PROCESS PUMPS – GENERAL REQUIREMENTS

1. GENERAL

1.1 Description

.1 This section defines the general requirements for the supply and supervision of installation and commissioning of all pumps.

1.2 References

.1 American National Standards Institute (ANSI)/Hydraulic Institute (HI)

.1 ANSI/HI M100 Pump Standards.

1.3 Submissions

.1 Shop Drawings: Submit in accordance with Section E3 - Submittals and Shop Drawings. For all pump shop drawings, include the following specific details:

.1 Performance curve for the pumping unit(s) superimposed on the system curve for the particular pumping application. With the performance curve, include efficiency isopleths and NPSHR variation with flow. Where required in the specific pump sections, the performance curve should be certified in accordance with ANSI/HI M100 Pump Standards.

.2 Motor operating data, including motor and insulation ratings, start-up and operating current ratings, operating voltage and amperage tolerances, description of construction complete with illustrative drawings, and any other pertinent information.

.3 List of materials of construction, detailing the component parts of the pump(s), their materials of construction, and reference specifications for those materials.

.4 Required ancillary services including, but not limited to electrical, seal water, and drains. The sizes, ratings, and any other pertinent information related to these services.

.5 Installation instructions indicating assembly and mounting requirements, alignment and assembly tolerances, and points of connection for ancillary services (electrical, seal water, drains, etc.).

.6 Start-up instructions including lubricant requirements, electrical requirements, etc.

.2 Operating and Maintenance Data: Provide for incorporation in operation and maintenance manual as specified in Section E51 – Closeout Submittals. Include the following:

.1 Complete description of operation

.2 General arrangement and detailed drawings

.3 Wiring diagrams for power and control schematics

.4 Parts catalogues with complete list of repair and replacement parts with section drawings, illustrating the connection and the parts manufacturer’s identifying numbers.

PROCESS PUMPS – GENERAL REQUIREMENTS

2. PRODUCTS

2.1 Couplings

.1 Design couplings so that the pump unit can be disassembled without disturbing face piping.

2.2 Spare Parts

.1 Except where specified for specific pumps as noted in the sections related to those pumps:

.1 For each pump, provide for one spare mechanical seal or packing kit (as applicable) and one set of pump bearings.

.2 For each size of seal water connection, one rotameter.

.3 For each pump type and size, provide a single impeller or propeller, wear plate, suction ring (if replaceable), one pump shaft, and nut.

2.3 Factory Performance Testing

.1 Where required for specific pumps, as noted in the sections related to those pumps, factory performance test all pumps.

.2 Conduct factory performance testing in compliance with the ANSI/HI Standards.

.3 Certify test results and summarize findings in a short report. Submit report within three weeks of completing factory tests.

.4 Where the pump(s) does not satisfy the specified performance requirements within the tolerances specified by the Hydraulics Institute, redesign, modify, and retest the pump(s), all at no additional cost.

.5 Do no ship the pump(s) until the test result report has been submitted to the Contract Administrator.

2.4 Finishes

.1 Factory prime and paint all pumps in accordance with manufacturer's recommendations.

3. EXECUTION

3.1 General

.1 Comply with the requirements of the specific sections for the pumps to be provided.

3.2 Testing

.1 Field test all pumps to verify performance.

.2 Provide temporary connections, flow monitoring, pressure monitoring, ammeters, and temporary tankage required for the performance of the tests.

.3 Flow Metering

.1 Where possible, use fill and draw techniques to determine the amount of flow conveyed during the test period. Ensure that the volumes are sufficient for at least 5 minutes of pump operation at the flows that are to be tested, other than run-out.

.2 Temporary metering may be used if accepted by the Contract Administrator. Temporary meters must have an accuracy of plus or minus 5 percent, at the rated flow of the pump, to be acceptable.

.4 Field Test Report

.1 Compile field test results into a report for submittal to the Contract Administrator.

.2 Describe test set-up and measurement devices used to conduct the tests.

.3 For each pump, list the specified performance requirements and field test results. Show field test results (flow, pressure, power draw) superimposed on the performance curve provided with the submission.

