

## **1. GENERAL**

### **1.1 Scope**

- .1 The scope of this section includes the design, supply, delivery, installation assistance and commissioning of all equipment and appurtenances required for the Pumps, Monitoring modules, and associated Pump Discharge Pipes.
- .2 Scope of Supply consists of the following major items:
  - .1 Two (2) pumps, complete with lifting system, power and control cables.
  - .2 Pump Monitoring equipment.
  - .3 Two (2) fabricated, pump discharge pipes. This pipe will be installed under another contract.
  - .4 Deliver the equipment specified to the project site. Pump discharge pipes must be delivered prior to the date listed in D15 Critical Stages.
  - .5 Provide installation training;
  - .6 Supervise installation of the pumps.
  - .7 Supervise equipment performance testing and commissioning.
  - .8 Provide As-Built mark-up drawings documenting all changes made.
  - .9 Provide technical support and remedy defects during the Warranty Period.
- .3 The supplied equipment shall include all accessories required to ensure the supplied equipment safely and satisfactorily operates as an integral system as required by the Bid Opportunity.
- .4 Provide any appurtenances or services not specifically mentioned or included in the Contract Documents but which are necessary as part of the Work to ensure that the equipment is fully operational when installed.

### **1.2 Shop Drawings**

- .1 Show pump electrical cable & pump lifting system details
- .2 Provide discharge pipe shop drawings.

### **1.3 Operating and Maintenance Manuals**

- .1 Prior to the time of Equipment Performance Testing, submit to the Contract Administrator for review two (2) draft copies of Operating and Maintenance (O&M) manuals containing information required by the Specifications. All instructions in these manuals shall be in simple language to guide the City in the proper operation and maintenance of the installation.
- .2 Submit O & M manuals in paper format.
- .3 Furnish four (4) complete O & M. Provide information as specified in this Section for installation check-out, operation, maintenance, and lubrication requirements for each unit of mechanical, electrical, and instrumentation equipment or system and each instrument.
- .4 Customize the O&M manuals to describe the equipment actually furnished. Do not include extraneous data for models, options, or sizes not furnished. When more than one (1) model or size of equipment type is furnished, show the information pertaining to each model, option or size.
- .5 In addition to information called for in the Specifications, include the following:
  - .1 Title sheet, labelled "Operating and Maintenance Instructions", and containing project name and date.
  - .2 List of contents.

- .3 Record Shop Drawings of all mechanical and electrical systems.
  - .4 Full description of entire mechanical and electrical system and operation.
  - .5 Address and telephone number of the Contractor and the nearest Contractor's Representative, including distributors for parts, servicing, and repairs.
  - .6 Detailed Specification and O&M instructions for all items of equipment provided including a preventative maintenance program.
  - .7 Process control/operating instructions for each component and the entire system as a whole. This shall include, but not necessarily be limited to:
    - .1 The Contractor's recommended step-by-step procedures for starting and stopping under normal and emergency operation. Include all specified modes of operation including recommended operation after the assembly or equipment has been in long-term storage.
    - .2 Control diagrams with data and information to explain operation and control of systems and specific equipment.
    - .3 Technical information on all alarms and monitoring devices provided with the equipment.
    - .4 Routine maintenance requirements including procedures and specific description of consumable items such as lubricants, filter, seals, etc. and listing Canadian sources of supply.
    - .5 Complete disassembly, inspection, repair and re-assembly instructions including required tolerances, fastener pre-loads, specialty tools and any other information necessary to restore equipment to correct operation.
  - .8 List of spare and replacement parts and consumables.
  - .9 List of special tools.
  - .10 Nameplate information including equipment number, make, size, capacity, model number, serial number and equipment tag number.
- .6 Submit separately originals of all warranties and guarantees. Arrange to conform to same sequence as project Specifications.

#### **1.4 Definitions**

- .1 Contractor's Representative: A Contractor's Representative is a trained serviceman empowered by the Contractor to provide:
  - .1 Witnessing of delivery
  - .2 Witnessing of equipment installation
  - .3 Assistance in equipment commissioning
  - .4 Confirmation of satisfactory equipment operation
  - .5 Participation in the performance testing.

