MICHIGAN

DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION

FOR

**PUMP STATION EQUIPMENT, MECHANICAL AND VERTICAL MIXED FLOW PUMPS**

DET:MS 1 of 8 APPR:DMG:CJD:07-28-21

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

**b. Materials.** Furnish mechanical materials in accordance with section 405 of the Standard Specifications for Construction, *ASTM* standards, the *Hydraulic Institute* and as specified herein.

1. Ensure the principal components of vertical mixed flow pumps in multiple pump installations, of like capacity, are interchangeable.

2. Ensure lubricants are as recommended by the pump manufacturer.

3. Vertical Mixed Flow Pump Performance. Design pumps capable of pumping storm water carrying suspended sand and able to pass up to two inch solids.

4. Pumping equipment includes motors, discharge head, baseplate and elbow, sole plate, pump column assembly, bowl assembly, supports, anchor bolts and other items specified herein.

A. Provide a 5 year non-prorated warranty against flaws in material and workmanship covering parts and labor on motors and pumps. Ensure this warranty is provided by the manufacturer, their representative, or by an insurance policy obtained by the Contractor naming the Department as the policy holder.

B. The pump and motor manufacturer must have an established factory authorized service and repair facility within a 100 mile radius of the location of the installed pumps.

C. Factory Testing of Vertical Mixed Flow Pumps. Furnish non-witnessed certified test curves for each pump based on the duty point shown on the plans and in accordance with the standards of the *Hydraulic Institute* showing head, capacity, efficiency and brake horsepower.

5. Vertical Mixed Flow Pump Requirements. Refer to the plans for pump duty point.

6. Pumping Equipment Design.

A. Discharge Head and Column. For each pump, furnish a 3/8 inch thick *ASTM A36/A36M* structural steel or *ASTM* *A242/A242M - A588/A588M* steel discharge head. Position the discharge elbow as shown on the plans. Ensure the baseplate is a minimum of 1 inch thick or as shown on the plans and designed for the entire load for which it will be subjected. Furnish a 1 inch thick sole plate as shown on the plans. Ensure the sole plate is machined in the factory to have the bolt holes aligned with the baseplate.

Ensure the discharge nozzle is oriented in reference to the baseplate as shown on the plans. Ensure the discharge nozzle is configured as shown on the plans. Furnish discharge pressure gauge connection and motor base drain.

B. Line Shaft Assembly. Ensure the line shaft assembly is an enclosed grease lubricated type. Ensure column pipe is flanged steel with machined register fits between mating flanges and minimum wall thickness of 3/8 inch. Ensure packing box assembly is *ASTM A48/A48M, Class 30* cast iron with bronze bearings. Furnish a minimum of 3 rings of non-asbestos packing with a split packing gland. Furnish an *AISI 416* stainless steel flanged motor shaft coupling for ease of motor removal. Ensure line shaft material is pump shaft quality (PSQ) grade 416 stainless steel. Ensure the discharge bowl bushings and line shaft bearings are lubricated by a manual grease lubrication system. Furnish a separate grease line from the base plate to the suction bowl bushing to recharge the bushing as needed. Ensure the line shaft bearings are threaded externally to act as a coupling for steel enclosing tubes. Ensure enclosing tube material is extra heavy *ASTM A53/A53M, grade B schedule 80* pipe. Ensure the line shaft bearings are bronze of the removable type and provided with a means of passing grease lubricant from one bearing to the next. Furnish a means for tension loading of the enclosing tube. Ensure the number of bearings and spacing is such that the pump operating speed will be 20 percent above or below the first critical speed of the shaft.

Furnish a 3/8 inch stainless steel grease line connected externally to the suction bowl. Ensure a grease bypass port is furnished with an elbow and riser, extending above the baseplate. Ensure a carbon steel head shaft made from *ASTM A108*, *Grade C-1045 Pump Shaft Quality (PSQ)* with a carbon steel adjusting nut is provided for the hollow shaft motor to provide a means to adjust the impeller to its proper running clearance.

