

## Section 15010 – MECHANICAL EQUIPMENT

### Part 1 - GENERAL

#### 1.01 Description of Work

- A. General: applicable provisions of the contract drawings and general conditions govern work.
- B. Scope of work: the work includes furnishing all labor, material and plant and installing all mechanical equipment necessary to the intended operation of the pumping station. While every effort has been made to show all necessary details of the equipment required, it is the intent of the plans and specifications to provide a completed, operable facility whether all minor components of construction are noted or not. All materials and work shall be in conformance with the city of Newport News, department of engineering, “standard specifications”, dated august 1983, as amended, except as noted herein.
- C. Work specified elsewhere but is not limited to:
  - Section 01330 - submittal procedures
  - Section 01781 - operation and maintenance data/manual
  - Section 03300 - cast-in-place concrete
  - Section 04200 - brick masonry
  - Section 04300 - concrete masonry
  - Section 16010 - electrical general provisions
  - Section 16550 - emergency power system
  - Section 16675 - pump control panel

#### 1.02 Manufacturers

- A. Manufacturers of equipment covered by these specifications shall be reputable firms with at least five years experience in the manufacturer, testing and supervision of installation and operation of the equipment. All materials and equipment furnished shall be guaranteed free from defects in workmanship or design, and the contractor shall replace, without cost to the owner, any part or equipment which is defective or shows undue wear within one year after the equipment has been in permanent operation.

#### 1.03 Submittals

- A. Shop drawings of all equipment shall be submitted to the owner for approval. Information shall include dimensions, capacity, material, finish, guarantee, etc.

- B. Six (6) copies of a complete operations manual for all equipment, including detail drawings, maintenance instructions and other pertinent data shall be compiled and submitted to the owner for review and approval before acceptance of the facility.

**1.05 Sewage Pumping Units**

**A. General**

Furnish and install a quantity of 2 Fairbanks Morse(or approved equal) pump 4” Model D5433MVK pull-up submersible sewage pumping unit(s), UL Listed for explosion proof Class I, Division 1, Groups C and D hazardous locations. The pumps shall be clockwise rotation and connect to the discharge piping when lowered into place.

**B. Conditions of operation**

Each pump shall provide the following hydraulic conditions:

	<b>Primary design conditions</b>	<b>Secondary conditions</b>
<b>Capacity</b>	352	687
<b>Total dynamic head</b>	89.8	57.4
<b>Maximum speed (rpm)</b>	1770	1770
<b>Efficiency (min hydraulic)</b>	50	57
<b>Shutoff head</b>	119	
<b>NPSHR</b>	19	25.8
<b>Spherical size</b>	3	3

**C. Impeller**

Impeller shall be matched to its constant velocity equalizing pressure volute, and be of the one-piece, single suction, enclosed bladeless, radial flow design with large openings, blunt well-rounded leading edges thick hydrofoil shape tapered to the trailing edge, and a circular flow pattern to prevent the accumulation of solids and stringy material. It is to be balanced and secured to the shaft by means of a key and fastener. Wiper vanes are not allowed. Impeller waterways and clearance between the pump’s full diameter impeller periphery and volute cutwater shall be capable of passing a 3” solid sphere. Impeller shall be trimmed to specifically meet the conditions of operation and be fitted with an axial (face-type), stainless steel wear ring with a minimum 300-350 Brinell hardness. The impeller is adjustable by the use of shims to restore the wear ring clearance in the field.

**D. Volute and Sliding Bracket**

Volute is to be cast with extra thick walls made of close-grained cast iron

conforming to ASTM A48, Class 30. It is to be one-piece, constant velocity equalizing pressure with smooth fluid passages large enough to pass any size solid that can pass through the impeller. The volute shall have an integral tapered suction inlet area to direct flow to the impeller eye and have a centerline flanged discharge. Volute discharge shall be minimum 4" diameter as measured on the inside diameter of the discharge flange opening. Volute shall be fitted with an axial (face-type), stainless steel wearing ring with a minimum 410-484 Brinell hardness.

The sliding bracket assembly shall be a part of the pumping unit constructed so that when lowered to the discharge base/elbow, the knifing action of the vertical metal-to-metal seal provides a self-cleaning, non-clogging, non-sparking UL Listed explosion-proof assembly.