### **1.5 Equipment Delivery**

- .1 Pack and crate each component to provide protection during transport, handling, and storage. The Contractor shall identify each component with durable labels or tags securely attached to each piece of equipment, crate or container.
- .2 Protect polished and machined metal surfaces from corrosion and damage during shipment and storage. Protect threaded connections with threaded plugs or caps and protect open plain end pipes with caps. Pack electrical equipment and control panels to prevent scratching, access by dirt, moisture, or dust or damage to insulation, and shall cover equipment having exposed bearings and glands to exclude foreign matter. All openings in the equipment shall be covered before shipment. Sufficient lifting hooks shall be supplied for handling all crates or boxes and heavy pieces

### **1.6 Installation Support**

- .1 Provide instructions regarding the installation of the equipment. If it is found necessary, or if so directed by the Contract Administrator, attends the site to provide assistance during installation
- .2 Prior to completing installation, the Contract Administrator will inform the Contractor and arrange for the attendance at the Site of the Contractor to verify successful installation.
- .3 Conduct a detailed inspection of the installation including, wiring, electrical connections, controls and instrumentation, rotation direction, running clearances, lubrication, workmanship, and all other items as required to ensure successful operation of the equipment.
- .4 Identify any outstanding deficiencies in the installation and provide a written report to the Contract Administrator describing such deficiencies.
- .5 Deficiencies shall be rectified and the Contractor's Representative shall then re-inspect.

### **1.7 Equipment And Performance Verification**

- .1 Equipment will be subjected to a demonstration test, running test, and equipment performance tests (EPT) after the installation has been verified and any identified deficiencies have been remedied.
- .2 The Contract Administrator will inform Contractor at least seven (7) days in advance of conducting the tests and arrange for the attendance of the Contractor. The tests may be concurrent with the inspection of satisfactory installation if mutually agreed by the Contract Administrator.
- .3 The Contractor shall conduct all necessary checks to the equipment and if necessary, advise the Contract Administrator of any further Work needed prior to confirming the equipment is ready to run.
- .4 Demonstration Test: If floodway levels are high enough to provide water for pump testing, the Contractor's Representative shall operate the equipment for at least one (1) hour to demonstrate to himself the operation of the equipment and any required ancillary services. Any remedial measures required to ensure satisfactory operation will be promptly undertaken.
- .5 Running Test: The equipment will then be run for one (1) hour. Local controls will be satisfactorily verified by cycling the equipment through several start-stop operations. Operating parameters such as temperature, pressure, voltage, vibration, etc., will be checked to ensure that they are within the specified or the Contractor's recommended limits, whichever is more stringent.

- .6 Equipment Performance Test: The equipment will be restarted and run continuously for three (3) days. During this period, as practicable, conditions will be simulated which represent maximum or most severe, average, and minimum or least severe conditions. These conditions will be mutually agreed by the Contractor, and the Contract Administrator on the basis of the information contained in the Contract Documents, as well as the methods utilized to create the simulated conditions and the time periods allotted to each.
- .7 Should the initial demonstration, running test or EPTs reveal any defects, then those defects shall be promptly rectified and the demonstration, running tests, and / or performance tests will be repeated to the satisfaction of the Contract Administrator.

## **1.8 Quality Assurance**

- .1 Build motors in accordance with Canadian Standards Association (CSA) C22.2 No. 100, CSA C22.2 No. 145, National Electrical Manufacturer's Association (NEMA) Standard MG1, and to the requirements specified.

## **1.9 Shipment, Protection and Storage**

- .1 Ship, protect, and store equipment in a manner that prevents damage or premature aging.
- .2 Handle motors with suitable lifting equipment.

## **2. PRODUCTS**

### **2.1 Acceptable Pump and Motor Manufacturers**

- .1 Flygt
- .2 KSB
- .3 ABS

### **2.2 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 Electrical and Electronic Manufacturers Association of Canada (EEMAC) Design B.
- .4 Provide motor nameplate rated for 600 V, 60 Hz, 3-phase service unless otherwise noted.
- .5 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.
- .6 Provide motors capable of ten (10) evenly spaced starts per hour on a continuous basis without temperature rises which would harm insulation and windings.
- .7 Design motors for semi-continuous immersion in liquid with an ambient temperature of 40°C unless higher temperatures are noted. Design casing for adequate heat rejection. Designs utilizing the circulation of the pumping liquid are not permitted.

