1 General

1.1 DESCRIPTION

.1 This section specifies the supply, installation, testing, and commissioning of two (2) new explosion proof, submersible sanitary waste pumps to be provided under this Contract.

.2 Provide submersible pumps complete with electric motors, leak seal and temperature monitoring devices, lifting chain, flushing valve, discharge elbow, guide rail supports, and all other specified appurtenances.

.3 Provide three submersible pumps and electric motors suitable for fixed speed operation. One pump to be provided as a spare and two pumps are to be installed as part of this contract.

.4 Submersible pumps to be heavy-duty submersible centrifugal non-clog type pumps.

.5 Pumps shall meet the dimensional constraints as indicated on the Contract Drawings.

.6 Conform to the general requirements of Section 40 05 00 - Mechanical General Requirements, unless otherwise specified.

1.2 REFERENCE STANDARDS

.1 Conform to the following reference standards:

.1 ASTM A48, Grey Iron Castings.

.2 ASTM A108, Steel Bars, Carbon Cold-Finishes, Standard Quality.

.3 ASTM A276, Stainless Steel and Heat Resisting Steel Bars and Shapes.

.4 ASTM A532, Abrasion Resistant Cast Iron.

.5 Canadian Standards Association, CSA C22.1, Canadian Electrical Code (CEC), Safety Standard for Electrical Safety Installations.

.6 Hydraulics Institute Standards

1.3 EQUIPMENT LIST

Equipment Name	Pumping Station	Quantity	Equipment Tag No.
Submersible Sanitary Waste Pump	Bowden Institute Sewage Lift Station	3	P-001, P-002, P-003

1.4 SUBMTTALS

.1 Provide the following information in one (1) complete submittal, in accordance with Section 01 33 00 - Submittals:

.1 Manufacturer's data, including equipment weight.

.2 Performance curves for specified operating conditions, indicating relationship between speed, volumetric flow, head, horsepower, efficiency and net positive suction head requirements; indicate the rated operating points on the curve.

.3 Shop drawings, including dimensions and sectional view of equipment, pump supports, pump clean out connections, discharge elbow and discharge piping arrangements, showing details of construction, arrangement and installation. Indicate minimum recommended clearance for maintenance procedures.

.4 Parts list, complete with a list of recommended spare parts and replacement part prices.

.5 Operating and maintenance data as specified in Section 01 91 33 – Commissioning Forms.

1.5 SERVICE CONDITIONS

.1 Pumps are to pump sanitary waste, solids including grit, rags, and plastics (from 0 up to 1000 mg/L concentration) from the sewage lift station wet well to one of the anaerobic cells. That represents a maximum static lift of approximately 5.9 m.

.2 Select and design submersible pumps specifically for continuous and intermittent duty and for pumping of, and suitable for exposure to, sanitary waste screened through a 50 mm spacing bar screen, which may contain dilute concentrations of dissolved H_2S gas, grease, solids, rags stringy matter, grit and other abrasive material .

.3 Ambient Air Temperature: 1ºC to 20ºC

.4 Water Temperature: 1 ºC to 20 ºC

.5 pH: 6.5 to 8

.6 Pump supplier to ensure pumps can operate under the conditions and the environment stated above.

1.6 QUALITY CONTROL

.1 To ensure unity of responsibility, the complete pumping units including discharge elbow and appurtenances shall be supplied, tested, and warranted by the pump manufacturer.

.2 Equipment specified under this section is to be standard pumping equipment manufactured by a company with no less than fifteen (15) years' experience in the manufacture of pumping equipment.

.3 Manufacturer of the pumping units to be ISO 9001 certified.

2 Products

2.1 FUNCTION

.1 Wet well mounted submersible pumps suitable for the conditions of Sections 1.5 and 2.3.

2.2 ACCEPTABLE PRODUCTS

.1 Provide products, modified as necessary, to meet the specified features and operating conditions.

.2 Design Standard: Xylem-Flygt NP 3153 HT-465.

