PUMP AT SOUTH PITTSBURG WATER TREATMENT PLANT

1. Remove and replace existing high service pump at South Pittsburg Wastewater Treatment Plant
2. Contractor shall furnish all labor and materials and must comply with pump specs.
3. Contractor is responsible for all miscellaneous piping to connect to existing pipe manifold.
4. Contractor must remove existing motor; remove wire; pull pump motor, etc.
5. Contractor must install pump and re-install motor and install all electrical, etc.

Please call ahead to schedule a site visit at 423-837-7164 or 423-837-6841.

VERTICAL TURBINE SPECIFICATION

GENERAL REQUIREMENTS:

Thee specifications are intended to cover the furnishing of a complete vertical motor-driven deep well turbine pump for the high service pump at South Pittsburg Water Treatment Plant.

Installation will be made by the owner.

OPERATING CONDITIONS: The following are the operating conditions:

(1) Size of well (inside diameter) ..... N/A inches
(2) Depth of well ..... 22 feet
(3) Standing water level below top of well ..... 16 feet
(4) Pumping level below top of well at rated pump capacity ..... N/A feet
(5) Pumping head or pressure above top of well ..... N/A feet
(6) Total pumping head (4 and 5) ..... 305 feet
(7) Capacity of pump ..... 1400 GPM

The total pumping head does not include losses in the pump, which must be allowed by the bidder. The efficiency of the pumping unit shall be as high as correct design and good engineering will permit. All things being equal, consideration will be given to overall pumping costs.

The motor shall be NEMA standard design B, Vertical Hollow Shaft high thrust, WP-1 enclosure, 1775 RPM, squirrel cage induction full voltage type starting, powered by an electrical service rated at 460 volts, 60 hertz, 3 phase. Each motor shall be capable of driving the pump under all head conditions without exceeding the rated capacity of the motor. Motor shall have class B insulation, 1.15 service factor rated 90&#17 6; rise at service factor load. Motor shall be supplied with a non-reverse ratchet. Motor shall conform to AIEE and NEMA standards. Motor design shall be premium efficiency style.

The motor thrust bearing shall be designed to carry the hydraulic thrust plus the weight of the shaft and the impellers. The thrust bearing life expectancy shall have a five year average rating based on 24 hours per day usage. The motor shall be capable of carrying up thrust equal to approximately 30% of the total down thrust. Bearings shall be oil or grease lubricated as per manufactures standard design.

Each motor shall be provided with a corrosion-resistant nameplate giving the name of the manufacturer, horsepower, voltage, frequency, speed, efficiency and current for unit at full load.

DISCHARGE HEAD ASSEMBLY

Discharge head shall be a cast iron surface discharge or with 250lb. ANSI dimension discharge flange and shall support the motor, column, shafting, and pump assembly. The discharge head shall be mounted on a fabricated steel, - sole plate which shall be anchored to a concrete pad over the well or sump. The bottom surface of the head shall be machined smooth. A tapped drain line connection shall be provided for the removal of the excess water to a drain.

A cast iron stuffing box shall be provided with a bronze removable stuffing box bushing, galvanized split gland, T-bolts with stainless steel clips and brass nuts. Stuffing box shall utilize a minimum of five synthetic Garlock 8913 packing rings, compressed around the pump shaft and lubricated by the pumped water.

Two piece top shaft shall be threaded and coupled just above the stuffing box (On column setting 50 feet or less).

COLUMN ASSEMBLY

Column pipe shall be furnished in interchangeable sections not over 5 feet in length and shall be connected with flanged couplings. The friction loss in the column shall not exceed 5 feet per 100 feet of column, based on the rated capacity of the pump. The weight and size of the column shall be no less than required in AWWA sped E101-1. The line shafting shall be AISI 416 stainless steel of ample size, minimum of 1" diameter, to operate the pump without distortion or vibration. The shaft shall be furnished in interchangeable sections not more than 10 feet in length and shall be coupled with AISI 410 stainless steel coupling. The column assembly shall have bronze bearing retainers retained by the butted pipe ends. Each bearing retainer shall contain a water-lubricated, cutless rubber bearing designed for vertical turbine pump service.