- .8 Design the pump control / monitoring system with solid modules for monitoring motor stator high temperature, high bearing temperature and moisture sensing / water intrusion into the stator housing and seal chamber.
- .9 Provide sealed ball bearing type bearings with an Anti-Friction Bearings Manufacturers Association (AFBMA) B10 life of 100,000 hours.
- .10 Provide 304 or 316 stainless steel hardware.

### **2.3 Motor Cable**

- .1 Supply submersible motors with cable, of a minimum length to reach the pump's control panel/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 prevent ingress of moisture.

### **2.4 Pump and Discharge Pipe System Description**

- .1 Mount pumps onto seats at the bottom of vertical discharge pipes in a wet pit. The pumps are held in place by their own weight and the pumping head.
- .2 Make pumps completely removable from the discharge columns from above so that entry into the wet pit is not required for inspection or service.
- .3 Close-couple pump and motor to form one integrated direct drive unit.
- .4 The discharge pipes shall be complete with seats and support flanges, as required to provide a long term, reliable operating interface with the pumps.

### **2.5 Pump Capacities and Performance**

- .1 Provide 2 pumps.
  - .1 Drive: Constant Speed
  - .2 Design Point – Flow: 1 m<sup>3</sup>/s
  - .3 Design Point – Head: 13 m
  - .4 Peak Operating Head Range: 14 to 2.0 m
  - .5 NPSHR not to exceed this value at pump head above 10 m: 9.5 m
  - .6 Maximum speed: 900 rpm

## **2.6 Pump Detailed Specifications**

- .1 Cast iron pump casing and impeller.
- .2 Fabricate all exposed nuts and bolts of 304 stainless steel.
- .3 Cast iron A48, impeller.
- .4 Use single piece shaft.
- .5 Completely isolate the shaft from the pumped liquid.
- .6 Provide bearings with a minimum Anti-Friction Bearings Manufacturers Association (AFBMA) B10 bearing life of 100,000 hours minimum.
- .7 For the lower bearing include a thermal sensor (RTD) of the platinum - 100 type to monitor the temperature of the thrust bearing outer race during operation.
- .8 Provide adequate length of cable to reach the junction box without splices.
- .9 Make outer jacket of oil resistant chloroprene rubber and insulate the copper conductors with ethylene-propylene rubber. Make the cable abrasion resistant.
- .10 Use cable rated for 750V and 90°C.
- .11 Design the cable entry to be 100% watertight during immersion of up to 20 m depth, while providing sufficient strain relief to prevent the cable from pulling out when handling, installing or operating the pump.
- .12 Seal the lower terminal board from the motor by an elastomer compression seal (O-ring) so that it is leakproof.
- .13 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.
- .14 Provide a pump control status monitoring system for each pump. The motor starters, disconnect switches, and other power ancillaries will be provided by Section 16000.
- .15 Design the pump control/monitoring system with solid state modules for monitoring motor stator high temperature, high bearing temperature and moisture sensing/water intrusion into the stator housing and cable connection housing.
- .16 Control system shall have capabilities equal to the Flygt 'MAS' system.
- .17 For each pump control/monitoring system provide 25 m of control wiring and a junction box to connect between the pump and the control enclosure.
- .18 Provide an O-ring seal at the bottom of the pump inlet so that the weight of the pump unit effectively forms a seal between pump and discharge column.

## **2.7 Factory Tests & Factory Performance Testing**

- .1 Perform the following inspections and tests on each pump before shipment from the factory. Include the test results in the O&M Manuals.
  - .1 Test motor and cable insulation for defects.

- .2 Prior to submergence, dry run the pump to establish correct rotation and mechanical integrity.
- .3 Submerge the pump and run for thirty (30) minutes.
- .4 Simulate the head conditions at 14.0 m and at 2 m.
- .5 Develop a certified test curve (per Hydraulic Institute Class A standards) showing the performance of the pump.
- .6 Repeat the insulation tests after the operational test.
- .7 Document the tests and submit the results.

## **2.8 Pump Discharge Pipes**

- .1 Within one week of Contract award submit for review detailed pump discharge pipe fabrication drawings and welding procedures stamped by a Professional Engineer as being suitable for this application for review.

**END OF SECTION**