**E. Guide Rail/Bracket**

Two stainless steel rails shall be provided to guide the pump when being raised or lowered in the sump and mount on the discharge base/elbow. Single rail or cable guide systems are not acceptable. The rails shall align the pump with the discharge elbow as it is lowered into place. A ductile iron upper rail guide bracket shall be furnished to support and align the rails at the top of the sump. For rail lengths greater than 20 feet, a stainless steel intermediate rail guide bracket shall be included.

**F. Discharge Base**

The installation shall include a rigid discharge base-elbow to support the total weight of the pumping unit. The base is to be bolted directly to the floor with the 90 degree elbow having a 125 lb. ANSI flange discharging vertically.

**G. Motors**

Pump(s) shall be driven by completely sealed, electric submersible squirrel cage induction motors with a maximum NEMA nameplate rating of 20 HP, 1.15 service factor, 1770 RPM, 230 volts, 3-phase, 60 Hertz. The motor nameplate horsepower rating should exceed the brake horsepower requirements of the specified head and capacity conditions and have a minimum full load efficiency of 83.9%. **The motor shall be non-overloading over the entire range of the impeller curve.**

Submersible equipment shall be UL Listed for Class I, Division 1, Groups C and D explosion-proof hazardous locations as defined by the National Electric Code. All electrical parts shall be housed in an oil-filled, 210 frame construction, cast iron, watertight enclosure which is sealed by the use of O-rings and rabbeted joints with extra large overlaps.

The stator-winding and lead shall be insulated with moisture-resistant Class F

insulation for continuous duty in 40 degree C ambient. The motor shall be designed for continuous duty capable of ten (10) starts per hour. Automatic reset, normally closed thermal overloads shall be imbedded in the motor windings to provide overheating protection. Motor winding thermostats must be connected to an electric controller per local and state codes and the National Electric Code.

Motor shaft shall be one-piece, 416 stainless steel. Carbon steel shafts or shaft sleeves are not acceptable. Rotor is to be dynamically balanced to meet NEMA vibration limits; all external hardware is to be stainless steel.

Cable leads are to enter at the top of the motor, and are to allow the cable-to-motor connection to be accomplished in the field without soldering. All power and control lead wires are to be double sealed as it enters the motor in such a manner that cable-wicking will not occur. This sealing system shall consist of a rubber grommet followed by epoxy that is high in adhesive qualities and has a low coefficient of expansion. Each cable wire is to have a small section of insulation removed to establish a window area of bare wire and each wire is to be untwisted and surrounded by epoxy potting material. A cable strain relief mechanism shall be an integral part of this sealing system. Cable sealing system shall be capable of withstanding an external pressure test of 1200 PSI as well as a cable assembly pull test as required by Underwriters Laboratories. Singular grommet or other similar sealing systems are not acceptable. Motor shall be supplied with 50 feet of multi-conductor type "SOW-A" or "W" power cable and control cable. Cable sizing shall conform to NEC specifications and be UL Listed.

Power and control leads shall be terminated on a sealed terminal board. The terminal board and its bronze lugs shall be O-ring sealed.

Pump(s) shall be provided with two separate tandem-mounted mechanical seals to prevent the pumped liquid from entering the rotor/stator cavity area to ensure reliability of operation. The upper and lower seals are mounted to rotate in the same direction.

The upper seal is to be completely immersed in an oil bath and seals the oil chamber and the motor housing. The lower seal mating surfaces are to be immersed in the oil bath sealing the pump volute and the oil chamber. Each seal shall be held in contact by its own spring system and require neither maintenance nor adjustment, but shall be easily inspected and replaceable. The lower seal spring shall be protected from trash in the pumped fluid by a spring cover which extends over the entire length of the compressed seal spring. Pressure generated by the pump assists in sealing the mating surfaces of the lower seal.

Seal materials for the upper seal shall be stainless steel and Buna-N components, carbon rotating face and Ni-resist stationary face. Lower seal construction shall be stainless steel and Buna-N components, silicon carbide rotating face against

tungsten carbide stationary face.