PUMP BOWL ASSEMBLY

The pump bowls shall be of close grained cast iron, having a minimum tensile strength of 30,000 pounds per square inch, free from blow holes, sand holes, and all other faults; accurately machined and fitted to close dimensions. Bowls are to be coated inside with a smooth vitreous enamel to reduce friction losses, corrosion and sand wear in the water passages and this gives better efficiency. Each intermediate bowl is to be constructed by using a bronze bearing and a neoprene bearing to support the impeller shaft which gives the longest possible life, based on the widest range of pump conditions.

The bowl is to provide a side seal at the impeller skirt and in addition, a resilient neoprene ring, reinforced with an imbedded steel core, is to be installed in the bowl directly below the impeller skirt. This "lateral bowl ring" is to reduce the wear of the impeller skirt. Original capacities and efficiencies are to be maintained by adjustment of the top shaft nut at the top of the motor. The impellers shall be of bronze enclosed type only, accurately machined and finished, and balanced. They shall be securely fastened to the impeller shaft with a steel taper bushing. The impeller shaft shall be of stainless steel of not less than 12% chrome. The impeller shaft shall be supported by a combination of water lubricated, fluted rubber and bronze bearings. Discharge and suction cases shall both be fitted with steel sand collars. All bowl bolting shall be of stainless steel.

STRAINER

The bell suction shall be fitted with a clip-on galvanized steel basket strainer. The openings in the strainer shall be of proper size to exclude anything large enough to clog the impeller. The open area of the strainer shall not be less than four times the impeller eye area.

WATER LEVEL INDICATOR

Grundfos Control Panel Specification

South Pittsburg, TN
2017

1. General Description and Qualifications

   1.1. Contractor shall furnish all labor, materials, equipment and appurtenances to provide a complete lift station control panel as specified herein.

   1.2. The pump control panel shall be manufactured and tested by a facility meeting U.L. Standard 508(A) for industrial controls. All components shall be the products of reputable manufacturers with at least five years of experience in the manufacture of similar equipment. Similar devices in the control panel shall be the products of the same manufacturer. All equipment shall be of modular design to facilitate interchangeability and ensure ease of service. Control panel must be UL 508(A) listed and include a standard 3-year warranty.

   1.3. The pump control panel shall be Dedicated Control series as Manufactured by Grundfos Water Utilities or approved equal.

2. Construction And Functionality

   2.1. Equipment Enclosure And Accessories

      2.1.1. Equipment Enclosure
      The pump control panel enclosure shall be rated UL Type 4X 304SS for outdoor use. Enclosure shall be designed to enclose electrical and electronic equipment and protect against harsh, industrial environments and sized according to the application, and include a 3-point latch, locking hasp and drip shield. Enclosure shall be Saginaw, Rittal, Hoffman or approved equal.

      2.1.2. Enclosure Cooling Fan
      If the enclosure contains soft starters or other significant heat-producing component, provide a cooling fan package with self-starting shaded pole axial fan motor, heat resistant plastic intake grill with fine filter, Rittal SK series or approved equal. Provide heat resistant plastic exhaust louver and fine filter, Rittal SK series or approved equal. Size ventilation equipment to satisfy the cooling requirements of all internal components. Type rated covers shall be supplied to maintain the type rating of the enclosure and maintain the UL listing.

   2.2. Power Distribution

      2.2.1. Circuit Breakers
      Molded case thermal magnetic circuit breakers shall be DIN rail mounted, cable in / cable out type, UL489 Listed for the applicable voltage. Breakers shall be provided with arc chutes on each pole. Breakers shall be provided with thermal and magnetic trip mechanisms on each pole. Two and three pole breakers shall be common trip. Provide one breaker for each pump power circuit, one breaker for control power and one breaker convenience outlet. 400-600VAC Circuit Breakers shall be Schneider Electric HDL Series, ABB Isomax or approved equal. 120-240VAC Circuit Breakers shall be Cutler-Hammer Q-Line, Schneider Electric Q Series or equal.