2.3 CAPACITIES AND PERFORMANCE

.1 Pump requirements are as follows:

Description	Details
Pumping Station:	Bowden Institute Sewage Lift Station
Pump Tag Number(s):	P-001, P-002, P-003
Pump Description:	Sanitary waste pumps
Type:	Wet well submersible, constant speed operation
Quantity:	2 Installed, 1 Spare
Capacity (Rated Condition): (L/s)	31.5
Minimum Static Head (m)	1.4
Maximum Static Head (m)	5.9
Friction Loss at Design Flow (m)	10.13
Total Discharge Head (Rated Condition): (m)	16.03
Shutoff Head: (m)	Approx. 30
Minimum Efficiency at Rated Capacity: (%)	65 (hydraulic efficiency)
Maximum Speed: (rpm)	1800
Maximum Pump Motor Size: (kW)	11.2
Pumping Liquid:	Sanitary waste containing grit, rags, plastics
Solids Content:	Pass solids and rags
Specific Gravity:	1.0
Liquid Temperature: (^{o}C)	1 to 20
Minimum Static Suction Head: (m)	0.220
Maximum Static Suction Head: (m)	5.545

.2 Supply submersible pumps under this specification suitable for continuous and intermittent operation.

.3 Supply submersible pumps capable of operating continuously under full load, without damage, for 24 hours.

.4 Submersible pumps to be capable of handling abrasive and fibrous materials having up to 75 mm diameter solids.

.5 Critical Speed

.1 The first critical speed of the pump shaft system shall be at least 20% above the maximum operating speed of the pump.

.6 Vibration at top of motor bearings shall not exceed 3.8mm/s.

2.4 MATERIALS

Component	Material
Casing, Discharge	Grey Cast Iron, ASTM A-48, Class 35B or Class 40
Impeller	Grey Cast Iron, ASTM A-48, Class 35B or Class 40
Pump Volute	Grey Cast Iron, ASTM A-48, Class 35B or Class 40
Shaft	AISI Type 420 or AISI Type 431 Stainless Steel
Motor	Grey Cast Iron, ASTM A-48; Class H insulation rated for 155 ºC. Minimum motor service factor not less than 1.15.
Mechanical seal	Tandem mechanical shaft seal system, independent mechanical seal assemblies.
O-rings	Nitrile or Viton rubber
Anchor Bolts	Drilled Chemical c/w epoxy capsules, AISI Type 316 Stainless Steel.

2.5 EQUIPMENT COMPONENTS

.1 Each submersible pump shall be provided with a stainless steel nameplate with the following information:

.1 Identification, Tag Number.

.2 Manufacturer’s name, address, and telephone number.

.3 Model number.

.4 Serial number.

.5 Year of manufacture.

.6 Head capacity, in meters, and RPM at the rated condition in L/s.

.7 Motor horsepower, RPM, rated current and frame size.

.2 Pump Volute and Motor Casing:

.1 Construct pump volute and motor casing of corrosion resistant grey Cast Iron, Class 35B or 40, designed to allow removal of all rotating parts from the motor end of the submersible pump.

.2 Machine all mating surfaces, where watertight sealing is required, and fit with Nitrile or Viton rubber O-rings.

.3 Discharge Connection:

.1 Provide cast iron discharge flange for connection of the discharge elbow in the wet well vertical configuration.

.2 Mounting to be semi permanent (sometimes known as P-installation) to allow removal of pumps from above grade without entering the wet well.

.4 Cooling System:

.1 Each unit shall be provided with the vendor's standard integral motor cooling system, using propylene glycol solution as the coolant.

.5 Wear Ring:

.1 Install a wear ring designed for abrasion resistance at the inlet of the submersible pump to provide protection against impeller wear.

.6 Impeller:

.1 Impeller to be non-clog, self cleaning, specifically design to pass material such as cloths and plastic.

.2 The clearance between the pump housing/insert ring and the impeller shall be adjustable. The impeller

.3 Provide pump with self cleaning, semi-open channel, 2 blade impeller.

.4 Backward swept impeller vanes .

.5 Grooved suction cover.

.6 Statically and dynamically balanced.