Two moisture detection probes shall be installed so that they will detect moisture in either the seal or stator cavity measuring resistivity between the probes. They shall be wired internally to the control cable connection at the top of the motor. Float type devices located in the rotor/stator area or single probe-to-ground moisture detectors measuring continuity are not acceptable. O-ring sealed inspection plugs shall be provided in the mechanical seal oil chamber for ease in inspection, draining and filling of oil.

The pump shall rotate on oil lubricated-for-life thrust bearing and oil lubricated radial bearing with a minimum L10 life of 50,000 hours. Lower shaft bearings shall be locked in place to prevent shaft movement and to take thrust loads.

A heavy-duty stainless steel lifting bail shall be included and be of adequate strength to lift the entire pump and motor assembly.

#### H. **Quality Assurance**

Pumps and motors are to be engineered, manufactured and assembled in the United States under a written Quality Assurance program. This written Quality Assurance program shall have been in effect for at least five (5) years, and include a written record of periodic internal and external audits to confirm compliance with UL Quality Assurance specifications.

**A manufacturers representative shall be present at pump startup to ensure that the pumps are operating correctly and all warranties remain in tact.**

#### I. **ISO-9001 Certification**

Pumps and motors shall be manufactured by ISO-9001 certified companies only.

### 1.06 **Ventilation Materials and Equipment**

- A. Ventilation work shall include the furnishing of all ductwork, exhaust fans and fan work. The purpose of the plans is to show the general arrangement and location of the various components of the ventilation system. Some flexibility in arrangement and locations may be permissible; however, no alterations shall be made except with the specific approval of the owner.
- B. All equipment shall be new and shall conform to underwriter's laboratories, incorporated, standards. The installation of the work shall be performed by skilled mechanics and shall comply with all requirements of the national fire protection association.

- C. Detail drawings: shop drawings of all equipment shall be submitted to the owner for approval. Drawings shall show dimensions, capacity, material, finish, guarantee, etc.
- D. Sheet metal work: metal ductwork shall be 1/16-inch thick aluminum alloy 6061-16. Ductwork shall be secured to the walls with 1-inch wide, 1/8-inch thick aluminum straps on 36-inch centers. Where cutting of walls is necessary for installation of ductwork, cuts shall be made as neatly as possible and after completion of the work shall be patched and the rough openings shall be covered with flashing. All aluminum which comes in contact with concrete surfaces shall be coated with a bituminous paint.
- E. PVC ductwork shall be as shown on the plans. It shall be secured to the walls as specified for metal ductwork.
- F. Exhaust fans:
  - 1. The control room ventilation fan shall be Stanley model dge/s, size 18, 115 volt, single phase, 60 hz, 1814 cfm, 1,700 rpm, 1/4 hp, 1/2- inch static pressure.
  - 2. The wet well vent fan shall be JennFan Upblast Roof Exhauster Model TXD-1425SC delivering 932 cfm at .25 - inch static pressure, .25 hp, single phase, 115 volt, 770 rpm motor with unibeam curb to provide 30 air changes per hour.

#### 1.07 **Miscellaneous**

- A. Painting: the entire pump assemblies shall receive two shop coats of machinery green enamel. Paint for touch-up painting shall be supplied by the pump manufacturer.
- B. Supervision of installation. The pump manufacturer shall furnish a service representative to supervise and inspect the installation and initial operation of the pump.

#### 1.08 **Alarm system**

- A. The contractor shall furnish and install complete; all internal alarm systems, circuits, sensing devices and appurtenant equipment to provide the specified alarm and operational information to the Newport news operations center. The alarm transmitter shall be Motorola (model MRU plus) advanced alarm status or equal. Location and height of antennae must be sufficient to ensure that the alarm signal will be received at the Newport News operations center.

- B. System equipment: the contractor shall furnish and install all sensing and transmitting equipment as follows:
1. Door monitor and alarm
  2. Limit switches on each discharge check valve
  3. High water
  4. Pump #1 failure to start
  5. Pump #2 failure to start
  6. Power failure
  7. Station on emergency generator
  8. Generator failure to start

## **Part 2 - TESTS**

### **2.01 General**

- A. Motor manufacturer to furnish guaranteed minimum efficiency based on test using method "b" (dynamometer) IEEE-112 test procedures for polyphase induction motors and generator.
- B. Manufacturer to furnish percentage of efficiency, percentage of pf, amp at full load, 3/4 load, 1/2 load with quotation and be prepared to furnish actual test results on individual ratings if requested.
- C. All equipment shall be tested under operating conditions. The necessary gauges, meters and devices required to display compliance of the equipment with the specifications shall be furnished by the contractor.

