1. GENERAL

1.1 Scope of Work

.1 Supply, installation, testing, and commissioning of two (2) submersible pumps **P-U4 and P-U5**, including mounting elbows, guide rails, motors, motor protection 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 A36/A36M - Standard Specification for Structural Steel.

.2 ASTM A48/A48M - Standard Specification for Gray Iron Castings.

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

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

.5 ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

.6 ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.

.7 ASTM A536 - Standard Specification for Ductile Iron Castings.

.8 ASTM A582/A582M - Standard Specification for Free-Machining Stainless Steel Bars.

.9 ASTM B505/B505M: Standard Specification for Copper Alloy Continuous Castings.

.10 ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

.3 National Electrical Manufacturers Association (NEMA)

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

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

.1 ANSI/HI M100 Pump Standards.

.2 ANSI/HI 2.1–2.2 - Rotodynamic Pumps for Nomenclature and Definitions.

.3 ANSI/HI 2.4 - Rotodynamic Pumps for Manuals Describing Installation, Operation and Maintenance.

.4 ANSI/HI 11.6 – Rotodynamic Submersible Pumps for Hydraulic Performance, Hydrostatic Pressure, Mechanical, and Electrical Acceptance Tests.

.5 ANSI/HI 14.6 - Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

1.3 Submittals

.1 Submittals shall be in accordance with Section E4 – Shop Drawings, allowing for a minimum of ten (10) business days for review

.2 Submit proof of CSA approval for the pump assembly as one unit, as per CSA standard C22.2-108-14

.3 Submit design data as shown in **Schedule 33-21-00 – 1**

.4 The pump assembly shop drawings shall include the following specific details:

.1 Dimensional drawings, cross sections and details of the pumps.

.2 Drawings of the mounting elbow and guide bars, including the diameter, wall thickness, material coating, guide rail supports, pump mounting to elbow detail, and detail of mounting elbow to the floor of the sump.

.3 The mounting detail and guide bars, including the supports, shall be designed and sealed by a Professional Engineer.

.4 Performance curve for the pumping unit(s) superimposed on the system curves for the duty operating condition, including the efficiency isopleth and NPSHr variation with flow. The performance curve shall demonstrate the pump(s) meet the specified requirements for head, capacity, horsepower, speed, efficiency and NPSHr for the range of operating conditions.

.5 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.

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

.7 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.

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

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

.5 Operating and Maintenance Data: Provide for incorporation in operation and maintenance manual as specified in Section 01 78 00 - 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, replacement and spare parts with section drawings, illustrating the connection and the parts manufacturer's identifying numbers.

.5 Detailed maintenance and lubrication schedule, including daily, weekly, monthly, semi-annual and annual checks.

.6 Detailed instructions on adjustment due to wear and replacement of parts.

.6 Coordination

.1 Coordinate with other Divisions to ensure that there is no conflict with the work.

2. PRODUCTS

2.1 Description

.1 Provide two (2) submersible, close coupled, single-stage centrifugal pumps for dewatering of the Wet Well.

.2 Each pump shall include a mounting elbow and a double guide rail system, such that the pump shall automatically connect to the discharge elbow when lowered into place.

.3 The mounting elbow shall be fastened to the bottom of the sump in the Wet Well.

.4 The pump shall be mounted to the mounting elbow.

.5 The mounting and guide rail system shall allow for removal of the pump to the intermediate level of the Wet Well such that man entry to the bottom of the Wet Well is not required for maintenance operations.

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

.7 Include monitoring and protection for each pump for moisture/leak detection and stator temperature.

2.2 Pump Characteristics

.1 Drive: Constant Speed

.2 Number of Pumps: 2

.3 Rated capacity per pump: 15 l/s

.4 Pumps to operate under a Duty-Standby cycle for the following conditions:

.1 Pump On: 222.2 m (water level in Wet Well)

.2 Pump Off: 221.9 m (water level in Wet Well)

.5 Duty point:

.1 Flow: 15 l/s

.2 Static Lift: 11.3 m

.3 Total Dynamic Head: 13.0 m

.6 Normal operating range:

.1 Maximum static lift: 9.5 m

.2 Minimum static lift: 11.6 m

2.3 Pump Performance Requirements

.1 Provides pumps that are suitable for continuous duty

.2 Demonstrate and clearly identify on the pump curve that the selected pump can achieve the duty point as identified in Section 2.2.5.