2.2.2. Fuses
Fuses shall be of the type and amperage required for adequate protection of panel components. Fuses shall be provided to protect panel components as recommended by the component manufacturer. All fuses shall be installed in compatible fuse holders. Fuses shall be Mersen, Eaton-Bussman, Littelfuse or approved equal.

2.2.3. Fuse Holders
Fuse holders shall be of the type and amperage rating required for fuses as recommended by the fuse manufacturer. Fuse holders shall be touch safe. Fuse holders shall be Wohner, Eaton-Bussman, Phoenix Contact, Mersen or approved equal.

2.2.4. Control Power Transformer
Control power transformer shall be panel mount, UL Listed, epoxy encapsulated core and coil type. Size control power transformer as required to provide 120-volt power for internal control circuits, as well as any lighting, heating, ventilation or convenience receptacle that may be required by this specification. Transformer shall be Schneider Electric 9070T Series, Acme AE Series, GE 9T Series or approved equal.

2.2.5. Surge Arrester
Provide parallel metal oxide varistor (MOV) surge arrester with molded polycarbonate housing, epoxy encapsulated to protect from moisture. Surge Arrestor shall be Schneider Electric SDSA or approved equal.

2.2.6. Terminal Blocks
Provide terminals for all control and pump circuit wire terminations for both field wiring and internal wiring. Terminals shall be capable of terminating #26-8 AWG stranded wires. Terminals shall be equipped with labeling devices designed specifically for use with provided terminal blocks. Terminals shall be Phoenix Contact UT6 Series terminal blocks or approved equal.

2.2.7. Distribution Terminal Blocks
Provide terminal blocks for all power-circuit wire terminations for both field wiring and internal wiring. Provide adequate terminals for all internal secondary circuits as well as tap off points for external circuits being fed from the panel power circuit. Terminals shall accommodate one conductor per opening and shall be touch-safe. Power distribution blocks shall be Mersen model FSPDB Series or approved equal.

2.2.8. Wire-ways
Provide molded plastic wire ways for all wiring in the panel. Wireways shall be complete with covers. Provide adequate wire way size to accommodate wires and maintain 25% unused. Wire-ways shall be manufactured by Panduit, Thomas & Betts or approved equal.

2.3. Motor Starters

2.3.1. The reduced voltage soft starter (RVSS) shall be digital microprocessor controlled with adjustable ramp up and ramp down times. The RVSS shall include an interface module for direct start/stop control and a selectable auxiliary contact. The interface shall be 120V. A bypass shorting contactor and shunt trip or isolation contactor shall be included. RVSS shall be Schneider Electric ATS48 Series or approved equal

2.3.2. IEC Rated Bypass Contactor
Contactor for motor starting shall be IEC rated with 120-volt coil and one normally open auxiliary contact. Definite purpose contactors will not be allowed. Select contactor appropriate for the horsepower, voltage, and current of the motor being started. Provide one contactor for each pump. The auxiliary contact shall be wired to the programmable controller for determination of contactor engagement. Controller programming shall automatically call next pump in rotation in the event that the scheduled pump contactor fails to engage. Motor contactor shall be Schneider Electric TeSys D Series, ABB AF Series or approved equal.

2.3.3. Overload Relay For Three Phase Motors
Overload relay shall be solid-state type with adjustable trip class setting for class 10, 20 & 30, selector for automatic or manual reset, visible trip indication, trip test, and manual reset button. The overload shall be sized appropriately for the motor full load amperage. A normally closed contact shall be wired in series with the contactor coil. A reset pushbutton shall be located on the dead front door for each overload relay. Overload relay shall be Schneider Electric 9065 Series, ABB E Series or approved equal.

2.4. Relays

2.4.1. General Purpose Relays
General-purpose relays shall be 2-pole, slim line ice cube design with have 8A contacts and standard blade style DIN rail mounted touch-safe socket. Relays shall be Idec RJ series with SJ series sockets or approved equal.

