MICHIGAN

DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION

FOR

**PUMP STATION EQUIPMENT, MECHANICAL AND SUBMERSIBLE PUMPS**

TAY:PJS 1 of 7 APPR:DMG:RPB:04-23-24

**a. Description.** This work consists of removal/demolition of existing piping and equipment and furnishing and installing refurbished piping and new mechanical equipment in the pump station as shown on the plans and specified herein.

**b. Materials.** Use materials in accordance with applicable *ANSI* and *ASTM* standards and as specified herein.

1. Furnish lubricants as recommended by the pump manufacturer.

2. Submersible Pump Performance. Design pumps capable of pumping storm water, carrying suspended sand, and other debris anticipated to be contained in storm water runoff.

Ensure the pumps, with appurtenances, and cable are capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet. In accordance with the *NEC*, ensure the pumps are classified explosion-proof, Class I, Division I Group D with a *Factory Mutual Research Corporation* (*FM)* or *UL* certification and designed for continuous duty. Ensure the motor and pump are produced by the same manufacturer.

Furnish either a 5-year non-prorated warranty against material and workmanship covering all parts and labor on motors and pumps from the manufacturer, or a separately obtained insurance policy covering all parts and labor on motors and pumps naming the Department as the policy holder.

Ensure the pump, and motor manufacturer has an established factory authorized service and repair facility within a 100-mile radius of the location of the installed pumps.

3. Factory Testing of Submersible Pumps. Hydrostatically test and test run pumps before shipping. Furnish non-witnessed certified test curves for each pump showing head, capacity and brake horsepower over a range covering the specified duty point.

**Table 1: Pump Station**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Station Name | Location | Pump Type | No. of Pumps | Capacity, gallons per minute (gpm) Each Pump(a) | Total Dynamic Head (a)(feet) | Motor (volts) |
| D01 of 82101 | Eastbound Old M-14 at CSX railroad crossing west of I-275 | Submersible | 2 | 1300 | 27 | 460 |
| a. Ensure pumps in this table are capable of pumping at the capacity and head conditions (duty point) listed, within the performance tolerances of the *Hydraulic Institute,* level B. | | | | | | |

4. Submersible Pump Construction. Ensure major pump components are of gray cast iron, *ASTM A48/A48M, Class No. 35 B*, with smooth surfaces devoid of blow holes or other casting irregularities. Ensure all exposed nuts or bolts are *AISI 304* stainless steel.

Ensure pump volute(s) are single-piece gray cast iron, *ASTM A48/A48M, Class No. 35 B*, non-concentric design with smooth passages large enough to pass 3-inch solids that may enter the impeller. Ensure minimum inlet and discharge size are as specified.

Ensure the pump shaft rotates on at least two grease-lubricated bearings, one of which is a double bearing. Ensure the upper bearing, provided for radial forces, is a single roller bearing. Ensure the lower bearings consists of at least one roller bearing for radial forces and one or two angular contact ball bearings for axial thrust. In accordance with the *American Bearing Manufacturers Association*, ensure the minimum L10 bearing life is 100,000 hours at any point along the usable portion of the pump curve at maximum product speed.

Furnish each pump with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. Ensure the lower seal is independent of the impeller hub. Ensure the seals operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. Ensure the lower, primary seal unit, located between the pump and the lubricant chamber, contains one stationary and one positively driven rotating tungsten-carbide seal ring. Ensure the upper, secondary seal unit, located between the lubricant chamber and the motor housing, contains one stationary tungsten-carbide seal ring and one positively driven rotating tungsten-carbide seal ring. Ensure each seal interface is held in contact by its own spring system. Ensure the seals require neither maintenance nor adjustment and can operate in either clockwise or counterclockwise direction of rotation without damage or loss of seal. Should both seals fail and allow fluid to enter the stator housing, ensure a port is provided to direct that fluid immediately to the stator float switch to shut down the pump and activate an alarm. Ensure any intrusion of fluid does not come into contact with the lower bearings. Ensure seal lubricant is *Food and Drug Administration* approved, nontoxic.