.5 Where field tests to not verify compliance with specified performance requirements, investigate cause for noncompliance, undertake remedial work as required to bring pump into compliance, or replace the pump and all necessary ancillaries, and retest to prove compliance. All work required to bring the pump into compliance is the responsibility of the Contractor.

3.3 Vibration Survey

.1 Conduct a vibration survey under normal operating conditions for all pumping equipment with a motor size *exceeding 37 kW* and for smaller units where specified.

.2 Use a calibrated vibration sensor, accepted by the Contract Administrator, and capable of measuring unfiltered vibration velocities and peak to peak amplitudes. Select a sensor capable of measuring velocities at a precision of 0.1 mm/s and an accuracy of plus or minus 0.2 mm/s.

.3 Monitor vibration in all three dimensions at the head and tail end of both the driver and driven units, at intermediate bearing points, and at other critical locations which may be specified by the Contract Administrator.

.4 Record the vibration velocities for each item of equipment and submit a report to the Contract Administrator detailing the findings. Include a description of the measuring equipment, identification of equipment on which vibration monitoring was completed, description of conditions under which the test was conducted, and a listing of all of the collected data.

.5 Unless specified otherwise, use unfiltered velocities as the vibration criteria. Unfiltered velocities less than 5 mm/s shall be considered acceptable. Undertake corrective action where unfiltered velocities exceed 5 mm/s.

END OF SECTION

SUBMERSIBLE PUMPS

1. GENERAL

1.1 Work Included

.1 This Section specifies the supply and supervision of the installation, testing, and commissioning of submersible pumps including two (2) sump pumps and two (2) dry pond pumps.

1.2 References

.1 ASTM International (ASTM)

.1 ASTM A48/A48M-03, Standard Specification for Gray Iron Castings.

2. PRODUCTS

2.1 Acceptable Manufacturers

.1 Xylem Inc.

.2 ABS (Sulzer Ltd.)

.3 KSB Aktiengesellschaft

2.2 Design

.1 Pumps shall automatically connect to the discharge elbow when lowered into place, and shall be easily removed for inspection or service without the need to enter the pump well.

.2 Pump and motor assemblies shall be close-coupled integral, wetwell submersible type.

.3 Seal the pump to the discharge elbow by a simple linear downward motion of the pump. Provide a sliding guide bracket attached to the pump.

.4 Guide the entire weight of the pump by a double guide bar and press the pump tightly against the discharge elbow with metal-to-metal contact.

2.3 Impeller

.1 Provide a cast iron, dynamically balanced, single-vane non-clogging impeller.

.2 Provide an impeller capable of pumping solids as follows:

.1 Sump pumps:

.1 75 mm

.2 Dry Pond pumps

.1 100 mm.

.3 Firmly affix the impeller directly to the motor shaft through a keyed and bolted connection. Design the connection to minimize solids capture.

2.4 Pump Volute

.1 Cast iron, Class 30, to ASTM A48.

.2 Single piece, non-concentric design.

.3 Fit a stainless steel wear ring to the volute inlet to provide efficient sealing between the volute and the impeller.

2.5 Motor

.1 Motors and the associated shafts, bearings, and seals shall comply with the provisions of Section 43 21 39.01.

2.6 Capacities and Performance

.1 Provide two Dry Pond pumps to be installed to lift stormwater into the Dugald Drain from the dry pond as follows:

.1 Drive: Constant Speed

.2 Design Point – Flow: 100 L/s

.3 Design Point – Head: 5.0 m

.4 Operating Range – Head: 1.8 to 5.0 m

.2 Provide two Sump Pumps to be installed to lift stormwater from the wet well to the dry pond/Dugald Drain as follows:

.1 Drive: Constant Speed

.2 Design Point – Flow: 10 L/s

.3 Design Point – Head: 12.3 m

.4 Operating Range – Head: 9.1 m to 12.3 m

2.7 Cables

.1 Provide approved SOW type cables, with a 90°C rating and neoprene jackets.

.2 Seal the junction chamber, containing the junction board, from the motor with an O-ring seal.