.3 Select an impeller that permits operation within 10% of the efficiency at the best efficiency point (BEP) at the duty point

.4 Maximum pump and motor speed: 1800 rpm

.5 The motor shall be sufficiently sized to drive the pumps for the specified range of operating conditions

.6 Net Positive Suction Head (NPSH) shall be adequate for the specified range of operation conditions.

.7 Motor power rating shall not exceed 5.6 kW (7.5 HP)

2.4 Acceptable Manufacturers

.1 Xylem Inc. – N 300 Series

.2 ABS (Sulzer Ltd.) – ABS XFP Series

.3 KSB Aktiengesellschaft – Amarex N Series

2.5 Impeller

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

.2 Provide an impeller capable of passing solids to a minimum of 75 mm.

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

2.6 Pump Volute

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

.2 Single piece, non-concentric design.

2.7 Motor

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

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

.6 Provide motors capable of 10 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 specified. Design casing for adequate heat rejection. Internal circulation of the pumped liquid for cooling is not permitted.

.8 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.

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

.10 Provide a float type moisture sensing device in the stator housing connected to the monitoring system.

.11 Provide Type 431 stainless steel motor shafts.

.12 Provide Type 316 stainless steel hardware.

.13 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.

.14 Pump motors shall be explosion proof and rated for Class 1 Zone 1 environment.

2.8 Cables

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

.2 Supply submersible motors with factory installed cables, 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.

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

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

.5 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.

2.9 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 The Manufacturer shall demonstrate to the Contract Administrator a methodology for prevention or managing moisture within the junction box. Should the methodology involve collection of moisture within a cavity, a float type moisture sensor shall be provided in the cavity to provide an alarm in the event of water intrusion into the cable junction box. The sensor shall be connected to the monitoring system.

2.10 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 specified in Division 26.

.2 Design the pump control and monitoring system for monitoring motor stator high temperature and moisture sensing/water intrusion in the stator housing and the junction box.

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

2.11 Cooling System

.1 The pump motor shall be cooled by the passage of the pumped fluid over the stator housing.

2.12 Mechanical Seals

.1 Provide tandem mechanical rotating shaft seal system between the impeller 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.

2.13 Bearings

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

.2 Provide information as to the proposed arrangement for both the upper support bearing and the lower main bearing configuration.

.3 Provide bearings with a minimum ABMA 9 and ABMA 11 L_{10} bearing life of 50,000 hours minimum.

2.14 Mounting and Guide Rail

.1 The pump shall seal to the discharge elbow by a simple linear downward motion of the pump. Provide a sliding guide bracket attached to the pump.

.2 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.

.3 The discharge elbow shall connect to the 100 mm discharge line

2.15 Accessories

.1 Galvanized steel lifting chain, shackle and hook.

.2 Power cable.

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

2.16 Finishes

.1 Factory prime and paint submersible pumps.

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 Impeller

.4 Casing wear ring (2).

.5 Bearing, motor side.

.6 Bearing, pump side.

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

.6 Conduct factory performance testing of all supplied pumps in compliance with ANSI/HI Standards 14.6 to an acceptance grade of 2B.

.7 Certify test results and summarize findings in a short report. Submit report within three weeks of completing factory tests, including calculations showing losses not included in shop tests, field performance curves, and computation and curves showing power consumption by motor and bhp load on motor.

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

.9 Do not ship the pump until the test results report has been submitted to the Contract Administrator.

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

.3 Field test all pumps to verify performance.

.4 Provide temporary connections, ammeters, and temporary tankage required for the performance of the tests.

.5 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 10 minutes of pump operation at the flows that are to be tested, other than run-out.

.6 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.

.7 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

.8 Cooperate with the installer to fulfill the requirements for successful testing of the equipment as outlined in Section 01 91 13 - General Commissioning Requirements.

3.3 Training

.1 Allow for a minimum of 1 day of operation and maintenance training as outlined in Section 01 91 13 - General Commissioning Requirements.

3.4 Installation Training

.1 Manufacturer to instruct the Contractor in the methods and precautions to be followed in the installation of the pumps.

.2 Attest to the Contractor's understanding by completing Form 101 as shown in Section 01 65 00.

3.5 Installation

.1 Manufacturer's Representative shall cooperate with the Contractor as documented by Form 102 shown in Section 01 65 00.

.2 Before commencing the installation of the Work, inspect and take field measurements and ensure that Work conducted previously in the area is not prejudicial to the proper installation of the works.

.3 Install the pump assemblies as shown on the Drawings.