.7 Acrylic resin primed and coated.

.7 Bearings:

.1 Provide heavy-duty, grease-lubricated bearings, ball type, double shielded, and factory sealed and designed for at least five (5) years heavy-duty service without requiring additional lubrication.

.2 AFBMA B-10 bearing life 100,000 hours minimum.

.8 Mechanical Seal:

.1 Provide each submersible pump with a tandem double mechanical seal running in an oil reservoir, composed of two (2) separate lapped face seals.

.2 Each seal consists of one (1) stationary and one (1) rotating tungsten-carbide ring, with each pair of rings held in contact by a separate spring.

.3 Conventional double mechanical seals, with a single or a double spring between the rotating faces or requiring constant differential pressure to effect sealing and are subject to opening and penetration by pumping force, are not acceptable.

.4 Provide submersible pumps capable of continuous submergence without loss of watertight integrity to a depth of 20 m.

.9 Motor and Cable:

.1 Provide Explosion Proof Class 1, Zone 2 motors. Pump motors shall be NEMA B design induction type with squirrel cage rotor, shell type, housed in a watertight chamber, rated at 208 V, 3 phase, 60 Hz.

.2 Pump manufacturer must own and operate a CSA Class 1 Division 1&2 approved repair facility in Alberta for future service of explosion proof pumping equipment.

.3 Motor shall be capable of up to 30 evenly spaced starts per hour.

.4 Provide a heavy-duty flexible, water-resistant, continuous non-wicking submersible power cable, sealed at the motor bell and of sufficient length to connect to a disconnect switch in the control panel.

.5 All cable and wiring must meet the requirements of the CEC and the details of Section 26 05 21 - Wire and Cables (0 - 1000 V).

.1 Cable entry seal designed to insure a watertight submersible seal.

.2 Cable entry junction chamber and motor to be separated by a stator lead sealing gland or terminal board.

.3 Provide shielded composite cable with power and leak and heat sensor cable to the motor with oil resistant chloroprene rubber insulation. Minimum power conductors to be as required to meet the motor demand amperage, length as required.

.4 Cable type: SOW, flexible, 90 deg C temperature rating, suitable for extra hard usage.

.6 Electrical equipment must be CSA approved and meet all of the general requirements detailed in Section 26 05 00 - Electrical: General Requirements.

.10 Protection:

.1 Each pump will be monitored by a monitoring relay detection module provided by the pump manufacturer. Three pump starters will be supplied to provide one spare unit for the two installed pumps.

.2 Provide sensors for monitoring of the following:

.1 Leakage in the pump junction box.

.2 Main bearing temperature.

.3 Leakage in the stator housing.

.4 Stator winding temperature.

.5 Water in oil.

.6 PTC thermistors for stator windings.

.7 One (1) analogue temperature sensors per phase of the stator windings.

2.6 ACCESSORIES

.1 Floats

.1 Provide pump manufacturer standard float switches and float hangers suitable for the area classification. Floats shall not contain mercury.

.2 Suction Elbow

.1 Provide a short radius suction elbow for each pump, sized for installation between the pump suction flange and the expansion joint component as indicated on Contract Drawings.

.3 Flushing Valve

.1 Each pump will be equipped with a non-electric mix flush valve

.2 Flush valve to be mounted directly to the pump discharge connection, not the piping.

.3 Duration of the flushing operation must be adjustable without electric control.

.4 Power and Control connectors

.1 Provide three (3) suitable waterproof quick disconnect cable plugs and mating receptacles complete with wiring diagrams and installation procedures for the following cables:

.1 Pump power cable.

.2 24-lead auxiliary cable suitable for monitoring relay detection module system.

.5 Lifting Chain

.1 Lifting chain shall incorporate a 4:1 safety factor

.2 Chain will be long enough to reach 1 m above the lift station floor.

2.7 ANCHOR BOLTS

.1 Discharge elbow to be mounted with stainless steel, epoxy adhesive system anchors. All mounting bolts to be stainless steel.

2.8 PROTECTIVE COATINGS

.1 Coatings in accordance with Manufacturer's standard specifications.