.3 Connect the cable conductors and stator leads with threaded binding posts permanently mounted into the terminal insulation the board, and thus permanently leak-proof.

.4 Provide the cable entry body with a strain relief function (separate from the cable sealing function) which strain relief is to be applied from the outer side of the cable entry assembly.

2.8 Accessories

.1 Galvanized steel lifting chain, shackle and hook.

.2 Power cable.

.3 Galvanized steel double guide bar with upper guide bar holder.

2.9 Finishes

.1 Factory prime and paint submersible pumps.

3. EXECUTION

3.1 Manufacturer's Representative

.1 Manufacturer's representative is to attend the site to train installation personnel; to train operating personnel; and to witness installation and testing to ensure the equipment is installed and operated as intended.

3.2 Testing

.1 Ensure that each pump, including all component parts, operates as intended.

.2 Cooperate with the installer to fulfill the requirements for successful testing of the equipment as outlined in Section E50 - Commissioning.

3.3 Training

.1 Allow for a minimum of 2 days of operation and maintenance training as outlined in Section E50 – Commissioning.

3.4 Commissioning

.1 Attend during commissioning of the process system which includes the pump specified in this section to ensure that the pump functions as intended in the process system.

END OF SECTION

VERTICAL AXIAL FLOW PUMPS

1. GENERAL

1.1 Work Included

.1 Supply and supervision of the installation, testing, and commissioning of three (3) submersible vertical axial-flow pumps, with motors, vertical discharge columns, alarm monitoring panel, and power and signal cables.

1.2 References

.1 American Bearing Manufacturers Association (ABMA)

.1 ABMA 9, Load Ratings and Fatigue Life for Ball Bearings.

.2 ABMA 11, Load Ratings and Fatigue Life for Roller Bearings.

.2 ASTM International (ASTM)

.1 ASTM A48/A48M-03 (2012), Standard Specification for Gray Iron Castings.

.2 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

.3 ASTM A123/123M-12: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.3 National Electrical Manufacturers Association (NEMA)

.1 NEMA MG 1-2011, Motors and Generators.

2. PRODUCTS

2.1 Description

.1 Pumps for pumping large volumes of storm water into the dry pond.

.2 Provide submersible single-stage vertical axial-flow pumps.

.3 Mount pumps onto seats at the bottom of vertical discharge columns in a wet well. The pumps are held in place by their own weight and the pumping head.

.4 Make pumps completely removable from the discharge columns from above so that entry into the wet well is not required for inspection or service.

.5 Close-couple pump and motor to form one integrated direct-drive unit.

.6 For each installed pump, include the vertical discharge column complete with seats and support flanges.

.7 Include a spring-loaded hooking device with a working load fifty percent greater than the weight of the pump-motor unit.

2.2 Acceptable Manufacturers

.1 Xylem Inc.

.2 ABS (Sulzer Ltd.)

.3 KSB Aktiengesellschaft

2.3 Pump Motors

.1 Heavy-duty service.

.2 Squirrel cage induction type with non-hygroscopic windings. Insulation temperature rise not to exceed Class F. Insulation to be moisture resistant.

.3 For starting and torque characteristics, conform to NEMA Design B.

.4 Type 316 stainless steel motor shafts.

.5 Provide motors nameplate rated for 600 V, 60 Hz, 3-phase service.

.6 Design motors for full voltage starting and capable of running successfully when terminal voltage is from +10% to -10% of nameplate voltage. Motors with a service factor of 1.0 shall run at not more than 90% of nameplate current rating and motors with a service factor of 1.15 shall operate at not more than 100% of nameplate current rating.

.7 Provide motors capable of 6 evenly spaced starts per hour on a continuous basis without temperature rises which would harm insulation and windings.

.8 Design motors for semi-continuous immersion in liquid with an ambient temperature of 40°C unless higher temperatures are specified. Design casing for adequate heat rejection. Internal circulation of the pumped liquid for cooling is not permitted.

