motor branch conductors and other power conductors shall not be loaded above the temperature rating of the connected termination. Wires shall be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be of the ring tongue type with nylon insulated shanks. All wires on the sub plate shall be bundled and tied. All wires extending from components mounted on door shall be terminated on a terminal block mounted on the back panel. All wiring outside the panel shall be installed in conduit.
- E. Control conductors connecting components mounted on the enclosure door shall be bundled and tied in accordance with good commercial

practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be allowed so that the door can swing to its full open position without undue mechanical stress or abrasion on the conductors or insulation. Bundles shall be clamped and held in place with mechanical fastening devices on each side of the hinge.

11. Conduit requirements are as follows:

- A. All conduit and fittings shall be UL listed.
- B. Liquid tight flexible metal conduit shall be constructed of a smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight, polyvinyl chloride cover.
- C. Conduit shall be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
- C. Conduit shall be sized according to the National Electric Code.

12. Grounding

- A. The pump unit manufacturer shall ground all electrical equipment to the enclosure back panel. The mounting surface of all ground connections shall have any paint removed before making final connections.
- B. The contractor shall provide an earth driven ground connection to the control panel at the main ground lug in accordance with the National Electric Code (NEC).

13. Equipment Marking

- A. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:
 - 1. Equipment serial number
 - 2. Control panel short circuit rating
 - 3. Supply voltage, phase and frequency
 - 4. Current rating of the minimum main conductor
 - 5. Electrical wiring diagram number
 - 6. Motor horsepower and full load current
 - 7. Motor overload heater element
 - 8. Motor circuit breaker trip current rating
 - 9. Name and location of equipment manufacturer
- B. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.
- C. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

M. LIQUID LEVEL CONTROL SYSTEM

1. The level control system shall start and stop the pump motors in response to changes in wet well level. The various control level are indicated on the drawings.
2. The level control system shall be capable of operating as either an air bubbler type level control system, submersible transducer type system, or ultrasonic transmitter type system.
3. The level control system shall be designed to accomplish the following tasks:
 - A. Continuously monitor the level of liquid in the wet well.
 - B. Start and stop pumps as required by the level of liquid in the wet well.
 - C. Select the sequence of pump operation upon operator command for automatic alternation.
 - D. Provide alarm indications upon occurrence of predetermined malfunctions.
 - E. When pumping to emergence wastewater storage tank, stop the pumps and prevent them from running when tank level reach a predetermine high level.
4. The level control system shall utilize alternation to select first one pump, then the second pump, to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle, or in the event of excessive run time.
5. The level control system shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the control shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the control shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the control shall start the second pump when the liquid reaches the "lag pump start level", or "standby pump start level" so that both pumps are operating. The control shall also activate the high wet well alarm at a predetermine level. These levels shall be adjustable.
6. Submersible Transducer System
 - A. The level control system shall utilize a submersible transducer. It shall be a strain gauge transducer with a pressure sensor housed in a 316 SST or Titanium case designed to extend into the wet well. The pressure transducer shall provide a proportional

signal for distribution to the display and electronic comparators of the electronic pressure switch, and remainder of the level control system. Sensor range shall be 0 - 12 ft. W.C. minimum with an over-pressure rating 3 times full scale. The transducer shall have output capability of 1.5-7.5VDC or 4-20mA. The transducer's polyurethane jacketed shielded cable shall be of suitable length for proper installation into the wet well without splicing.

- B. An intrinsically safe repeater shall be supplied in the control enclosure. Repeater must be recognized and listed as intrinsically safe by a nationally recognized testing laboratory. Station manufacturer shall make all connections from repeater to feeder lines and motor controls. Installing contractor shall make connections from repeater to transducer.
- C. Submersible transducer will be furnished with transient voltage surge suppression to protect related equipment from an induced voltage spike from lighting.
- D. A spare submersible transducer shall be provided.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Pump unit manufacturer shall provide written instruction for proper handling. Immediately after off-loading, contractor shall inspect complete pump unit and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all unit serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

3.2 INSTALLATION

- A. Install, level, align, and lubricate pump unit. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.
- B. Suction pipe connections are vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports to prevent strain and vibration on pump unit piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.
- C. Check motor and control data plates for compatibility to site voltage. Install and test the unit ground prior to connecting line voltage to pump unit control panel.
- D. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

3.3 FIELD QUALITY CONTROL**A. Operational Test**

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

B. Manufacturer's Start-up Services

1. Co-ordinate pump unit start-up with manufacturer's technical representative. The representative or factory service technician will inspect the completed installation. He will calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.
2. Provide services of manufacturer's technical representative for at least four hours to instruct VA Personnel in operation and maintenance of units.

- C. Coordinate the startup and contractor testing schedules with the COR. Provide a minimum of 7 days prior to notice.

3.4 CLEANING

- A. Prior to acceptance, inspect exterior of pump units for dirt, splashed material or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap and debris.

3.5 PROTECTION

- A. The pump unit should be placed into service immediately. If operation is delayed. Unit is to be stored and maintained per manufacturer's written instructions.

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