2.4.2. Three Phase Voltage Monitor Relay
The voltage monitor relay shall continuously measure the voltage of each phase. The voltage monitor relay shall detect over and under voltage, voltage unbalance, phase loss, and phase reversal. The voltage monitor relay shall have a standard plug-in base with DIN rail mounted socket and SPDT isolated 10A contacts. The voltage monitor relay shall be SSAC PLMU series or approved equal. A normally open contact shall be wired to the programmable controller for voltage status determination. Controller programming shall automatically disable all pumps in the event of unacceptable line voltage. Pumps shall automatically be enabled once normal voltage has been restored.

2.5. Controller

2.5.1 Hardware

a. The controller shall be microprocessor based capable of having software changes and updates via personal computer (notebook). The controller user interface shall have a color display with a minimum screen size of 3-1/2" x 4-5/8" for easy viewing of system status parameters and for field programming. The display shall have a backlight with contrast adjustment. Password protection of system settings shall be standard.

b. The controller shall provide internal galvanic isolation to all digital and analog inputs as well as all fieldbus connections.

c. The pump system controller shall be a standard product developed and supported by the pump manufacturer.

d. The controller shall have the ability to be connected to a battery to maintain power on controller during periods of loss of supply power.

e. The controller shall have built in data logging capability. Logged vales shall be displayed on the controller and able to be exported to computer via standard connection. A minimum of 3600 samples per logged value with the following parameters available for logging:

- Average flow-rate (inflow and outflow)
- Number of flow reading taken
- Station operating hours
- Time since service
- Total Number of pump starts
- Total Number of pump starts per hour
- Pump Starts per hour
- Individual operating hours
- Discharge pressure (head pressure)
- Power consumption
- Average current consumption
- Number of anti-blocking attempts

f. The controller shall display the following as status readings from a single display on the controller (this display shall be the default "home" screen):
- Current station liquid level with corresponding water graphic
- Alarm status on the station (if any)
- Lead pump on and off set points and graphically display on water graphic
- System status with current operating mode
- Status of each pump with current operating mode and total hours run on the pump
- Estimated flow-rate, (not requiring flow meter connection)
- Date and Time
- Station Name

g. The controller shall have as a minimum the following hardware inputs and outputs:
- Three analog inputs (4-20mA or 0-10VDC)
- Three digital inputs
- Two digital outputs
- Ethernet connection
- Field Service connection to PC for advanced programming and data logging
- Expandable inputs and outputs using expandable I/O modules for up to: 30 digital inputs, 23 digital relay outputs (240VAC, 2A), 9 analog inputs (4-20mA, 0-20mA, 0-10V), 9 analog outputs (0-10V), 12 PTC inputs for motor protection

h. The controller shall be capable of receiving a redundant sensor input to function as a backup to the primary sensor.

i. The controller shall be capable of displaying instantaneous power consumption (Watts or kilowatts) and cumulative energy consumption (kilowatt-hours).

j. The controller shall be capable of displaying instantaneous specific energy use (kw/gpm), (optional flow meter must be connected or advanced flow calculation activated).

k. The controller shall be capable of displaying an estimated flow-rate on the default status screen.

2.5.2 Functionality

a. The wastewater pump station controller shall provide "out of the box" control of a typical lift (empty) station, with an intuitive color user-interface. The pump station controller shall come with pre-built configuration parameters which are selectable via the user interface, including:
   - Pump mode, for each pump, between Auto/ Manual / Off.
   - Functionality for advanced pump control of up to six (6) pumps.
   - Set point adjustment for pump activation/deactivation and level alarms.
   - Level transducer or ball floats
     - Redundant level device handling from two 4-20mA devices
   - Functionality for grouping and alternation of up to 6 pumps
   - Station optimization including:
     - Anti-seizing function
     - Maximum pumps to run
     - Maximum starts per hour
     - Inter-pump start and stop delays
     - Maximum run time
     - Anti-blocking function
       - Pump controller shall have the ability to "flush" or "reverse" sewage pumps if the control system deems the pump to be blocked
       - Triggers are selected and tolerances set by user and include low flow, current, torque, power factor, and pump over temperature
     - Foam-Draining function
     - Daily Emptying
     - Mixer Configuration
     - Pump groups with the ability to select alternation within groups or between groups