Design the pump so that it will not be damaged by reverse rotation caused by back flow on the pump.

C. Bowl Assembly. Ensure the suction bell and discharge bowl are *ASTM* *A48/A48M* cast iron with vanes for directing flow to the impeller.

Ensure the impeller is lead free bronze in accordance with *ASTM* *B584, C90300*. Ensure impeller(s) are retained and keyed with a stainless steel key and vertically secured by means of a split thrust collar. Ensure the impeller is dynamically balanced.

D. Hydrostatic Testing. Hydrostatically test pump bowls, discharge columns, and discharge heads at 150 percent of the maximum pump pressure.

E. Accessories. Furnish *AISI grade 316* stainless steel anchor bolts that are a minimum 3/4 inch diameter with length in accordance with the manufacturer’s recommendations. Ensure anchors are adhesive type and long enough to pass through concrete equipment pads and be anchored into the existing floor slab a minimum embedment length of 6 inches.

Furnish all necessary shaft coupling guards.

F. Data Plates. Mount a stainless steel data plate on each pump unit. Provide the manufacturer’s name, pump size and type, serial number, speed, and other pertinent data.

G. Painting. Paint the entire pump column, elbow, and bowl assembly in accordance with the Special Provision for Pump Station Special Coatings.

7. Pump Motor. Ensure the motor is a hollow shaft, high thrust type, vertical, 3 phase, 460 volt, 60 hertz squirrel cage induction motor. Ensure motors are *NEMA WP-1* designation with Class B insulation. Furnish premium efficiency motors guaranteeing a minimum of 95 percent efficiency at 75 percent of full load. Ensure the combined service factor (combined effect of voltage, frequency and specific gravity) is a minimum of 1.15. The motor must have a voltage tolerance of ±10 percent. Ensure the motor is capable of at least 8 starts per hour.

Embed the motor thermal switches in the stator to monitor the temperature of each phase winding. Use thermal switches in conjunction with and supplemental to external motor overload protection and are connected to the control panel.

Furnish the maximum motor horsepower shown on the plans. Verify that the horsepower is adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

Provide a performance chart showing curves for torque, current, power factor, input/output kilowatt (kW) and efficiency. This chart must also include data on starting and no-load characteristics.

8. Miscellaneous Items.

A. Grouting. Ensure configuration of pump bay grouting is as required by the pump supplier with minimum requirements as shown on the plans. Ensure grout is non-shrink in accordance with section 1005 of the Standard Specifications for Construction.

B. Discharge Piping and Fittings. Furnish discharge pipe and fittings as shown on the plans. Ensure all non-buried discharge pipes and fittings are *ASTM A36/A36M* steel, or Class 53 ductile iron (DI), and connect to the discharge column pipe stub.

(1) Furnish connections as shown on plans.

(a) Grooved Pipe Connection. Furnish rigid grooved pipe coupling in accordance with *AWWA C606*; Victaulic, Anvil, or approved equal.

(b) Flanged Pipe Connection. Furnish flanges in accordance with *AWWA C115*. Ensure flange hardware is *AISI grade 304* stainless steel. Ensure flange gaskets are rubber and are full face.

(c) Plain End Pipe Connection. Furnish flexible coupling; Dresser, Smith-Blair, or approved equal.

(2) Coat piping and fittings in accordance with the Special Provision for Pump Station Special Coatings.

C. Polyvinyl Chloride (PVC) Piping and Fittings. Furnish vent pipe and fittings and vactor pipe and fittings as shown on the plans. Ensure pipes and fittings are PVC Schedule 80 manufactured from virgin rigid PVC with a cell class of 12454 in accordance with *ASTM D1784*. Ensure pipes are PVC Schedule 80 Iron Pipe Size (IPS) in accordance with *ASTM D1785* and fittings are injection molded in accordance with *ASTM D2467*. Ensure pipe and fittings are manufactured as a system and the product of one manufacturer. Ensure connections are as shown on the plans and as follows:

(1) Furnish solvent cement joints in accordance with *ASTM D2564*.