.4 Supply and install all necessary shims, gaskets etc., required to complete the installation.

.5 Dimensions shown on the Drawings for equipment base, piping connection and length, column supports etc. are approximate and must be corrected by the Contractor to suit the exact dimensions of the equipment provided for each application. Arrange any necessary modifications to piping connections, pipework, or other ancillaries at no cost and after acceptance by the Contract Administrator.

.6 Provide for the use of all necessary lifting and loading equipment and all tools required to complete the installation.

.7 Demonstrate to the Owner, Contract Administrator, and Manufacturer's Representative the final alignment.

.8 Extend any inaccessible lubrication points and lubricant drains to convenient locations.

3.6 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.

.2 Cooperate with the Contract Administrator, and the City to fulfill the requirements for successful commissioning of the system as documented by Section 01 91 13 - General Commissioning Requirements.

4. SCHEDULES

SCHEDULE 43 21 39 - 1

VERTICAL AXIAL FLOW PUMP DATA SHEET

SCHEDULE 43 21 39 - 1 **VERTICAL AXIAL FLOW PUMP DATA SHEET**	
Pump Characteristics	
Pump manufacturer	
Rate capacity (l/s)	
Rated maximum total head (m)	
Rated minimum total head (m)	
Speed (rpm)	
Pump efficiency at rated capacity at maximum total head (%)	
Pump efficiency at rated capacity at minimum total head (%)	
Pump power at rated capacity (kW)	
Shutoff power (kW)	
Number of stages	
Shutoff pressure (m)	
Diameter of discharge piping (mm)	
O.D. of volute (mm)	
O.D. of suction bowl (mm)	
Weight of pump (kg)	
Motor Characteristics	
Manufacturer of motor	
Type of motor	
NEMA Frame	
Motor power (kW)	
Full load speed (rpm)	
Voltage (v)	
Frequency (hz)	
Poles	
Phase	
Service factor	
Type of lubrication (motor)	
Weight of motor (kg)	
NEMA nominal efficiency (%)	
Guaranteed efficiency (%)	
NEMA design letter	
NEMA code letter	
Efficiency (%):	
1/4 load	
1/2 load	

SCHEDULE 43 21 39 - 1 VERTICAL AXIAL FLOW PUMP DATA SHEET	
3/4 load	
Full load	
Service factor	
Power factor (%):	
Locked rotor	
No load	
1/4 load	
1/2 load	
3/4 load	
Full load	
Service factor	
Current (amps)	
Locked rotor	
No load	
1/4 load	
1/2 load	
3/4 load	
Full load	
Service factor	

END OF SECTION

1. GENERAL

1.1 Scope of Work

.1 Supply, installation, testing, and commissioning of three (3) submersible vertical axial-flow pumps **P-U1, P-U2 and P-U3**, including 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 A36/A36M - Standard Specification for Structural Steel.

.2 ASTM A48/A48M - Standard Specification for Gray Iron Castings.

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

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

.5 ASTM A153-A153M – Standard Specification for Zing Coating (Hot-Dip) on Iron and Steel Hardware

.6 ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

.7 ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.

.8 ASTM A536 - Standard Specification for Ductile Iron Castings.

.9 ASTM A582/A582M - Standard Specification for Free-Machining Stainless Steel Bars.

.10 ASTM B505/B505M: Standard Specification for Copper Alloy Continuous Castings.

.11 ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

.3 National Electrical Manufacturers Association (NEMA)

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

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

.1 ANSI/HI M100 Pump Standards.

.2 ANSI/HI 2.1–2.2 - Rotodynamic Pumps for Nomenclature and Definitions.

.3 ANSI/HI 2.4 - Rotodynamic Pumps for Manuals Describing Installation, Operation and Maintenance.

.4 ANSI/HI 9.8 - Intake Design for Rotodynamic Pumps.

.5 ANSI/HI 14.6 - Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

1.3 Submittals

.1 Submittals shall be in accordance with Section E4 - Shop Drawings, and allowing for a minimum of ten (10) business days for review

.2 Submit proof of CSA approval for the pump assembly as one unit, as per CSA standard C22.2-108-14

.3 Submit design data as shown in **Schedule 43-21-43 – 1**

.4 The pump assembly shop drawings shall include the following specific details:

.1 Dimensional drawings, cross sections and details of each pump.

.2 Drawings of the vertical discharge column, including the diameter, wall thickness, material, coating, column supports and mounting detail in the discharge chamber.