## **Part 3 - EXECUTION**

### **3.01 Installation**

- A. Installation of all equipment shall be accomplished in accordance with contract drawings and the equipment manufacturers recommendations. Equipment must be properly aligned and anchored to prevent movement or undue stress or associated components or adjacent equipment.
- B. The contractor shall verify that the openings called for on the contract drawings are of the correct dimensions to facilitate the installation of the equipment to be provided.

## **Part 4 – SPARE PARTS**

### **4.01 General**

A. Contractor to provide the following spare parts:

1. Impeller (2)
2. One complete pump seal kit

**END OF SECTION**



## SECTION 16675 - PUMP CONTROL PANEL

### 1. SCOPE

A. The CONTRACTOR shall furnish and install one complete station control panel as manufactured by Automation Controls, Inc. of Newport News, Process Control Services of Seaford, Universal Controls of Chesapeake, Systems East Inc. of Newport News, Electric Motor and Contracting Company, Inc. of Courtland, or Thermo-Trol Corporation of Tidewater, Inc.. No substitutes. The control panel shall control two (2) 7.5 hp Submersible Grinder Sewage Pumps at 230V, 3 Phase. The control panel shall contain the following:

1. A 70A/3P main breaker and a 30 amp/3P circuit breaker and NEMA size 1 starter for each pump motor properly sized for motor running current and short circuit protection.
2. One control circuit to provide a field adjustable lead, lag, alternate operation for all pumps with provisions for hand-off-auto operation. Elapsed time meters to be provided for each pump.
3. Adjustable three phase voltage sensor to protect motors from single phasing and under voltage conditions.
4. The control Panel shall include an Allen Bradley SLC505 programable logic controller integrated with the digital set point controllers.
5. Provisions to shut down pumps in even of a failure-to-pump condition to prevent pump damage.
6. Limit switches on station check valves to sense a failure to pump condition.
7. Each Control Panel will be equipped with correctly sized line reactors and isolation contacts. The purpose of the line reactor and isolation contacts is to provide protection to the electrical components from electrical transients and/or electrical noise. MTE is a manufacturer of such products and Electrical Equipment Co. of Norfolk is a local point of contact for additional

information.

8. The Control Panel shall be UL listed as a complete assembly in accordance with UL-508.
9. All control panels will be equipped with an adequately sized heat removal unit (e.g., vent fan, heat exchanger or air conditioner). The control panel manufacturer shall certify the adequacy of the proposed heat exchange unit.
10. Phase monitor to monitor utility power.
11. Phase monitor to monitor generator power.

#### B. Responsibility

1. The prime CONTRACTOR shall be responsible for the performance of the panel manufacture.
2. The panel manufacturer shall be responsible for the proper coordination of starting current available, voltage, control circuits and the alarm system for the pump motors and control panel.

#### C. Submittals

1. The control panel manufacturer shall submit drawings, bearing the seal of a Certified Professional Engineer in the State of Virginia experienced in Electrical Engineering, adequate for panel fabrication, installation and maintenance. Drawings shall be submitted and approved prior to the control panel manufacturer starting any fabrication. Approval of the drawings does not relieve the manufacturer from his responsibility for satisfactory performance of the equipment provided nor from compliance with the specifications.
2. No substitute on panel manufacturer other than those specified. Others wishing to be approved as an equal to those specified in future projects must be approved by the City of Newport News, Department of Public Works Product Review Committee.

## 2. MATERIALS

### D. Panel Enclosures

All motor branch components and all electrical control components shall be mounted in one floor standing or wall mounted enclosure to UL Standards. The enclosure shall be NEMA 12 in design. The interior shall be finished white and the exterior shall be finished with acrylic, "Vista Green" in color, for protection from the pump station atmosphere. All components shall be wired to terminal strips and bulkhead fittings. All items coming from the wet well shall be sealed off prior to reaching the panel. All control panels shall not be of the MCC type.