2.9 SPARE PARTS

.1 Provide the following spare parts:

.1 Two (2) sets of all gaskets.

.2 One (1) mechanical seal assembly.

.3 One (1) impeller.

.4 One (1) pump complete with cabling and flushing valve.

.2 Tag spare parts with common name, part number, manufacturer and Equipment Tag Number of the equipment for which the part can be used.

2.10 FACTORY TESTING

.1 The pump manufacturer shall perform the following inspections and tests on the pumps before shipment from the factory:

.1 Impeller size, motor rating, voltage, and phase shall be checked for compliance with specifications.

.2 A motor and cable check to test for insulation defects and moisture content shall be conducted prior to the wet pit test.

.3 A dry run test shall be performed to ensure mechanical integrity.

.4 Conduct a wet test by submerging the entire pump assembly in a wet pit and run completely submerged to check amperage readings across entire operating range.

.5 After immersion test, pump inspected for oil seepage and/or water infiltration.

.6 A motor and cable check to test for insulation defects and moisture content shall be conducted after the wet pit test.

.7 Inspections and tests performed to confirm the pump listed met all established quality assurance standards set for similar materials. Pump shall be warranted against defects in design, workmanship, and materials.

.2 All pump tests to be conducted in accordance with the "Hydraulics Institute Standards."

.3 Submit certified pump performance curves, witnessed and signed by a factory engineer, for review and approval in accordance with Section 01 33 00 - Submittals.

2.11 CONTROL PANEL

The pump manufacturer supplies a completely assembled control panel for the operation of two submersible pumps of 11.2 kW, 208 volts and 3 phase. The control panel is to include a microprocessor controller and fault diagnostic system for the

control and the surveillance of a pumping station. It shall also include floats for discrete level control. In order to accomplish all the necessary functions for the control of pumps, the following components are necessary:

.1 Panel

.1 All parts are of the best industrial quality designed for extended, reliable and maintenance-free operation under cold (-20°C) and warm (40°C) weather conditions. Electromechanical components are limited to a strict minimum.

.2 The enclosure is of heavy industrial quality in accordance with EEMAC to provide reliable indoor operation. The box is fitted with a heavy steel inner door which is hinge-mounted, with at least 135° angle opening to allow easy access to the components.

.3 The control panel is equipped with a main disconnect switch mechanically interlocked with the door to electrically isolate the components of the control panel.

.4 For ratings up to 100A, the main disconnect switch is of the fusible type with fuses rated at 100,000A short circuit capacity. For capacities above 100A, the main disconnect switch is a thermal-magnetic circuit breaker having a fast response, high interrupting capacity and sealed contact chambers with clear covers for inspection.

.5 Each pump circuit is fitted with a three-pole thermal-magnetic circuit breaker or current limiting motor protector with instantaneous magnetic trip and overload relay. The response time under short circuit conditions is less than one-quarter of a cycle; the action opens all poles thus avoiding single phase operation of three-phase pumps.

.6 Isolated rotary handles for each motor protector is mounted on the inner door.

.7 The circuit breaker and overload relay exhibits stable operation under changing temperature conditions from -20°C up to 40°C. The circuit breaker has a high interrupting capacity independent of the thermal setting.

.8 Each pump circuit is fitted with a three-pole fast-acting magnetic contactor, designed for a minimum of 20 years service under normal operating conditions of pumping stations. Under overload conditions, the circuit is designed to clear the fault by opening the motor protector or circuit breaker and then the contactor.

.9 The control panel is fitted with a MANUAL/OFF/AUTO switch to allow manual pump operation.

.10 The control panel and microprocessor controller operate the pumps as per the following sequence:

.11 Float FL1: stop/alternate the pump(s)

.12 Float FL2: starts the duty pump

.13 Float FL3 starts the stand-by pump

.14 Float FLH: Indication of a high level alarm and starting of pump(s)-backup ctrl

.2 Microprocessor

.1 A microprocessor-based control with fault diagnostics and display is to be used to provide failsafe operation of the sewage pumping station. The microprocessor control can fulfil, but is not limited to the following functions:

.2 The microprocessor controls the starting, stopping and, if necessary, alternation of the pumps. An adjustable software time delay from zero to fifty seconds, before the starting of a pump must be available to prevent the high inrush current which would result if both pumps were started at the same time.