.3 The vertical discharge column support plates and support brackets shall be designed and sealed by a Professional Engineer.

.4 Drawings of the proposed pump installation and mounting on the vertical discharge column, including anti-rotation details.

.5 Detailed calculations of hydraulic losses used to develop the system curves for the maximum and minimum operation conditions, reflecting the manufacturers proposed pump assembly, including the vertical discharge column. At minimum the following information shall be included:

.1 Summary of the minimum and maximum static lift values used, as identified in Section 2.2.6

.2 A list of minor losses through the pump assembly, including the vertical discharge column

.1 It may be assumed that there are no backwater effects at the outlet of the vertical discharge column and that there is a free discharge condition.

.3 Roughness coefficients in the vertical discharge column

.6 Performance curve for the pumping unit(s) superimposed on the system curves for the minimum, duty and maximum operating conditions, including the efficiency isopleth and NPSHr variation with flow. The performance curve shall demonstrate the pump(s) meet the specified requirements for head, capacity, horsepower, speed, efficiency and NPSHr for the range of operating conditions.

.7 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.

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

.9 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.

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

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

.5 Operating and Maintenance Data: Provide for incorporation in operation and maintenance manual as specified in Section - 01 78 00 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, replacement and spare parts with section drawings, illustrating the connection and the parts manufacturer's identifying numbers.

.5 Detailed maintenance and lubrication schedule, including daily, weekly, monthly, semi-annual and annual checks.

.6 Detailed instructions on adjustment due to wear and replacement of parts.

.6 Coordination

.1 Coordinate with other Divisions to ensure that there is no conflict with the work.

2. PRODUCTS

2.1 Description

.1 Provide three (3) submersible single-stage vertical axial-flow pumps suitable for a large volume low head pumping arrangement.

.2 For each installed pump, include a vertical discharge column complete with seats and support flanges to suit.

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

.4 Pumps shall be completely removable from the discharge columns from above so that entry into the wet well is not required for inspection or maintenance services.

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

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

.7 Include a monitoring system for each pump capable for monitoring of moisture/leak detection, stator temperature, and bearing temperature.

2.2 Pump Characteristics

.1 Drive: Constant Speed

.2 Number of Pumps: 3

.3 Rated capacity per pump: 700 l/s

.4 Pumps to operate under a Lead-Lag-Standby cycle for the following conditions:

.1 Pump 1 – On: 225.1 m (water level in Wet Well)

.2 Pump 2 – On: 225.6 m (water level in Wet Well)

.3 Pump 3 – On: 226.0 m (water level in Wet Well)

.4 Pump 1, Pump 2, Pump 3 – Off: 224.0 m (water level in Wet Well)

.5 Pumps to lift water to the top of their respective discharge tube at an elevation of 233.5 m

.6 Total Dynamic Head Ranges:

.1 Maximum: 9.5 m (maximum static lift) plus minor, friction and pump losses

.2 Duty point: 8.4 m plus minor, friction and pump losses

.3 Minimum: 7.2 m (minimum static lift) plus minor, friction and pump losses

2.3 Pump Performance Requirements

.1 Provide pumps that are suitable for continuous duty

.2 Demonstrate and clearly identify on the pump curve that the selected pump can achieve the duty point as follows:

.1 700 l/s at a water elevation in the Wet Well of 225.1 m, corresponding to a static lift of 8.4 m.

.3 Select a propeller that permits operation within 5% of the efficiency at the best efficiency point (BEP)

.4 Maximum pump and motor speed: 1200 rpm

.5 The motor shall be sufficiently sized to drive the pumps for the specified range of operating conditions

.6 Net Positive Suction Head (NPSH) shall be adequate for the specified range of operation conditions.

.7 Motor power rating shall not exceed 105 kW (140 HP)

2.4 Acceptable Manufacturers and Models

.1 Xylem Inc. – PL 7061

.2 ABS (Sulzer Ltd.) – VUPX 0502

.3 KSB Aktiengesellschaft – Amacan PB

2.5 Pump

.1 All major castings shall consist of gray iron casting, Class 35, to ASTM A48 with smooth surfaces devoid of blow holes and other irregularities.

.2 All castings shall have an epoxy protective coating to a minimum 350 µm, applied in a minimum of two or more layers as recommended by the manufacturer.

.3 All major castings shall have cathodic protection by means of sacrificial zinc anodes to prevent corrosion. The manufacturer shall demonstrate to the satisfaction of the Contract Administrator that sufficient cathodic protection is provided for the castings to have a 25 year design life.