Ensure pump and motor shaft is a solid continuous shaft. Ensure the pump shaft is an extension of the motor shaft. Couplings are prohibited. Ensure the pump shaft is of carbon steel *AISI C1035* or *430F* stainless steel and is completely isolated from the pumped liquid.

Ensure the impellers are of cast iron, *ASTM A48/A48M, Class No. 35 B,* or higher, dynamically balanced, solids-handling, non-clogging design. Ensure the impeller(s) are capable of handling solids, fibrous materials, heavy sludge, and other matter found in stormwater runoff. Ensure impellers are keyed to the shaft, retained with an expansion ring or bolt assembly which cannot be loosened by torque from either forward or reverse rotation. Ensure the impeller can pass a minimum 3-inch diameter solid or be of the cutting type as scheduled. Ensure all impellers are coated with an acrylic dispersion zinc phosphate primer.

Ensure a wear ring system is used to provide efficient sealing between the volute and suction inlet of the impeller. Ensure each pump is equipped with Grade 316 stainless steel, nitrile rubber coated steel or brass wear rings.

5. Ensure all metal surfaces coming into contact with the pumped media, other than stainless steel, are protected by a factory applied coating of acrylic dispersion zinc phosphate primer with a final coat of polyester resin paint finish coat on the exterior of the pump.

6. Submersible Pump Motor. Ensure the pump motor is induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber, *NEMA* *B type*.

In accordance with *NEMA*, ensure the stator windings and stator leads are insulated with moisture resistant Class F insulation rated for 155 °C (311 °F). In accordance with *NEMA*, ensure the stator is dipped and baked three times in Class F varnish and is heat-shrink fitted into the stator housing. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is prohibited.

Design the motor specifically for submersible pump usage and for continuous duty pumping media of up to 40 °C (104 °F) with an 80 °C temperature rise and capable of at least 15 evenly spaced starts per hour. Ensure the rotor bars and short circuit rings are made of cast aluminum. Ensure the combined service factor (combined effect of voltage, frequency, and specific gravity) is a minimum of 1.15. Ensure the motor has a voltage tolerance of ±10 percent.

Ensure the power cable is sized in accordance with the *NEC* and *ICEA* standards and of sufficient length to reach the junction box without the need of any splices. Ensure cables are approved for use in hazardous locations and conforms to industry standards for loads, resistance under submersion against sewage.

Ensure the motor horsepower is adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

Furnish inverter duty rated motors for pumps scheduled to operate with variable frequency drives.

Ensure thermal switches are embedded in the stator end coils to monitor the temperature of each phase winding. Ensure these thermal switches are used in conjunction with and supplemental to external motor overload protection and are connected to the control panel.

Ensure the junction chamber contains two distinct and separate terminal boards. Ensure the first terminal board is used for the connection of the pilot sensor leads with the pilot sensor cable. Ensure the second terminal board is utilized for the line power connection to the motor stator leads. Ensure this power terminal board uses threaded compression type binding posts to connect the cable conductors and motor stator leads. The use of wire nuts or crimping type connectors is prohibited.

Furnish the manufacturer’s standard motor thermal and seal leak monitoring relay for each pump.

7. Pump Base. Ensure the pumps are automatically and firmly connected to the discharge connection, guided by stainless steel guide rails extending from the top of the wet well to the base mounted discharge connection. Ensure there is no need for personnel to enter the wet well for pump removal.

Ensure sealing of the pumping unit to the discharge connection is accomplished by a machined metal-to-metal watertight contact.

Ensure the entire weight of the pump/motor unit is borne by the pump discharge elbow. Ensure no portion of the pump/motor unit bears on the wet well floor directly or on a wet well floor mounted stand.

8. Pump Removal System. Ensure a sliding guide bracket is an integral part of the pumping unit and the pump casing has a connecting flange to connect with the discharge connection, which is bolted to the floor of the sump and so designed as to receive the pump connecting flange without the need of any bolts or nuts.