(2) Ensure flanges are threaded. Ensure flange hardware is *AISI grade 304* stainless steel.

D. DI Piping and Fittings. Furnish vent pipe and fittings and vactor pipe and fittings as shown on the plans. Ensure piping is DI in accordance with *AWWA C151, Class 54* and fittings are DI in accordance with *AWWA C110.* Ensure pipe and fittings are cement mortar lined in accordance with *AWWA C104* and have an exterior asphaltic coating when buried and red primer otherwise. Ensure connections are as shown on the plans and as follows:

(1) Ensure flanges are in accordance with *AWWA* *C115*. Ensure flange hardware is *AISI grade 304* stainless steel. Ensure flange gaskets are rubber and are full face.

(2) Coat piping and fittings in accordance with the Special Provision for Pump Station Special Coatings.

E. Modular Mechanical Seals. Ensure modular mechanical seals consist of interlocking, chemical resistant synthetic rubber links shaped to continuously fill the annular space between a pipe and wall opening. Ensure the seals expand by the tightening of stainless steel bolts. Furnish a pressure plate under each bolt head. Ensure the modular mechanical seal provides a water-tight and gas-tight seal between passing pipe and sleeve.

F. Spare Parts. Furnish one spare impeller, bowl shaft, bushings, and bearings for each pump.

**c. Construction.** Ensure the construction methods for equipment removal are in accordance with sections 204 and 206 of the Standard Specifications for Construction, except as modified herein.

1. Demolition. Remove portions of the existing pump station mechanical equipment as shown on the plans. Coordinate mechanical equipment demolition with other construction activities. All items not shown to be removed must remain intact and protected. Clean, repair, patch, and paint all areas affected by demolition work at the pump station site in a manner approved by the Engineer.

Notify the Engineer at least 2 work days prior to pump removal or electrical equipment modifications that may affect the operation or control sequence of the pumps.

Contact the Engineer to determine which equipment will remain the property of the Department and/or Local Agency. All other existing material removed will become the Contractor’s property and must be immediately removed from the site and disposed of as necessary.

2. Protection of Existing Equipment. The Contractor is responsible for protecting existing pump station equipment during demolition. It is the responsibility of the Contractor to remove, modify and reinstall any items that lay both within the demolition portion of the pump station and the portion that remains intact as shown on the plans or as required by the Engineer.

The Contractor is responsible for providing temporary bulkheads between the surge chamber and motor room to prevent back flow in the event of a precipitation event.

3. 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, a minimum of 40 percent of existing pump capacity must remain in service at all times.

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

C. Where three pumps are present, a minimum of 33 percent of existing pump capacity must 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).

4. Pump Installation. Install each pump in the pump structure in accordance with the plans and pump manufacturer’s instructions. Furnish anchor bolts to secure the pump base plate and sole plate to the equipment pad. Install each pump column to the elevations shown on the plans and at the proper orientation designated by the pump manufacturer.

In the event that the factory applied coatings are damaged, ensure the coatings are touched up in the field in accordance with the manufacturer’s recommendations and/or the requirements of the specified coating system.

Ensure the pump supplier arranges and pays for a representative of the pump manufacturer to furnish onsite pump installation supervision for a minimum of 3 work days, not necessarily continuous.

5. Submittals. Do not use any materials in the work until the Engineer has had ample time to determine the products’ suitability and compliance with the specifications. Ensure all submittals are electronic PDF. Allow at least 15 work days for review.

Review and approval of submittals are only to determine compliance with the plans, specifications and details and conformance with the design concept of the completed project as a functioning whole. The Contractor is responsible for all matters relating to fabrication, shipping, handling, storage, assembly, installation, and construction, for all safety aspects of performing the work, and for coordinating the work.

Submit the following information for review by the Engineer:

A. Shop Drawings. Submit shop drawings for all equipment to be used, including but not limited to pumps and accessories. Shop drawings must contain the following: manufacturer and model; performance curves and power requirement data; equipment outline drawing with dimensions; equipment assembly drawing (exploded view) with parts list; detailed motor and electrical data.