.4 The propellers shall be made of stainless steel suitable equivalent to a Type 316 stainless steel capable of withstanding cavitation and resistance to corrosion.

.5 All fasteners to be Type 316 stainless steel.

.6 All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber O-rings. The correct compression of the O-rings shall be assured by the depths of the grooves into which they fit.

.7 Separate drain and inspection plugs with positive anti-leak seals shall be easily accessible from the outside.

.8 The pump shall include an anti-reverse rotation device, such as a nonreverse ratchet, to prevent damage caused by the propeller reversing its rotation during shutdown.

.9 Guide vanes shall be provided above the propeller to minimize clogging.

2.6 Pump Motors

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

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

.6 Provide motors capable of 10 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 specified. Design casing for adequate heat rejection. Internal circulation of the pumped liquid for cooling is not permitted.

.8 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.

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

.10 A moisture sensor shall be included to monitor moisture/leakage in the stator housing connected to the monitoring system

.11 Provide Type 431 stainless steel motor shafts.

.12 Provide Type 316 stainless steel hardware.

.13 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.

.14 Pump motors shall be explosion proof and rated for Class 1 Zone 1 environment.

2.7 Cables

.1 Supply submersible motors with factory installed cables, 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 monitoring instrument leads, shielded as necessary to prevent electrical interference.

.4 Provide heavy duty cable, water tight and capable of withstanding operating loads such water turbulence and maintenance procedures.

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

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

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

.8 Use cable rated for a minimum of 600V and 90°C.

2.8 Cable Entry

.1 Provide sufficient strain relief to prevent the cable from pulling out when handling, installing or operating the pump.

2.9 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 The Manufacturer shall demonstrate to the Contract Administrator a methodology for protection/managing of moisture within the junction box. The sensor shall be connected to the monitoring system.

2.10 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 specified 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 in the stator housing and the junction box.

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

2.11 Cooling System

.1 The pump motor shall be cooled by the passage of the pumped fluid over the stator housing.

2.12 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.

2.13 Bearings

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

.2 Provide information as to the proposed arrangement for both the upper support bearing and the lower main bearing configuration.

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

.4 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.

2.14 Pump Discharge Column

.1 Fabricate the vertical discharge column to suit the pump, and sized to ensure that the maximum velocity is less than 3.0 m/s. The maximum internal diameter of the vertical discharge column is 1.0 m.

.2 For each vertical discharge column, provide a support plate mounted on the floor of the pump discharge chamber capable of supporting the pump and all loads associated with pump operation. The connection between the support frame and the floor of the discharge chamber shall be water tight.

.3 The Manufacturer shall demonstrate to the satisfaction of the Contract Administrator that the proposed installation will prevent rotation of the pump inside the vertical discharge column and rotation of the vertical discharge column during the operation of the pump.

.4 Provide an O-ring seal between the pump and vertical discharge column such that the weight of the pump unit effectively forms a seal between the pump and discharge column.

.5 Provide sufficient external brackets, supports and mounting hardware to support the vertical discharge column against the wetwell and pump discharge chamber walls to ensure the vertical discharge column remains plumb and secure throughout the entire operation of the pump.

.6 All fasteners shall be hot dipped galvanized in accordance with ASTM A153/A153M.

.7 The vertical discharge column shall be Schedule 40 mild steel pipe, in accordance with ASTM A53 Type ERW or S, Grade B, Hot Dipped Galvanized to a minimum net retention of 610 g/m^2.

.8 Cathodic protection to be provided consisting of a minimum of 11 kg of zinc anode bolted to the discharge column in both the wet well and the discharge chamber for each discharge column as approved by the Contract Administrator.

.9 Provide a guide vane mounted to the bottom of the Wet Well below in the inlet to the vertical discharge chamber as shown in the Drawings. The guide vane and fastener shall be galvanized.

2.15 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 Propeller

.5 Casing wear ring (2).

.6 Bearing, motor side.

.7 Bearing, pump side.

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

.6 Conduct factory performance testing of all supplied pumps in compliance with ANSI/HI Standards 14.6 to an acceptance grade of 2B.

.7 Certify test results and summarize findings in a short report. Submit report within three weeks of completing factory tests, including calculations showing losses not included in shop tests, field performance curves, and computation and curves showing power consumption by motor and bhp load on motor.