.9 Provide thermal protection. Incorporate two bimetallic sensors that sense when the motor temperature rises above 140°C. The motor shall automatically restart after cool-down. For TEXP motors, calibrate the two bimetallic sensors to shut down the motor at 120°C. Include three additional thermistors which shut down the motor at 140°C. On sensing this condition, the motor will be shut down and held until reset. Use the thermal switches in conjunction with, and supplemental to, external thermal motor overload protection.

.10 Provide a moisture sensing device in the stator.

.11 Attach an oil-filled reservoir to the bottom of the motor. Prevent the entry of moisture with inner and outer single mechanical seals.

.12 Place a moisture sensing device in the reservoir to indicate seal failure.

.13 Provide 316 stainless steel hardware.

.14 Cable

.1 Supply submersible motors with cable, of a minimum length to reach the pump's control panel and starter. The motor and cable to be capable of continuous submergence under water without loss of watertight integrity to a depth of 20 m.

.2 Provide cable that contains power and ground wires, copper, of sufficient size for the service and in compliance with applicable codes.

.3 Provide cable that contains instrument leads, shielded as necessary to prevent electrical interference.

.4 Provide heavy duty cable, water tight and capable of withstanding operating loads.

.5 Seal end of cable prior to shipping to prohibit ingress of moisture.

.15 Mounting

.1 All motors are to be supplied integrally with the related equipment.

.2 Factory align and balance motors with the related equipment to minimize vibration and undue stresses.

.16 Finishes

.1 Factory prime and paint submersible motors as recommended by manufacturer.

2.4 Capacities and Performance

.1 Provide three pumps to be installed to lift stormwater into the dry pond as follows:

.1 Drive: Constant Speed

.2 Design Point – Flow: 550 L/s

.3 Design Point – Head: 10.2 m

.4 Operating Range – Head: 7.8 to 10.2 m

2.5 Materials

.1 Major pump components: gray iron casting, Class 35, to ASTM A48 with smooth surfaces devoid of blow holes and other irregularities.

.2 All exposed nuts and bolts: 316 stainless steel.

.3 Pump discharge column:

.1 Mild steel pipe, ASTM A53 Type ERW or S, Grade B, Black Steel.

.2 Apply hot dip galvanizing coating in accordance with ASTM A123/A123M-12 to pump discharge column after test fitting to a minimum net retention of 610 g/m^2.

.3 Cathodic protection to be provided consisting of a minimum of 7 kg of zinc anode bolted to each discharge column as approved by the Contract Administrator.

2.6 Guide Vanes

.1 At the pump suction, incorporate guide vanes designed to minimize clogging.

2.7 Pump Shaft

.1 Use single-piece shaft.

.2 Completely isolate the shaft from the pumped liquid.

2.8 Bearings

.1 Design the motor shaft to rotate on four permanently lubricated bearings.

.2 Provide cylindrical roller upper motor bearing.

.3 Provide a lower bearing arrangement of two (2) single-row angular contact ball bearings in tandem with one (1) cylindrical roller bearing.

.4 Provide bearings with a minimum ABMA 9 and ABMA 11 L_{10} bearing life of 100,000 hours minimum.

.5 For the lower thrust bearing housing, include a thermal sensor (RTD) of the platinum - 100 type to monitor the temperature of the thrust bearing outer race during operation.

2.9 Mechanical Seals

.1 Provide tandem mechanical rotating shaft seal system between the propeller and the motor.

.2 Design seals to run in an oil reservoir.

.3 Design lapped seal faces to be hydrodynamically lubricated at a constant rate.

.4 Provide tungsten carbide seals.

.5 Design each interface to be held in contact by its own spring system.

.6 Provide each pump with an oil chamber for the shaft sealing system. Design the oil chamber for oil pressure compensation.

2.10 Pump Discharge Column

.1 Fabricate pump discharge column to meet the requirements of the pump. Size to ensure velocity is less than 3.0 m/s.

.2 Provide stiffening and guiding webs at the pump support seat to ensure concentric positioning of the pump within the discharge column.

.3 Provide an O-ring seal at the bottom of the pump's inlet bellmouth so that the weight of the pump unit effectively forms a seal between pump and discharge column.