2.5.3 Faults and Alarm

a. The pump controller shall monitor and store alarm conditions
b. The pump system controller shall store up to 50 warning and alarms in memory.
c. The time, date and duration of each alarm shall be recorded.
d. All Faults and Alarms shall have the ability to be disabled by user.
e. All Faults and Alarms shall have a user adjustable time delay of activation.
f. All Faults and Alarms shall have a Warning option allowing the user to set the condition with a warning threshold or change the Alarm to a Warning.
g. All Faults and Alarms shall be user selectable to send over SCADA

h. All Faults and Alarms shall be selectable by the user as Automatic reset or require Manual reset at the control system.

i. Control system shall have a user-defined alarm option available for any alarm of fault condition not preloaded in to control system

j. The controller shall display all alarm conditions:

- Overflow
- High Level
- Dry Running
- Float Switch Inconsistency
- System Power Loss
- Overflow
- High Level
- Loss of sensor signal (4-20mA)
- Max Starts/Hour, Pump
- VFD Trip/Failure
- System Failure
- Contactor feedback, Pump
- Flow Meter Failure
- Power Meter Failure
- Controller Hardware Fault
- Battery Backup Fault (UPS)
- Communication Fault (GENIbus)
- Communications Card Fault
- SCADA Callback Error
- Ethernet Fault
- User-defined Sensor Fault
- Discharge Pressure Sensor Fault
- Water on Pit Floor
- Gas Detector
- Extra Fault Failure
- Motor Protection, Tripped
- Common Phase Error
- Low Flow
- Auto/On/Off Switch Change
- Time for Service
- Pump Over Temperature
- Pump Moisture/Seal Failure
- Latest Runtime of Pump
- VFD not ready
- Torque
- Pump Blocked
- Contactor Feedback, Mixer
- Time for Service, Mixer
- Max Starts/Hour, Mixer
- Loss of Sensor signal (4-20 mA)

2.5.4 Flow Monitoring

a. The pump system controller shall be able to accept a physical flow meter input or calculate flow rates.

b. Simple Flow Calculation

- The pump system shall be able to calculate station inflow and pump outflow rates using volumetric-over-time calculations (i.e. draw down test)

c. Advanced Flow Calculation
   a. The pump system shall be able to utilize the following parameters monitored within the control system to calculate flow within 1% to 2% of a physical flow meter:
      - Nominal pump power (Pnom)
      - Nominal head pressure (Hnom)
      - Pit Area (sqft)
      - Nominal flow rate (gpm)
   b. The pump system shall be able to utilize the following parameters monitored within the control system to calculate flow within 1% to 2% of a physical flow meter.

2.5.5 Communication

a. The pump system controller shall have the ability to communicate through the following common fieldbus protocols via communications card installed inside the controller:
   c. Modbus RTU
   d. Modbus TCP/IP
   e. GRM via cellular using CDMA or GPRS (3G/4G)
   f. GRM via direct internet connection

b. The controller shall have a built in Ethernet connection allowing controller to connected to network and access of controller via web browser and internet anywhere around the world where internet communication is available.

c. The controller shall have the ability to communicate GENIbus to down-stream components that make up the entire control system.

3 Level Control

3.1 Float Switches

Liquid –level will be determined based on float switch inputs. Provide one set of terminals for connection to each float switch. Float switch terminals shall be wired to the controller to provide digital inputs for the following conditions:
   a. Float 4: High level float shall force alarm
   b. Float 3: Shall engage lag pump
   c. Float 2: Shall engage lead pump
   d. Float 1: All pumps off

4 Operator Interface Devices

4.1 All operator interface devices shall be located on the panel dead front unless indicated otherwise. Each device shall be labeled according to its function and the designation of any associated equipment.

4.1.1 H-O-A Switch

The H-O-A switch shall be UL Listed Type 4X, oil tight, heavy duty type with detachable contact blocks, Idec TWTD series or approved equal. One H-O-A switch shall be supplied for each pump. Each H-O-A switch shall be labeled

according to function and designation of the associated pump. The H-O-A switch shall have auxiliary contacts wired to the controller for pump in auto status determination. Controller programming shall automatically call next pump in rotation in the event that the scheduled pump is determined to be not in auto.