Ensure the pumps are easily removable for inspection or service, requiring no bolts, nuts, or other fastenings to be removed for this purpose, and no need for personnel to enter the pump well.

Ensure each pump is fitted with a 5/8-inch, Grade 316L stainless steel chain to permit raising the pump for inspection and removal.

Ensure stainless steel pipe guide rails of standard dimension schedule 40 stainless steel with a minimum diameter of 1¼ inches, complete with intermediate support brackets as recommended by the manufacturer, are furnished with the pumps. Furnish stainless steel anchor bolts.

**c. Construction.** Remove and/or demolish existing interior piping and equipment in accordance with the applicable sections of the standard specifications, the plans, and as specified herein. Construct all work associated with the mechanical equipment and interior piping in accordance with the applicable sections of the standard specifications, the plans, and as specified herein.

Remove portions of the existing pump station mechanical equipment as shown on the plans. Ensure all areas not shown to be removed remain intact and protected. Coordinate mechanical equipment demolition with other construction activities. Notify the Engineer at least 2 work days prior to pump removal and any time modifications are made to the electrical equipment that may affect the operation and control sequence of the pumps. Clean, repair, patch, and paint all areas effected by demolition work at the pump station site in a manner approved by the Engineer.

Refer to the Special Provision for Bypass Pumping for project requirements during construction.

Protect existing pump station equipment during demolition. Remove, modify, and reinstall any items that lay both within the demolition portion of the pump station and the portion that will remain intact as shown on the plans or as directed by the Engineer.

1. Construction Pumping Capacity. Ensure the pump station remains in service during construction. Pump station capacity requirements during construction are as follows:

A. Where five pumps are present, ensure a minimum of 40 percent of existing pump capacity remain in service at all times.

B. Where four or two pumps are present, ensure a minimum of 50 percent of existing pump capacity remain in service at all times.

C. Where three pumps are present, ensure a minimum of 33 percent of existing pump capacity remain in service at all times.

D. In all cases, ensure the new pump(s) are shipped, delivered and available to be installed before demolishing the existing pump(s).

Ensure a qualified manufacturer’s representative furnishes on-site pump installation supervision for a minimum of 3 work days, not necessarily continuous.

Ensure existing pumps are delivered to and remain the property of the Department after removal. All other existing material removed becomes the property of the Contractor and is to be immediately removed from the site.

2. Pump Installation and Connections. Ensure a pump base for each pump is permanently installed in the wet well floor in accordance with the pump manufacturer’s instructions. Ensure the pump/motor provides a tight seal with the discharge elbow. Ensure the pump/motor unit is held in place by its own weight and the pumping head. Install discharge connections at the elevations shown on the plans and at the proper orientation designated by the pump manufacturer. Furnish elbow support to the floor of the wet well as required to support pump at the elevation shown on the plans.

3. Pump Removal System. Ensure the pump slide rail system is permanently mounted to the floor of the wet well and the floor level of the pump room. Furnish and install all anchor bolts as required.

4. Shop Drawing Submittals. Submit shop drawings and product data for all appropriate equipment detailed in this special provision. Do not start the work until the Engineer has approved the shop drawings. Submittals will be returned in 15 work days. Submit the following information for approval by the Engineer:

A. Three sets of the Catalog Cuts and/or Product Data Sheets to the Engineer for review and approval. Ensure Catalog Cuts are furnished for standard manufactured items. Ensure each sheet identifies the exact equipment for which it is intended. All pertinent current information such as physical dimensions and approved listings such as *UL* label or other testing agencies.

B. Ten Sets of Pump Station Mechanical Equipment. Furnish detailed shop drawings and product/manufacturer data for pumps, pump base, slide rail system, pump certified factory testing, including certified pump curves; manufacturer’s installation test and inspection reports; operation and maintenance manuals for each facility; record drawings; and warranty certificates.