.3 The microprocessor must register the running time of each pump running separately and of two pumps running together. It also registers the number of start-ups of each pump.

.4 The microprocessor must have a Max Run Time function available and settable by the user. This function limits a one pump running time to a preset value forcing pump's stop & alternation.

.5 The microprocessor must measure the pumps current consumption and activates an alarm if the reading deviates from the minimum and the maximum adjustable levels.

.6 The microprocessor must allow for the protection of operating parameters using a password.

.7 The microprocessor must allow for the selection of the operation of one or two pumps in parallel.

.8 The microprocessor must measure the total number of hours during which the overflow float has been activated.

.9 The microprocessor must allow for the selection of an adjustable software time delay from zero to sixty seconds, during which an alarm has to be present in order for the alarm signal to be issued. This avoids the signal of false alarms caused by erroneous measurements, or the transmission of these alarms to the service personnel.

.10 The microprocessor constantly monitors the pump to verify if there is no leakage or any rising temperature of the motor winding. For both of these situations, the microprocessor stops the faulty pump and activates an alarm. For these functions, the control panel must be equipped with a monitoring relay detection module from the pump manufacturer.

.11 The microprocessor detects and signals the following alarms: high level, low level, and for each pump, motor overload, leakage, and high temperature. The operator can acknowledge these alarms using the alarm register channel.

.12 The microprocessor must be able to store the last 100 alarms in a FIFO (First in, First out) file, with the date and the hour of occurrence. The recording of the alarms are made in chronological order.

.13 The microprocessor must have an operator interface for reading and modification of the operating parameters and also for retrieving alarms. A normal text is displayed, as opposed to a modified one. Therefore the modification of the operating parameters is simple and does not require a programming specialist. Text of the optional alarms can be modified by user.

.14 The microprocessor must be capable of using a modem to establish an interactive communication with a SCADA system. The microprocessor will be capable of accepting remote commands such as modification of the starting or stopping parameters and will also allow remote transmission of alarms and data acquisition. The modem and SCADA system are for future upgrades and not part of this contract.

.15 The microprocessor must be protected against signal interference that could occur in the pumping stations. In order to reduce the sensibility of these signal interference's, all inputs and outputs are galvanically isolated from ground.

.16 The microprocessor must be equipped with a memory board allowing recording of set points and operating values. The information is recorded in a Nickel Cadmium EPROM battery, even in case of power failure.

.17 The microprocessor must be equipped with LED type lights indicating the operational functions, the communication interactions and the Alarms State.

.18 The microprocessor signals the transmission and reception of data using LED type lights. It also indicates the type of transmission (alarm, report, trend, etc.).

.19 The microprocessor shall be equipped with:

.20 16 digital inputs:

.21 - 8 for pumps' signals (over temperature, overload, contactor feedback, pump in AUTO mode)

.22 - 4 for level ctrl with floats (STOP, START1, START2, HIGH LEVEL)

.23 - 4 configurable: (Leakages for each pump, low level, overflow, power failure etc.)

.24 - 3 analogue inputs	1 for level reading probe
.25	2 for pump current
.26 - 6 digital outputs:	2 for pump start/stop signal
.27	1 for alarm signal
.28	3 additional outputs configurable by user

.29 The microprocessor shall be supplied with 120 VAC power.

.30 The microprocessor shall have a power consumption no greater than 40 VA and an operating temperature range of 0° to 50°C.

2.12 ACCESSORIES

.1 The panel shall be equipped with a monitoring relay detection module for leakage detection and stator high temperature. In case of a malfunction, the monitoring relay should stop the pumps. On a high temperature detection a pump shall not be made available until a manual reset has been performed.

.2 The floats shall be mercury free.