### E. Items to be Mounted on the Door of the Panel Enclosure

1. On-off circuit breaker operators, one for main breaker and one for each pump motor, to be General Electric T-HM2 series or equal sized to fit properly with the pump motor circuit breakers and main breaker. Panel circuit breakers shall be interlocked with panel door.
2. 1 - Control Power circuit breaker, General Electric TE III series or equal "Control On" pilot light.
3. Provide a digital wet well level graph indicator in the control panel to monitor the wet well level and to provide start/stop contacts for control of the pumps. The level indicator/controller shall be a Texmate Leopard Vertical Bargraph.
4. Provide a digital pressure graph indicator in the control panel to monitor the discharge pressure. The indicator shall be a Texmate Leopard Vertical Bargraph.
5. Provide a digital flow indicator to display Flow in gpm from the Khrono Magnetic Flow meter.
6. 1 - Running ammeter with 3 phase selector switch for each pump.
7. Running time meters reading in hours and tenths, total of 6 digits, one for each motor, to be ATC series 5700 or equal.

8. Hand-off Auto switches, one for each pump motor, to be Allen-Bradley 800 T series or equal.
9. Overload reset buttons - one for each pump motor to be Allen-Bradley 1493 series or equal. Provide Allen-Bradley 800 T series lights to indicate motor overload. One light for each motor. Overload alarm contacts are required for connection to the SCADA system.
- 10.1 - Selector switch for pump alternator - "On" - "Pump #1 Lead" - "Pump #2 Lead" - for a duplex configuration; alternator - "On", - "Pump #1 lead" - Pump #2 lead", alternate selection between - "Pump #1 and #2".
11. Failure to pump lights, over temperature and seal failure lights, one of each pump to be Allen Bradley 800 T series or equal. Also include failure to pump reset buttons, one for each motor.
12. "Pump Running" lights, one for each pump to be Allen-Bradley 800 T series or equal.
13. Name tags for the above shall be located on the panel door.
14. One momentary push button switch that, when depressed, will simulate a failure status of all alarms. This switch shall be labeled "Alarm System Test Switch."
15. Branch circuit breakers, General Electric TE III series to supply power to lights, receptacles and vent fans with engraved name plates and ampere rating as indicated.
16. Seal fail and over temperature lights, if applicable, one for each pump.

F. Items to be Mounted on the Interior of the Panel Enclosure

1. Circuit breakers to serve as disconnects and short circuit protection for pump motors, to be molded case circuit breakers of adequate size voltage rating and short circuit capacity to meet NEC requirements.

2. One motor starter for each pump motor. Starters shall be of adequate size and voltage rating to properly start the pump motors complete with properly sized overhead heating elements. Starters to have overload relays installed in all three (3) phases. Starters to be Allen Bradley FVNR.
3. 1 - Adjustable voltage sensor, diversified model #SLA-230-ALA, time mark 258B or equal.

12. A lightning surge protection device shall be provided.

13. The following alarm contacts wired to a separate terminal strip:

1. Wet well high water
2. Wet well High High water
3. Wet well Overflow
4. Wet well low water
5. Dry well high water
6. Pump #01 Run
7. Pump #01 Flow Fail
8. Pump #01 Motor Overload
9. Pump #01 Seal Fail
10. Pump #01 Over Temperature
11. Pump #02 Run
12. Pump #02 Flow Fail
13. Pump #02 Motor Overload
14. Pump #02 Seal Fail
15. Pump #02 Over Temperature
16. Utility Power Fail
17. Station Power Fail
18. Generator Run (to be active whenever generator is running regardless of transfer switch position).
19. Generator Exercise
20. Generator Fail
21. Intrusion
22. PLC Fail
23. RTU Fail

6. Terminal strips to accept all field control wiring.

8. Each Control panel shall be equipped with a properly sized 5% line load reactor with isolation contacts (MTE or equal).
9. GFI Receptacle in side of panel.
10. Provide a Siemens pressure transmitter in the piping header 0-58psi, with chemical seal and Texmate Leopard vertical Bargraph meter in the control panel to monitor the discharge pressure.
11. Provide a Texmate Leopard vertical Bargraph meter and setpoint controller in the control panel to monitor the wet well level. A level transmitter shall output a 1-5V analog signal proportional to the wet well level to the programmable controller. The pressure transmitter shall be KPSI Series 705 0-5psi with lightning protection.
12. Digital graph meters shall be mounted flush in the control panel to display the wet well level, discharge pressure and flow. The meters shall receive a 1-5V process input signal and shall digitally display the wet well level in inches and pressure in feet. The digital meter shall operate on 120 VAC power and shall have an accuracy of  $\pm 0.02\%$  of the reading. The digital meters shall be Texmate Leopard Vertical Bargraph model.