4.1.2 Pump Running Pilot Light
The pump running pilot light shall be UL Listed Type 4X, oil tight, heavy duty type with 120VAC LED lamp and green lens, Idec TWTD series or approved equal. Incandescent bulbs will not be considered equal. One pump running pilot light shall be supplied for each pump. Each pump running pilot light shall be labeled according to function and designation of the associated pump. The pump running pilot light shall be illuminated when the associated pump starter is engaged.

4.1.3 Pump Fail Pilot Light
The pump fault pilot light shall be UL Listed Type 4X, oil tight, heavy duty type with 120VAC LED lamp and red lens, Idec TWTD series or approved equal. Incandescent bulbs will not be considered equal. One pump fault pilot light shall be supplied for each pump. Each pump fault pilot light shall be labeled according to function and designation of the associated pump. The pump fault pilot light shall be illuminated when the associated pump has failed.

4.1.4 Pump Over-Temperature Pilot Light
The pump over-temperature pilot light shall be UL Listed Type 4X, oil tight, heavy duty type with 120VAC LED lamp and red lens, Idec TWTD series or approved equal. Incandescent bulbs will not be considered equal. One seal fail pilot light shall be supplied for each pump. Each pump over-temperature pilot light shall be labeled according to function and designation of the associated pump. The pump over-temperature pilot light shall be illuminated when the associated pump reaches an internal temperature to activate the corresponding over-temperature sensor.

4.1.5 Pump Seal Fail Pilot Light
The seal fail pilot light shall be UL Listed Type 4X, oil tight, heavy duty type with 120VAC LED lamp and amber lens, Idec TWTD series or approved equal. Incandescent bulbs will not be considered equal. One seal fail pilot light shall be supplied for each pump. Each seal fail pilot light shall be labeled according to function and designation of the associated pump. The seal fail pilot light shall be illuminated when the associated pump has had an internal seal fail and corresponding sensor has activated.

4.1.6 High Level Alarm Pilot Light
The high level pilot light shall be UL Listed Type 4X, oil tight, heavy duty type with 120VAC LED lamp and red lens, Idec TWTD series or approved equal. Incandescent bulbs will not be considered equal. The high level alarm pilot light shall be illuminated during high level conditions.

4.1.7 Elapsed Time Meter
The elapsed time meter shall be a seven-digit hour meter with 0.01-hour resolution, Redington or approved equal. One elapsed time meter shall be supplied for each pump. Each elapsed time meter shall be labeled according to function and designation of the associated pump. The elapsed time meter shall be energized when the associated pump starter is engaged.

4.1.8 A duplex GFCI service outlet shall be furnished with each control panel. The outlet shall be rated 20A at 120VAC. The outlet shall be fed through a 20A circuit breaker. GFCI outlet shall be Levington or approved equal

4.1.9 Audible Alarm

The audible alarm shall be of molded case waterproof design with epoxy encapsulated solid state electronics, UL Listed Type 4X, mounted through the bottom of the enclosure, Floyd Bell MW series or approved equal. The audible alarm shall function during any general alarm condition.

4.1.10 Liquid-level Flashing Beacon

The flashing alarm beacon shall be a 120 volt, 40 watt, UL listed Type 4X, shatter resistant flashing beacon with red lens, Ingram LRX Series or approved equal. The flashing alarm beacon shall function during any general alarm condition.

4.2 Device Labeling

External or flush mounted devices shall be labeled with engraved laminated phenolic nameplates secured with permanent pressure sensitive adhesive. Internal labels shall be white polyester permanent pressure sensitive tape printed with black thermal transfer lettering.

Where operator interface devices are grouped according to associated equipment it shall be permissible to provide one label for each group of devices, i.e. an H-O-A switch, pump running pilot light, and elapsed time meter for pump #1 could be grouped together and identified with one label reading "PUMP 1".

4.3 Wire Labeling

All internal connection wires shall be numbered at each end using pre-printed heat shrink sleeve markers or wrap around tape markers with clear cover.

4.4 Schematic

A laminated wiring diagram schematic shall be included on the inside door using removable convenience ring paper.