The approval of shop drawings does not relieve the Contractor from the responsibility to correct errors or omissions or to furnish adequate field measurements as may be required. It is the Contractor’s responsibility to call attention to all deviations from the plans, specifications, and details. If deviations have not been clearly identified, they will not be considered as part of the shop drawing approval.

5. Sequence of Construction. Submit sequence of construction schedule prior to beginning work; prepare the schedule in recognition of the following constraints:

A. Always maintain the Department personnel’s access to the existing facilities. Maintain operation of the facility during the reconstruction process and provide temporary power and/or bypass pumping as needed.

B. Furnish temporary, existing, or proposed electrical power in whatever combination necessary to accommodate required pumping capacity.

C. No demolition or removal of equipment can commence until new equipment has been approved, shipped to pump station site, and is available for installation. Once demolition begins, ensure work proceeds continually during normal working hours until new equipment is in service. Arrange for support and protection of structures or parts of structures not to be demolished.

D. Ensure demolition work of structure, hatches, and other accesses include provisions to maintain security and weather protection of existing and proposed work at the station.

E. Coordinate with the electrical utility company to arrange for proper scheduling of any utility work.

F. Shoring and re-shoring or other temporary support will be required for demolition and reconstruction of the pump station. Coordinate shoring installation and removal, structural demolition, and structural reconstruction with removal of existing pumps and installation of new pumps. Design shoring and/or other temporary supports to support existing and proposed dead loads, construction live loads and pump operating loads of existing and new pumps. Ensure the shoring plan and calculations are sealed by a Professional Engineer licensed in the State of Michigan and submitted to the Engineer for review and comment. The Contractor is fully responsible for the accuracy of the shoring plan drawings and calculations.

6. Field Performance Tests of Submersible Pumps. Engage a factory authorized service representative to inspect field assembled components and equipment installation, including pump, piping, and electrical connections. Ensure the factory authorized service representative furnishes written certification that installed products meet or exceed the specified requirements.

Clean all sumps within and on inlet sewers adjacent to the pump station, including the discharge chamber, of silt, sand, and other debris before operation of the pumping equipment. Ensure lubricating systems, mechanical systems, and electrical overload and control systems are fully operative before the electrical system is energized.

Before acceptance, complete performance tests on all pumps as directed by the Engineer. Supply the water for testing and furnish competent personnel to make necessary adjustments or alterations in accordance with the operation guarantee.

Ensure the Engineer and a representative from the Operations Staff are present during the field performance tests to document alterations made to the equipment.

A. Leak Test. After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

B. Operational Test. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

C. Final Checks before Startup. Perform the following preventive-maintenance operations and checks:

(1) Lubricate oil-lubrication-type bearings.

(2) Ensure that the pump is free to rotate by hand. If pump is bound or if it drags even slightly, do not operate until cause of trouble is determined and corrected.

(3) Ensure accuracy of direction of pump rotation.

D. Starting procedure for pumps in accordance with the pump manufacturer and as follows:

(1) Prepare pump for operation.

(2) Start motor.

(3) Check mechanical operation of pump and motor.

7. Demonstration and Training for Submersible Pumps. Engage a factory authorized service representative, for a minimum of 1 day to train Department personnel to adjust, operate, remove/install, and maintain units as specified:

A. Train the Department’s maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining units.

B. Review data in maintenance manuals.

C. Schedule training with the Department with at least 7 calendar days advanced notice.

**d. Measurement and Payment.** The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

**Pay Item Pay Unit**

Pump Station Equipment, Mechanical (Structure Identification) Lump Sum

Submersible Pump (Structure Identification) Each

1. **Pump Station Equipment, Mechanical** **(Structure Identification)** will be measured and paid for by lump sum for furnishing and installing all the mechanical equipment associated with the pump station as detailed on the plans and herein including piping, sole plates, minor structural work, and removal/demolition of pumps and piping.

2. **Submersible Pump (Structure Identification)** will be measured and paid for by unit cost of each for installing the pump, pump base, and pump removal system as shown on the plans and specified herein.