G. Additional items:

1. Furnish and install a limit switch on each pump check valve to indicate whether the check valve has lifted off its seat. The check valve limit switches shall be wired to the programmable controller and used for pump failure monitoring. The check valve limit switches shall consist of a corrosion-resistant pre-wired limit switch with a 12-inch long nylon rod lever. The limit switches shall be Allen-Bradley Bulletin 802MC-AY5, or equal.
2. Furnish and install two (2) mercury float switches in the wet well to detect a high water level and low water condition. The float switches shall have a normally closed contact that shall be wired directly to the alarm

transmitter. The float switches shall be Anchor Scientific Roto-Float Type S, or equal

3. Furnish and install a backup Float system in the event of level transducer failure. Provide Float switches for Lead, Lag and pump off conditions. The general sequence of operation shall be as described in section "C" of this specification. Float backup system operation shall be selectable operator on the front of the panel.
4. Provide a 316 stainless steel wall mounting bracket for mounting each float switch. The mounting brackets shall be Anchor Scientific #WMS, or equal.
5. Furnish and install a magnetic door switch at the station entry door and on valve vault hatch to detect that someone has entered. The magnetic door switch shall be hermetically sealed and shall be Sentrol, or equal.
6. A solid state submersible pressure transducer shall be provided for installation in the wet well. The transducer shall provide a 1-5V signal proportional to wet well level to the control panel mounted Level Indicating Controller (LIC). The controller converts the analog signal to a digital display to allow the operator to view and adjust level control set-points. The transducer shall be designed for continuous operation in the sewage wet well. The transducer housing shall be an all-welded design, constructed of corrosion resistant 316 stainless steel. The transducer shall be provided with a sufficient length of polyurethane jacketed cable. The transducer shall be a KPSI model 705. A 1 1/2 inch PVC pipe assembly and mounting hardware as shown on the contract drawings shall be provided for installation of transducer into the wet well.

#### C. Sequence of Operation

1. The Submersible transducer and Texmate 4 point controller with digital bar graph (LIC) shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator's selection of automatic operation, the (LIC) shall start the motor for one pump when the liquid in the wet well rises to the "lead pump on" level.

When the liquid is lowered to the "lead pump stop" level, the (LIC) shall stop this pump. These actions constitute one pump cycle.

If the wet well level continues to rise with the lead pump operating, the (LIC) shall start the second pump when the liquid reaches the "lag pump start" level. All pumps shall continue to operate until the liquid is lowered to the "lead pump stop" level.

Should any pump experience a failure, the circuit shall be designed so that the standby pump is immediately energized and will continue to operate until the liquid reaches the "lead pump stop" level.

Pumps shall alternate each cycle.

2. In addition to the panel enclosure completely wired containing the above mentioned items, the CONTRACTOR shall supply the following items for mounting in the sewage station:

- a. Install high and low water alarm float switch in wet well. Float switches shall be ABS mercury float switches Model No. 3288881 or equal. Provide aluminum brackets to locate switch from station walls.
- b. One limit switch for each door alarm.
- c. Two check valve limit switches for failure to pump alarm.

3. GENERAL

- a. Control panel shall be sized to permit at least 3 feet of working space including door opening.
- b. Control panel doors shall not conflict with other station equipment.
- c. All existing controls shall be removed and returned to the city.

4. INSTALLATION

PUMP STATION No. 5 Renovation Section 16675-8 PUMP CONTROL PANEL



Control panel and support systems shall be installed by factory-trained technicians.

5. TRAINING

After the pumps have been placed and all pumps are operational and fully controlled by the control panel, CONTRACTOR shall provide a factory-trained technician for one 8-hour day to train City personnel.

Control panel shall be designed for pumps operating at voltage and amperage specified for the approved pumps being installed. Contractor is responsible for verifying all pump station existing conditions.