For mixed flow pumps, submit all of the above in addition to discharge column and sole plate fabrication drawings and details.

The review of shop drawings does not relieve the Contractor from the responsibility to correct errors or omissions or to provide 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 review.

B. Catalog Cuts and/or Product Data Sheets. Submit catalog cuts and/or product data sheets for standard manufactured items such as conduit and conduit fittings, piping, etc. Each sheet must identify the exact equipment for which it is intended. Include all pertinent information such as physical dimensions, materials, and approved listings such as *UL* labels.

C. Operation and Maintenance Manuals. Submit operation and maintenance manuals for each facility. Operation and maintenance manuals must contain the following: equipment function; normal operating characteristics and limiting conditions; assembly, installation, alignment, adjustment, and checking instructions; operating instructions for start-up, routine and normal operating, regulation and control, and shutdown and emergency conditions; lubrication and maintenance instructions; guide to troubleshooting; parts lists and predicted life of parts subject to wear; outline, cross-sections, assembly drawings, engineering data, and wiring diagrams; test data and performance curves.

6. Pump Supplier’s Field Services. Ensure the pump supplier arranges and pays for a representative of the pump manufacturer to perform the following for each facility:

A. Check the work and assist in start-up.

B. Demonstrate the operation and maintenance of the pumping equipment to Department personnel.

C. Review the operation and maintenance manual with Department personnel.

D. Provide a minimum onsite time of 3 work days (not necessarily continuous) for start-up, operation and maintenance demonstration, and review.

E. Promptly make all changes and additions required by the manufacturer’s representative.

F. Provide a written letter of acceptance of installation along with the warranty information required herein.

7. Project Closeout Documentation. Furnish the following documentation to the Engineer prior to project closeout for each facility: pump manufacturer’s installation test and inspection reports; record drawings; warranty certificates.

A. Operational Guarantees and Equipment Warranties. Ensure the vertical mixed flow pumps have a 5 year non-prorated warranty against flaws in material and workmanship covering parts and labor on motors and pumps. Ensure this warranty is provided by the manufacturer, their representative, or by an insurance policy obtained by the Contractor naming the Department as the policy holder. The pump and motor manufacturer must have an established factory authorized service and repair facility within a 100 mile radius of the location of the installed pumps.

8. Sequence of Construction. Submit a sequence of construction schedule prior to beginning the work. Prepare the schedule in recognition of the following constraints:

A. Arrange the work to provide Department personnel access to the existing facilities at all times.

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

C. No demolition or removal of equipment will commence until new equipment has been approved and shipped to the pump station site and is available for installation. Once demolition begins, work must proceed continually during normal working hours until new equipment is in service. The Contractor must arrange for support and protection of structures or parts of structures not to be demolished.

D. Additional pump(s) or other support equipment may not be demolished until newly installed pump(s) are operational and commissioned.

E. All newly installed pumps must operate automatically utilizing the existing, temporary or proposed automatic controls prior to demolition of the next pump.

F. Demolition work of structure, hatches, and other accesses must include provisions to maintain security and weather protection of existing and proposed work at the station.

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

H. Shoring and re-shoring or other temporary support may be required for demolition and reconstruction of the pump station. If shoring is required, the Contractor must 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 be capable of supporting 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 by the State of Michigan and submitted to the Engineer for review and comment. The Contractor is fully responsible for the correctness of the shoring plan drawings and calculations and for the ultimate safety of any shoring installed.

**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**

Mechanical Equipment, Vertical Pumps (Structure Identification) Lump Sum

Vertical Mixed Flow Pump (Structure Identification) Each

1. **Mechanical Equipment, Vertical Pumps (Structure Identification)** includes furnishing and installing all mechanical equipment associated with the pump station as shown on the plans and detailed herein including piping, minor structural work, demolition of pumps and piping.

2. **Vertical Mixed Flow Pump (Structure Identification)** includes installing the pump, sole plate, motor and pump column as shown on the plans and detailed herein.