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

.9 Do not ship the pump until the test results report has been submitted to the Contract Administrator.

3. EXECUTION

3.1 Manufacturer's Representative

.1 Arrange for a technically qualified Manufacturer’s Representative with a minimum of 10 years of relevant work experience 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 Field test all pumps to verify performance.

.4 Provide temporary connections, ammeters, and temporary tankage required for the performance of the tests.

.5 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 2 minutes of pump operation at the flows that are to be tested, other than run-out.

.6 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.

.7 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

3.3 Training

.1 Allow for a minimum of 1 day of operation and maintenance training as outlined in Section 01 91 13 - General Commissioning Requirements.

3.4 Installation Training

.1 Manufacturer to instruct the Contractor in the methods and precautions to be followed in the installation of the pumps.

.2 Attest to the Contractor’s understanding by completing Form 101 as shown in Section 01 65 00.

3.5 Installation

.1 Manufacturer’s Representative shall cooperate with the Contractor as documented by Form 102 shown in Section 01 65 00.

.2 Before commencing the installation of the Work, inspect and take field measurements and ensure that Work conducted previously in the area is not prejudicial to the proper installation of the works.

.3 Install the pump assemblies as shown on the Drawings.

.4 The vertical clearance between the bottom of the pump/vertical discharge column and the wet well floor shall be between 0.3 to 0.5 times the outside diameter of the inlet bell, or as otherwise specified by the Manufacturer.

.5 The pump shall be installed on a pump seat at the bottom of the vertical discharge column, complete with anti-rotation devices and an O-ring to provide a seal between the wet well and annulus around the pump and vertical discharge column, such that pumped water is not recirculated around the pump.

.6 The vertical discharge column shall be supported on a plate mounted on a 75 mm housekeeping pad fitted with a gasketed seal on the floor of the discharge chamber.

.7 Supply and install all necessary shims, gaskets etc., required to complete the installation.

.8 The vertical discharge column shall be supported by brackets mounted to the wall of the wet well as determined by the Manufacturer.

.9 Dimensions shown on the Drawings for equipment base, piping connection and length, column supports etc. are approximate and must be corrected by the Contractor to suit the exact dimensions of the equipment provided for each application. Arrange any necessary modifications to piping connections, pipework, or other ancillaries at no cost and after acceptance by the Contract Administrator.

.10 Provide for the use of all necessary lifting and loading equipment and all tools required to complete the installation.

.11 Demonstrate to the Owner, Contract Administrator, and Manufacturer's Representative the final alignment.

.12 Extend any inaccessible lubrication points and lubricant drains to convenient locations.

3.6 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 Section 01 91 13 - General Commissioning Requirements.

4. SCHEDULES

SCHEDULE 43 21 43 - 1
VERTICAL AXIAL FLOW PUMP DATA SHEET

Pump Characteristics	
Pump manufacturer	
Rate capacity (l/s)	
Rated maximum total head (m)	
Rated minimum total head (m)	
Speed (rpm)	
Pump efficiency at rated capacity at maximum total head (%)	
Pump efficiency at rated capacity at minimum total head (%)	
Pump power at rated capacity (kW)	
Shutoff power (kW)	
Number of stages	
Shutoff pressure (m)	

SCHEDULE 43 21 43 - 1 **VERTICAL AXIAL FLOW PUMP DATA SHEET**	
Diameter of discharge column (mm)	
Diameter of shaft (mm)	
O.D. of discharge bowl (mm)	
O.D. of suction bowl (mm)	
Length of column (m)	
Weight of pump (kg)	
Motor Characteristics	
Manufacturer of motor	
Type of motor	
NEMA Frame	
Motor power (kW)	
Full load speed (rpm)	
Voltage (v)	
Frequency (hz)	
Poles	
Phase	
Service factor	
Type of lubrication (motor)	
Weight of motor (kg)	
NEMA nominal efficiency (%)	
Guaranteed efficiency (%)	
NEMA design letter	
NEMA code letter	
Efficiency (%):	
1/4 load	
1/2 load	
3/4 load	
Full load	
Service factor	
Power factor (%):	
Locked rotor	
No load	
1/4 load	
1/2 load	
3/4 load	
Full load	
Service factor	

SCHEDULE 43 21 43 - 1 VERTICAL AXIAL FLOW PUMP DATA SHEET	
Current (amps)	
Locked rotor	
No load	
1/4 load	
1/2 load	
3/4 load	
Full load	
Service factor	

END OF SECTION