.4 For each pump discharge column, provide a support frame to be embedded in the concrete roof of the wet well (i.e. floor of the pump discharge chamber).

.5 Provide a support ring with suitably designed gussets on the exterior of the column to transmit the load of the pump and column onto the support frame.

.6 Provide sufficient external brackets, supports and stainless steel mounting hardware to support the discharge column against the wetwell and pump discharge chamber walls.

2.11 Anti-rotation Device

.1 Equip each pump with anti-rotation device to prevent rotation of the pump/motor unit within the discharge tube.

2.12 Cooling System

.1 Design each pump and motor to be cooled by the passage of the pumped fluid up, about, and past the motor housing.

2.13 Power Cable

.1 Provide cable long enough to reach the junction box without splices.

.2 Make outer jacket of oil-resistant chloroprene rubber and insulate the copper conductors with ethylene-propylene rubber. Make the cable UV- and abrasion-resistant.

.3 Use cable rated for 750V and 90°C.

2.14 Cable Entry

.1 Design the cable entry to be 100% watertight up to 20 m depth of immersion, while providing sufficient strain relief to prevent the cable from pulling out when handling, installing or operating the pump.

2.15 Junction Box

.1 Design the junction box with two separate terminal boards, one for connecting the signal wires and signal cable, and one for connecting the stator leads and power cables.

.2 Seal the lower terminal board from the motor by an elastomer compression seal (O-ring) so that it is leakproof.

.3 In the junction box, provide a collection cavity placed so that any leakage into the junction box terminates in the cavity. Separately wire a sensor in the cavity to provide an alarm in the event of water intrusion into the cable junction box.

2.16 Controls

.1 Provide a pump control and status monitoring system for each pump. The motor starters, disconnect switches, control panel, and other power ancillaries are provided in Division 26.

.2 Design the pump control and monitoring system with solid state modules for monitoring motor stator high temperature, high bearing temperature and moisture sensing/water intrusion into the housing.

.3 For each pump control/monitoring system provide control wiring and a junction box to connect between the pump and the control enclosure.

2.17 Spare Parts

.1 Provide the following spare parts for each pump:

.1 Casing gaskets and O-rings for motor/pump and for cable duct.

.2 Mechanical seal assembly.

.3 O-ring for discharge column sealing.

.4 Impeller.

.5 Casing wear ring (2).

.6 Bearing, motor side.

.7 Bearing, pump side.

.2 If within the first six months of pump start-up the design or duty conditions change, provide a one-time exchange impeller having a different blade pitch as determined by the Contract Administrator, at no cost to the City.

2.18 Factory Tests

.1 Perform the following inspections and tests on each pump before shipment from the factory. Include the test results in the Operations and Maintenance Manuals.

.1 Check the propeller, motor rating, and electrical connections for compliance to the specifications and the pump data plates.

.2 Test motor and cable insulation for defects.

.3 Prior to submergence, dry run the pump to establish correct rotation and mechanical integrity.

.4 Submerge the pump and run for 30 minutes.

.5 Develop a certified test curve showing the performance of the pump.

.6 Re-test motor and cable insulation for defects after the operational test.

.7 Document the tests and submit to the Contract Administrator.

3. EXECUTION

3.1 Manufacturer's Representative

.1 Arrange for a technically qualified Manufacturer’s Representative to attend the installation work, certify correct installation, train operating and maintenance staff and undertake the testing of the system for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the manufacturer's recommended procedures.

3.2 Testing

.1 Ensure that each pump, including all component parts, operates as intended over the full design range.

.2 Cooperate with the Contract Administrator to fulfill the requirements for successful testing of the equipment.

.3 Refer to Section 43 21 00 for testing requirements.

3.3 Training

.1 Allow for a minimum of 2 days of operation and maintenance training as outlined in E50 – Commissioning.

3.4 Commissioning

.1 Attend during commissioning of the process system which includes the pump specified in this section to ensure that each pump functions as intended in the process system.

.2 Cooperate with the Contract Administrator, and the City to fulfill the requirements for successful commissioning of the system as documented by E50 – Commissioning.

END OF SECTION