.3 The control panel shall be equipped UPS provide approximately three hours of back-up.

.4 The control panel shall be supplied with the following equipment mounted on the inner door:

.1 Three time totalizers; one for each pump and one for parallel operation of two pumps. For parallel operation, the individual time totalizers shall not record the time but only the third one.

.2 An ammeter per pump with phase selector.

.3 A voltmeter with phase selector.

.5 The control panel shall be supplied with a protective relay against phase failure and phase reversal.

.6 The control panel shall be supplied with lightning arrester and surges capacitors.

.7 An alarm silencing push button shall be present to stop the alarm from unnecessary operation once the station operator has taken notice of the fault.

.8 The control panel shall be in accordance to the specifications and the wiring.

3 Execution

3.1 TEMPORARY PUMPING

.1 General

.1 Provide temporary by-pass pumping for the sanitary waste that would normally flow to the lift station. The supply line entering the wet well must be isolated and pumping provided upstream of the isolation. All cost of temporary pumping will be borne by the contractor.

.2 Isolation

.1 Isolation may be provided at the end of the line or at an access point up stream of the lift station.

.2 Isolation must ensure that access to the wet well complies with Alberta Occupational Heath and Safety code.

.3 Pumping

.1 Provide bypass pumping upstream of the isolation point.

.2 Pumping must be able to pump sanitary waste to the discharge point at a rate not less than 21.5 liters per second.

.3 Discharge of by-pass pumping may be sent to the sewage lagoons. An alternate discharge may be used if approved by Departmental Representative.

.4 When pumping to lagoons provision must be made to pump to any of the following:

.1 Anaerobic Cell A

.2 Anaerobic Cell C

.3 Primary Cell

.4 Secondary Cell No. 2

.4 Redundancy

.1 Provide an installed redundant pumping system to protect from failure of the primary pump.

.2 Provide back-up power for the pumps to protect from power failure.

3.2 INSTALLATION

.1 Install all pumping equipment in accordance with manufacturer and supplier's instructions:

.1 Ensure that no damage results from either failure to observe the installation instructions or as a result of proceeding with installation without complete knowledge of the installation process.

.2 Certify in writing when the installation and operation is satisfactory and that the units are available for operation.

.3 Coordinate the work and informing the Departmental Representative, in advance, when each phase of the work is to be started to ensure that the manufacturer's representative is on-site.

.4 Provide the services of a qualified technical manufacturer's representative for a minimum of one (1) day per pump to provide on-site instructions on installation requirements.

3.3 TESTING

.1 After installation, test each pump to demonstrate compliance with operating requirements as specified in Section 01 91 31 - Commissioning (Cx) Plan.

.2 Provide the services of the manufacturer's qualified technical representative for a minimum of one trip of one day duration to witness field testing of all pumps in this Section.

.3 Once the equipment manufacturers technical representative has advised that equipment installation is in order then advise, in writing, that the system can be operated.

.4 After equipment installation, Pump Supplier is required to conduct performance tests on-site to confirm performance according to the pump curves for each pump. Measure

flow with the magnetic flow meter provided, discharge pressure with the temporary pressure gauge and current draw on the motor by temporarily installed metering. Costs of temporary metering will be borne by the Mechanical Contractor. Tests are to be witnessed by the Departmental Representative.

.5 Pump supplier to submit three detailed copies of Final Testing Report to Departmental Representative one week following testing. Report to include testing method, measured testing results including flow meter readings, suction and discharge pressure readings and current draw for each of the pumps.

3.4 COMMISSIONING

.1 Commission the equipment in accordance with Section 01 91 13 – General Commissioning (Cx) Requirements, 01 91 31 – Commissioning (Cx) Plan, and 01 91 33 – Commissioning Forms.

.2 Arrange with the equipment supplier for the provision of a qualified technical manufacturer's representative to commission the pumping equipment. Allow for a minimum of four hours for commissioning all pumps in this Section.

3.5 TRAINING

.1 Provide the services of a qualified technical manufacturer's representative for a minimum of four hours duration for operator and maintenance training.

END OF SECTION